UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.
Petitioner

v.

MULLEN INDUSTRIES LLC
Patent Owner

Case IPR2025-00742
U.S. Patent No. 11,904,243 B2
Issue Date: February 20, 2024

Title: SYSTEMS AND METHODS FOR LOCATION BASED GAMES AND EMPLOYMENT OF THE SAME ON LOCATION ENABLED DEVICES

DECLARATION OF JEREMY COOPERSTOCK

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I, Jeremy Cooperstock, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

A. Qualifications and Experience

1. I am an expert in the field of interactive computing systems, including virtual and augmented reality systems, as well as mobile and wearable technologies. I have studied, taught, practiced, and researched the design of such interactive computing technologies for over 30 years, and I have been leading research and development activities pertaining to hardware and software designs for interactive virtual and augmented reality computing systems since at least 2007.

2. I have summarized in this section my educational background, work experience, and other relevant qualifications, as reflected in my curriculum vitae, attached to this declaration as **Appendix A**.

3. I earned a Bachelor of Applied Science (B.A.Sc) degree in Electrical Engineering (Computer Engineering Option) with Honors from the University of British Columbia in 1990, a Master of Science (M.Sc.) degree in Computer Science from the University of Toronto in 1992, and a Doctor of Philosophy (Ph.D.) degree in Electrical and Computer Engineering from the University of Toronto in 1996. My dissertation on "Reactive Environments and Augmented Media Spaces" was nominated by the University of Toronto for the Natural Sciences and Engineering

Research Council (NSERC) Doctoral Dissertation Award.

4. From 1987 to 1988, I worked at IBM Research on very large scale integration (VLSI) circuit simulation, and in 1989, I worked at the IBM T.J. Watson Research Center on very long instruction word (VLIW) simulation. In 1990, I worked at Fibronics Research to develop and test an FDDI-to-token ring bridge for network communication.

5. After obtaining my Doctorate degree, I carried out research and development work at the Sony Computer Science Laboratory in Tokyo, Japan from 1996 to 1997, working in part on "smart" consumer electronics.

6. I have been employed at McGill University since November 1997, where I am currently a Full Professor in the Department of Electrical and Computer Engineering, and recently, the endowed Werner Graupe Distinguished Chair in Automation Engineering.

7. I am a member of the Centre for Intelligent Machines, a founding member of the Centre for Interdisciplinary Research in Music Media and Technology, a member of the International Laboratory on Learning System, a member of the McGill Institute for Aerospace Engineering, and an associate member of Biomedical Engineering at McGill University.

8. In this capacity, I conduct and supervise research activities, directing a

group of approximately 50 researchers at the Shared Reality Lab, which focuses on computer mediation to facilitate high-fidelity human communication and the synthesis of perceptually engaging, multimodal, immersive environments. Over the span of my academic career, I have supervised more than 100 graduate students and post-doctoral fellows, and approximately 250 undergraduate research students.

9. I have also developed and continue to teach courses on human-computer interaction, artificial intelligence, embedded systems, haptic interaction design, computer architecture, and operating systems.

10. I led the development and demonstrations of the world's first high-fidelity multichannel audio streaming system over the Internet in 1999 and 2000, recognized by a Distinction Award from the Audio Engineering Society, and followed in 2005 by simultaneous low-latency transmission of multiple streams of uncompressed high-definition video as part of the McGill Ultra-Videoconferencing system. This work was recognized by an award for Most Innovative Use of New Technology from the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) Supercomputing.

11. Among other projects, I led the development and supported ongoing use of a semi-automated classroom environment (the "Intelligent Classroom"), a high-fidelity orchestra rehearsal simulator ("Open Orchestra,"), a simulation

environment that renders graphic, audio, and vibrotactile effects in response to footsteps ("Natural Interactive Walking"), and a mobile game treatment for amblyopia that was licensed to Novartis.

12. The research and development I supervised on the Autour project earned the Hochhausen Research Award from the Canadian National Institute for the Blind and an Impact Award from the Canadian Internet Registry Association. My Real-Time Emergency Response project won the Gold Prize (brainstorm round) of the Mozilla Ignite Challenge. I have carried out significant research involving design and implementation of haptic feedback systems, virtual and augmented reality, and mobile computing applications. My research experience includes design of systems employing virtual and augmented reality devices for simulation, training, gaming, distributed performance, and medical applications, as well as the use of various sensor technologies including GPS, WiFi and Bluetooth, and inertial measurement units (IMUs) for tracking position and orientation of a user.

13. My research activities are funded by industry contracts, collaboration programs, and government grants. In the past 5 years, I have obtained grants and contracts for my research program of approximately three million dollars.

14. I led the theme of Enabling Technologies for a Networks of Centres of Excellence on Graphics, Animation, and New Media (GRAND), and chaired the

Technical Committee on Network Audio Systems. Among other visiting academic appointments, I was a visiting professor at Bang & Olufsen, Denmark, where I conducted research on telepresence technologies as part of the World Opera Project.

15. I have authored and co-authored more than 200 journal articles and peer-reviewed conference proceedings papers, mostly concerning human-computer interaction and applications of these technologies. Eight of my publications were finalists or winners of “best paper”, “honorable mention”, and similar awards from scholarly societies. A complete list of my publications is contained in my curriculum vitae.

16. My professional affiliations include services in various professional organizations and serving as a reviewer for a number of technical publications, journals, and conferences, which are listed in my curriculum vitae. I served as an Associate Editor of the Journal of the Audio Engineering Society, and presently serve as Associate Editor in Chief for the IEEE Transactions on Haptics, and Associate Editor for the Frontiers in Virtual Reality.

17. I have also served as an expert in numerous legal proceedings, both on behalf of patent owners and petitioners, including proceedings involving industrial design, hardware architecture, and firmware of wearable technologies. A list of cases in which I have provided written declarations, testified at trial or by deposition is

provided in my curriculum vitae.

18. My experience in academic and practical situations as well as my hands-on experience with hardware and software related to virtual and augmented reality systems, provides me with an appreciation of, and expertise in, the technology involved with U.S. Patent No. 11,904,243 B2.

19. I have been retained by counsel for Petitioner to provide my expert opinion in connection with the above-captioned proceeding as set forth herein. I am being compensated for my work in this case at my standard consulting rate. This compensation is not contingent upon my performance, the outcome of this case, or any issues involved in or related to this case. I have no financial interest in this matter.

B. Materials Considered

20. The analysis that I provide in this Declaration is based on my education, research, and experience, as well as the documents I have considered. In forming my opinions, I have read and considered U.S. Patent No. 11,904,243 B2 ("'243 patent") (**EX1001**) and its prosecution history. I have cited to the following documents in my analysis below:

Exhibit No.	Description of Document
1001	U.S. Patent No. 11,904,243 B2 to Jeffrey D. Mullen (filed July 15, 2007, issued February 20, 2024) (“**’243**” or “**’243 patent**”)
1003	U.S. Patent Application Publication No. 2004/0110565A1 to Louis Levesque (filed December 4, 2003, published June 10, 2004) (“**Levesque**”)
1004	U.S. Patent Application Publication No. 2002/0163486A1 to Peter A. Ronzani et al. (filed May 16, 1997, published November 7, 2002) (“**Ronzani**”)
1005	U.S. Patent Application Publication No. 2004/0104934A1 to Jan G. Fager et al. (filed February 7, 2002, published June 3, 2004) (“**Fager**”)
1006	U.S. Patent No. 6,951,515 B2 to Toshikazu Ohshima et al. (filed February 17, 2000, published October 4, 2005) (“**Ohshima**”)
1007	U.S. Patent App. No. 10/932,536 (“**2004 Utility Application**”)
1008	U.S. Provisional Patent Application No. 60/603,481 (“**2004 Provisional**”)
1009	U.S. Provisional Patent Application No. 60/499,810 (“**2003 Provisional**”)
1010	U.S. Provisional Patent Application No. 60/430,682 (“**Levesque Provisional**”)
1011	Redline Comparison of Levesque Provisional and Levesque
1012	Defendant Meta Platforms, Inc.’s Opening Claim Construction Brief filed in *Mullen Industries LLC v. Meta Platforms, Inc.*, No. 1:24-cv-00354-DAE (W.D. Tex. Feb. 26, 2025)

II. PERSON OF ORDINARY SKILL IN THE ART

21. I understand that, under the patent laws in effect before the America Invents Act (“AIA”) of 2011, an assessment of claims of a patent filed before the

AIA took effect should be undertaken from the perspective of a person of ordinary skill in the art as of the earliest claimed priority date (i.e., the "time the invention was made"). I have preliminarily for purposes of my Declaration only assumed that date to be September 1, 2004, the filing date of the earliest application to which the '243 patent can claim priority (utility application no. 10/932,536). I understand that the '243 patent claims priority to two earlier-filed provisional applications—no. 60/499,810, filed September 2, 2003, and no. 60/603,481, filed August 20, 2004. As I explain in **Part IV.A** below, it is my opinion that the '243 patent is not entitled to a priority date based on either of these provisional applications.

22. I have also been advised that to determine the appropriate level of a person having ordinary skill in the art, the following factors may be considered: (1) the types of problems encountered by those working in the field and prior art solutions thereto; (2) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (3) the educational level of active workers in the field; and (4) the educational level of the inventor.

23. The '243 patent states that it "relates to video games and video game systems." ('243, 1:22-23.) The patent states that it "provides an actual, reality-based video game in which a user's physical (actual) location on a playfield, reflects a virtual game character's virtual location in a video game environment." ('243, 2:28-

31.)

24. In my opinion, a person of ordinary skill in the art as of September 2004 would have possessed a bachelor's degree in electrical engineering, computer science, or similar field, with two years combined experience in designing and/or developing interactive location-based computer systems/software, such as video games or other simulations incorporating location information (such as GPS information associated with a user's physical location), and in designing and/or developing computer systems/software involving graphical virtual and/or augmented reality. A person could also have qualified as a person of ordinary skill in the art with some combination of (1) more formal education (such as a master's of science degree) and less technical experience, or (2) less formal education and more technical or professional experience. My opinion would be the same for the level of ordinary skill in the art as of September 2003.

25. My opinions regarding the level of ordinary skill in the art are based on, among other things, my experience in the fields of computer science and engineering, my understanding of the basic qualifications that would be relevant to an engineer or scientist tasked with investigating methods and systems in the relevant area, and my familiarity with the backgrounds of colleagues and students, both past and present.

26. Although my qualifications and experience exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the ’243 patent have been based on the perspective of a person of ordinary skill in the art as of September 2004.

III. STATEMENT OF LEGAL PRINCIPLES

A. Claim Construction

27. I understand that a purpose of claim construction is to determine what a person of ordinary skill in the art would have understood the claim terms to mean. Claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art in question as of the effective filing date.

28. I understand that the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification. I understand that the patent specification, under the legal principles, has been described as the single best guide to the meaning of a claim term, and is thus highly relevant to the interpretation of claim terms. And I understand for terms that do not have a customary meaning within the art, the specification usually supplies the best context of understanding the meaning of those terms.

29. I further understand that other claims of the patent in question, both asserted and unasserted, can be valuable sources of information as to the meaning of a claim term. Because the claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

30. I understand that the prosecution history can further inform the meaning of the claim language by demonstrating how the inventors understood the invention and whether the inventors limited the invention in the course of prosecution, making the claim scope narrower than it otherwise would be. Extrinsic evidence, such as dictionaries, may also be consulted in construing the claim terms.

31. I understand that, in *Inter Partes* Review (IPR) proceedings, a claim of a patent shall be construed using the same claim construction standard that would be used to construe the claim in a civil action filed in a U.S. district court (which I understand is called the "*Phillips*" claim construction standard), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

32. I have been instructed by counsel to apply the "*Phillips*" claim

construction standard for purposes of interpreting the claims in this proceeding, to the extent they require an explicit construction. The description of the legal principles set forth above thus provides my understanding of the "*Phillips*" standard as provided to me by counsel.

33. For purposes of my analysis here, I do not believe express claim constructions are necessary because the prior art renders the claims obvious under any reasonable construction.

B. Obviousness (§ 103)

34. I understand that a patent claim is obvious if, as of the effective filing date, it would have been obvious to a person having ordinary skill in the field of the technology (the "art") to which the claimed subject matter belongs.

35. I understand that the following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the pertinent art. I also understand that certain other facts known as "secondary considerations" such as commercial success, unexplained results, long felt but unsolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others may be utilized as indicia of nonobviousness. I understand, however, that secondary considerations should be connected, or have a

"nexus," with the invention claimed in the patent at issue.

36. I understand that a reference qualifies as prior art for obviousness purposes when it is analogous to the claimed invention. The test for determining what art is analogous is: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

37. I understand that a person of ordinary skill in the art is assumed to have knowledge of all prior art. I understand that one skilled in the art can combine various prior art references based on the teachings of those prior art references, the general knowledge present in the art, or common sense. I understand that a motivation to combine references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Thus, one may take into account the inferences and creative steps that a person of ordinary skill in the art would employ to combine the known elements in the prior art in the manner claimed by the patent at issue. I understand that one should avoid "hindsight bias" and *ex post* reasoning in performing an obviousness analysis. But this does not mean that a person of ordinary skill in the art for purposes of the obviousness inquiry does not have recourse to common sense.

38. I understand that when determining whether a patent claim is obvious in light of the prior art, neither the particular motivation for the patent nor the stated purpose of the patentee is controlling. The primary inquiry has to do with the objective reach of the claims, and that if those claims extend to something that is obvious, then the entire patent claim is invalid.

39. I understand one way that a patent can be found obvious is if there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims. I understand that a motivation to combine various prior art references to solve a particular problem may come from a variety of sources, including market demand or scientific literature. I understand that a need or problem known in the field at the time of the invention can also provide a reason to combine prior art references and render a patent claim invalid for obviousness. I understand that familiar items may have obvious uses beyond their primary purpose, and that a person of ordinary skill in the art will be able to fit the teachings of multiple prior art references together like the pieces of a puzzle. I understand that a person of ordinary skill is also a person of at least ordinary creativity. I understand when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her

technical grasp. If this finite number of predictable solutions leads to the anticipated success, I understand that the invention is likely the product of ordinary skill and common sense, and not of any sort of innovation. I understand that the fact that a combination was obvious to try might also show that it was obvious, and hence invalid, under the patent laws. I understand that if a patent claims a combination of familiar elements according to known methods, the combination is likely to be obvious when it does no more than yield predictable results. Thus, if a person of ordinary skill in the art can implement a predictable variation, an invention is likely obvious. I understand that combining embodiments disclosed near each other in a prior art reference would not ordinarily require a leap of inventiveness.

40. I understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I understand that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a person of ordinary skill in the art to combine the invalidating references. I also understand that this suggestion or motivation may come from the knowledge of a person having ordinary skill in the art, or from sources such as explicit statements in the prior art. I understand that

when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of ordinary skill may be motivated to apply common sense and his skill to combine the known options in order to solve the problem.

41. I understand the following are examples of approaches and rationales that may be considered in determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art:

(1) Some teaching, motivation, or suggestion in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;

(2) Known work in one field of endeavor may prompt variations of it for use in the same field or a different field based on design incentives or other market forces if the variations would have been predictable to a person of ordinary skill in the art;

(3) Combining prior art elements according to known methods to yield predictable results;

(4) Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;

(5) Applying a technique or approach that would have been "obvious to try" (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);

(6) Simple substitution of one known element for another to obtain predictable results; or

(7) Use of a known technique to improve similar products, devices, or methods in the same way.

42. I understand that, when determining whether a claimed combination is obvious, the correct analysis is not whether one of ordinary skill in the art, writing on a blank slate, would have chosen the particular combination of elements described in the claim. Instead, I understand the correct analysis considers whether one of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to selecting the combination claimed.

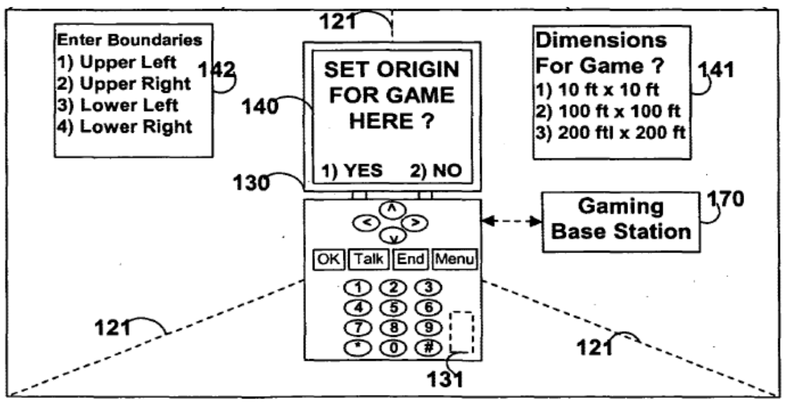
43. I understand that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference. The test for obviousness, in other words, is not whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole.

IV. THE ’243 PATENT

A. Priority Date

44. As noted above, the ’243 patent claims priority to two provisional applications—no. 60/499,810 filed September 2, 2003 (“2003 Provisional”), and no. 60/603,481, filed August 20, 2004 (“2004 Provisional”). I have reviewed both of these provisional applications, and neither provides support for the following limitation of claim 1: “**wherein said processing circuitry is operable to execute said computer programming to allow said user of said head-mounted device to manually set one or more boundaries for said location based game**.” With respect to the 2003 Provisional, the word “boundary” appears nowhere, nor do its figures illustrate a boundary, let alone a boundary manually set by the user of the head-mounted device as required by the claim. As to the 2004 Provisional, it mainly describes a wireless device with only a passing mention of games. (EX1008 (2004 Provisional), p.0007:23-25 (“For example, if a user desires to play an location-based game, the ACTUALITY button may be utilized.”).) It uses the word “boundary” only once, in describing a housing portion of a device, not a game boundary. (EX1008 (2004 Provisional), p.0013:9-12 (“Structures 711 and 722 may be spaced such that they do not extend outside of the boundary defined by housing portion 701 when retracted.”).)

45. In contrast, the 2004 utility application (U.S. Patent App. No. 10/932,536) at least states, for example, that "GUI 412 may be provided in which a user may go to a physical playfield boundary that the user desires and establish that location as a location boundary for a game." (EX1007 (2004 Utility Application), pp.0015:33-0016:3.) Similarly, the application includes a new Figure 1:



(EX1007 (2004 Utility Application), Fig. 1 (excerpt).)

46. Accordingly, it is my opinion that the '243 patent cannot claim priority to either provisional application.

B. Specification

47. The '243 patent states that it "provides an actual, reality-based video game in which a user's physical (actual) location on a playfield, reflects a virtual game character's virtual location in a video game environment." ('243, 2:28-31.) The '243 patent states that such a system allows an "actuality game" to be provided—*i.e.*, "a location-based game where a user's location on a physical

playfield corresponds to a video game character's location on a virtual video game playfield." (*Id.*, 2:31-36.) For example, the '243 patent describes "Actuality Pacman," a game in which a user's changes in physical location are translated into control signals to "move PACMAN through a virtual video-game playfield such as a maze":

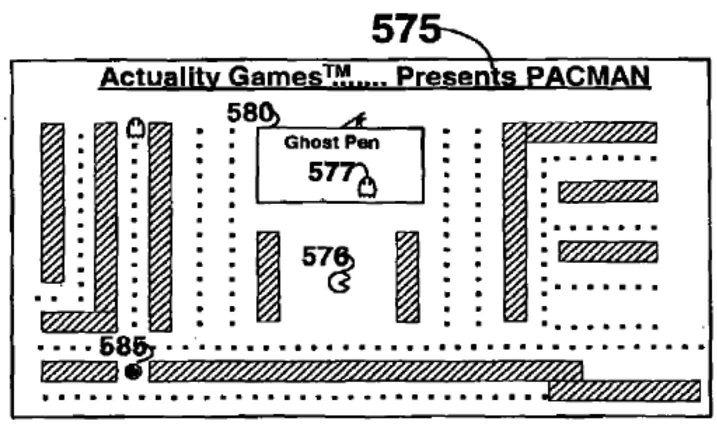


FIG. 5

('243, Fig. 5 (excerpt), 8:45-50, 12:4-6.) To obtain the location of a video game character, the '243 patent states that "[a] location device may be included in the video game system[,]" such as Global Positioning System (GPS) and accelerometers. ('243, 2:44-48; *see also id.*, 7:6-8, 7:15-20.)

48. Figure 6 depicts an embodiment involving head-mounted display devices (**620** and **630**) for playing an "actuality game":

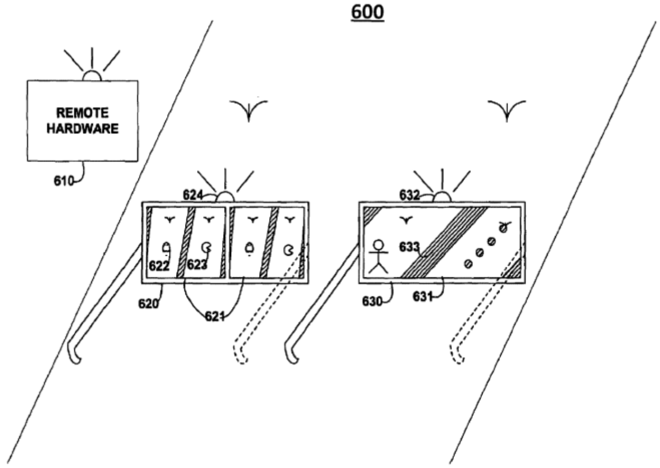


FIG. 6

('243, Fig. 6.) The '243 patent states that the device displays "may be, for example, visible or semi-visible environment displays such that a user can see the environment around him/her." ('243, 13:64-67.) "Images can then be selectively displayed on displays **621** and **622** such that a user can be displayed gaming indicia (e.g., virtual game characters, virtual interactive objects, and virtual impenetrable objects)." ('243, 13:67-14:3.) For example, "[v]irtual game character **622** may be provided to device **620** to represent the character that the user of device **620** is controlling" and "virtual character **623** may be generated at the position where device **630** is located on the virtual playfield to represent the user of device **630**." ('243, 14:3-6, 14:17-22.)

49. I discuss additional aspects of the '243 patent in my analysis of the claims below.

C. The Challenged Claims

50. This Declaration addresses claims 1, 6-10, 14, 17, 22, 24-28, and 30 of the ’243 patent. Independent claim 1 is representative and recites:

1. A location based game system comprising:

[a] a head-mounted device operable to provide a location based game in a semi-visible environment in which a user of said head-mounted device can simultaneously view at least a portion of a real-world environment around said user as well as virtual indicia for said location based game, said virtual indicia comprising at least one of a virtual game character and a virtual interactive object;

[b] processing circuitry in said head-mounted device;

[c] memory in said head-mounted device storing computer programming capable of execution by said processing circuitry;

[d] a first locating device in said head-mounted device for providing a first control signal for said location based game;

[e] a second locating device in said head-mounted device for providing a second control signal for said location based game; and

[f] a display provided on said head-mounted device, wherein said head-mounted device is a portable device and said processing circuitry is operable to execute said computer programming to cause said display to display said location based game based on a location, direction, and pitch associated, at least in part, with said first control signal and said second control signal, said display of said location based game comprising display of said virtual indicia in a manner that blocks part of, but not all of, said user's view of said real-world environment around said user, and

[g] wherein said processing circuitry is operable to execute said computer programming to allow said user of said head-mounted device to manually set one or more boundaries for said location based game.

('243, 23:59-24:26 (Claim 1; bracketed notation (e.g., **[a]**) added).)

51. I address the claims further in my detailed analysis in **Part V** below.

V. APPLICATION OF THE PRIOR ART TO CHALLENGED CLAIMS

52. I have reviewed and analyzed the prior art references and materials listed in **Part I.B** above. In my opinion the claims of the '243 patent would have been obvious to a person of ordinary skill in the art based on the following combinations of the prior art.

Ground	Claims	Basis for Challenge Under § 103
1	1, 6-8, 17, 24-28, 30	Levesque in view of Ronzani
2	9, 10, 22	Ground 1 Prior Art + Fager
3	14	Ground 1 Prior Art + Ohshima

53. As explained in Part V.A below, I am informed by counsel that each of the references cited in the grounds above qualifies as prior art to the challenged

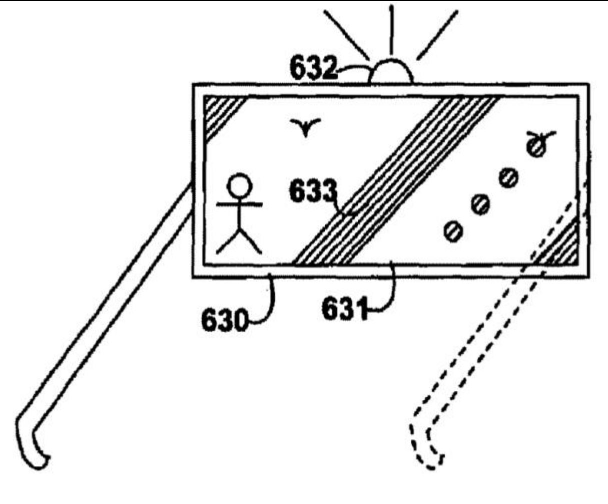
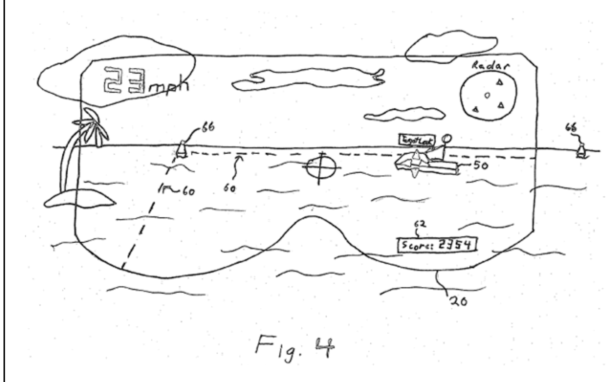
claims.

A. Brief Summary and Overview of Prior Art

1. Levesque (EX1003)

54. **Levesque**, U.S. Patent Application Publication No. 2004/0110565A1, is entitled "Mobile Electronic Video Game." I am informed that Levesque qualifies as prior art because, first, its utility application was both filed (on December 4, 2003) and published (on June 10, 2004) before the September 1, 2004 priority date of the '243 patent. Second, even if the '243 patent were entitled to the September 2, 2003 filing date of its 2003 provisional application (which it is not, as I discussed above), as I show below, Levesque is entitled to the December 4, 2002 filing date of its own provisional application.

55. Levesque discloses a location-based video game system played using see-through head-mounted displays and locating devices that is strikingly similar to the '243 patent—for example, as shown below, Figure 6 of the '243 patent and Figure 4 of Levesque both illustrate location-based game play with virtual indicia presented in a head-mounted display:

’243 Patent, Fig. 6	**Levesque, Fig. 4**
	

(’243, Fig. 6 (excerpt); Levesque, Fig. 4.)

56. In particular, Levesque describes a “video gaming device includ[ing] a central gaming unit in communication with a heads-up display and a location sensing sensor[,]” where “the video gaming device is used in conjunction with a vehicle, such as a recreational vehicle in the form of a snowmobile, all terrain vehicle or personal watercraft.” (Levesque, ¶8.) Figures 1 and 2 of Levesque show a gaming unit **12**, which contains processor **30** and memory **32** and connects to heads-up display **20**, sensors including GPS sensor **14**, and a wireless network through network interface **36**.

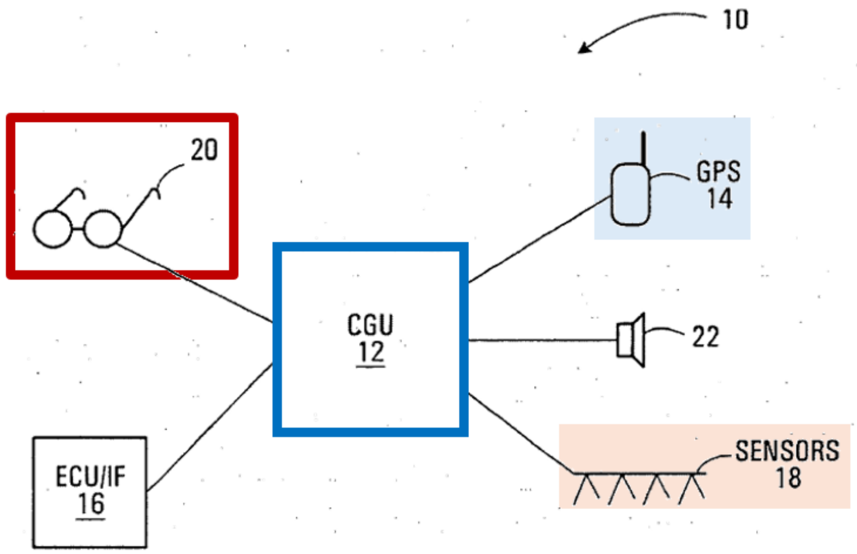

10
20
GPS
14
CGU
12
22
ECU/IF
16
SENSORS
18

FIG. 1

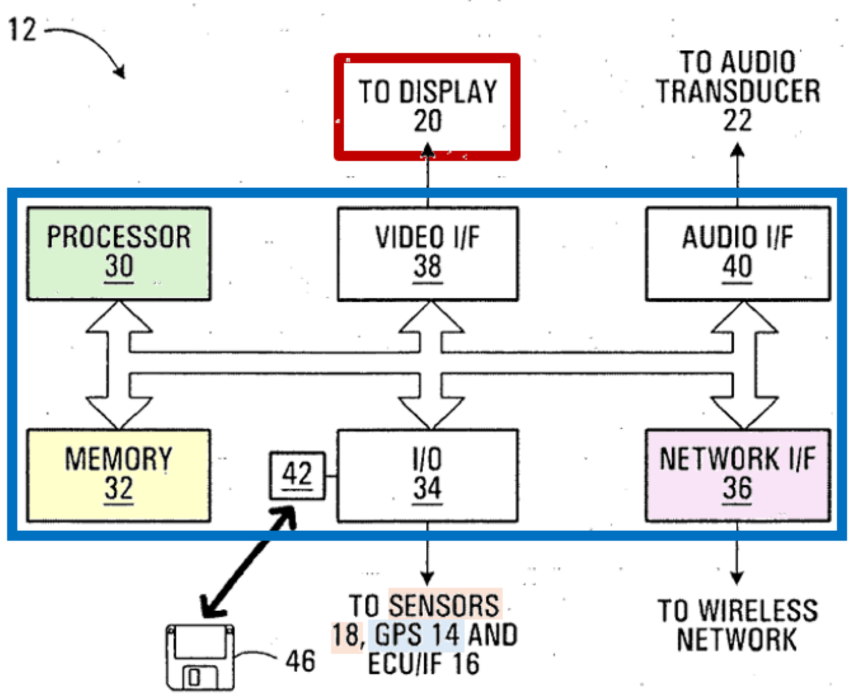

12
TO DISPLAY
20
TO AUDIO
TRANSDUCER
22
PROCESSOR
30
VIDEO I/F
38
AUDIO I/F
40
MEMORY
32
42
I/O
34
NETWORK I/F
36
46
TO SENSORS
18, GPS 14 AND
ECU/IF 16
TO WIRELESS
NETWORK

FIG. 2

(Levesque, Figs. 1-2 (highlighting and annotation added), ¶¶18-28.)

57. Heads-up display **20** "is preferably a video display device that allows an operator to view an image without diverting his or her eyes from their normal point of focus"—for instance, "monocular or binocular viewers that may, for example, be in the form of integrated eye glasses" or "part of a helmet visor." (Levesque, ¶24.) Figure 3 of Levesque shows an embodiment of heads-up display **20**:

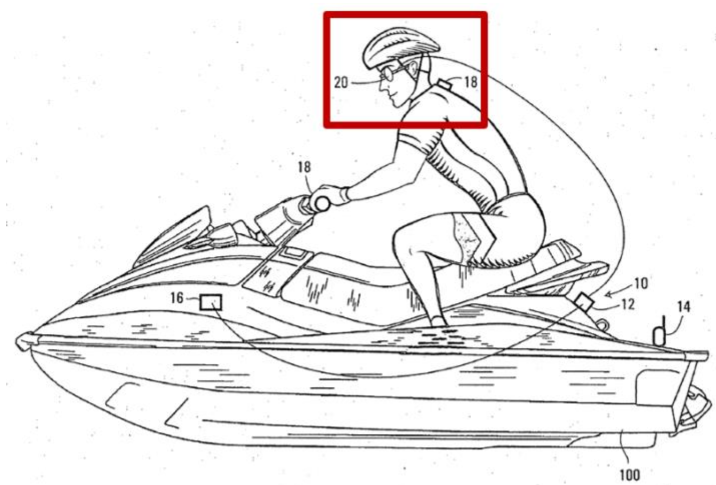


FIG. 3

(*Id.*, Fig. 3 (annotation added), ¶¶30-31.)

58. Location sensor **14** is "preferably a conventional global positioning system (GPS) satellite receiver that provides an indication of sensed geographic location to gaming unit **12**[.]" (Levesque, ¶25.) Levesque discloses games that receive inputs from location sensor **14** to control play of a video game. (*Id.*, ¶¶8, 10,

18, 28, 32, 34.) For example, Levesque discloses a game where simulated opponents **50** are presented on heads-up display **20** where "[i]nputs received by way of … location sensor **14** allows gaming device **10** to simulate interaction with these virtual opponents **50**." (*Id.*, ¶34.) Levesque discloses that as the simulated opponents **50** are approached based on location sensor **14** inputs, "their size may be magnified on display **20**, much in the same way a user would view actual opponents." (*Id.*) Additionally, Levesque discloses that virtual opponents **50** can fire weapons, and a user can avoid their weapon fire through "[a]ctual motion" based on inputs from the location sensor **14**. (*Id.*, ¶34.)

59. Levesque further discloses external sensors **18**, including "sensors to sense the position (e.g. tilt and rotation) of the user's head relative to the user's torso." (*Id.*, ¶26.) Based on these sensors, a user can look around the virtual world as if it were the real world, with "[a]ny motion of the user's head, as sensed by one of external sensors **18** … taken into account." (*Id.*, ¶34; *see also id.*, ¶42 (tracking "user's line of sight (as determined through sensors **18**)").)

60. Processor **30** in communication with memory **32** "present[s] a near real-time gaming environment" to a user. (Levesque, ¶20.) Further, network interface **36** allows for communication of gaming unit **12** with a server or other gaming units. (*Id.*, ¶22.)

61. Levesque discloses various games that can be played using its video gaming device. (Levesque, Figs. 4-8, ¶¶34-43.) One example game embodiment is shown in Figure 4:

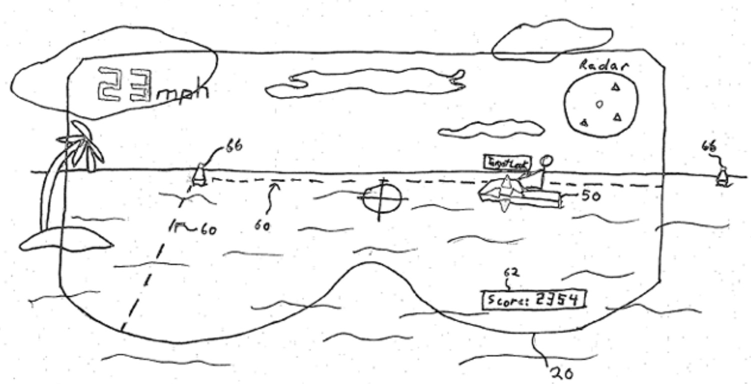


Fig. 4

(*Id.*, Fig. 4, ¶34.) Virtual opponents **50** are shown, along with various other virtual elements (speed, score, radar, etc) along with the user's real-world surroundings. (*Id.*, ¶34.)

62. Figure 4 also show a virtual boundary **60**, which Levesque discloses can be defined using a configuration screen like the one shown in Figure 5:

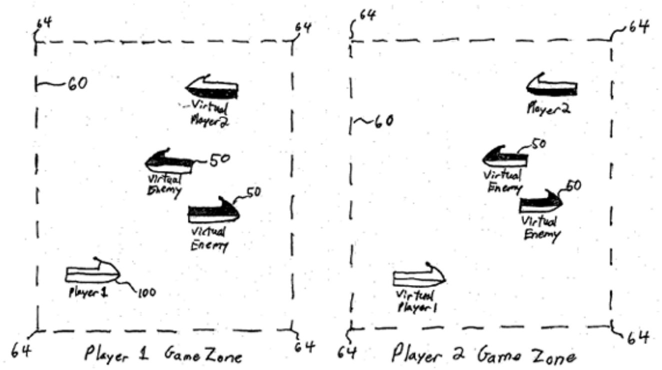


Fig. 5

(Levesque, Fig. 5, ¶¶35, 38.) "The configuration screen may allow a user to travel to the corners **64** of the boundary using vehicle **100** and providing an input by way of one of sensors **18**, for example in the form of a button on the player's uniform or on vehicle **100**." (*Id.*, ¶35.) Levesque's video gaming device can also determine a boundary based on buoys **66**, which may be equipped with transmitters the gaming device can detect and can be connected to each other using rope or string. (*Id.*, ¶38.)

63. Other example games are shown in Levesque, including as shown in Figure 6:

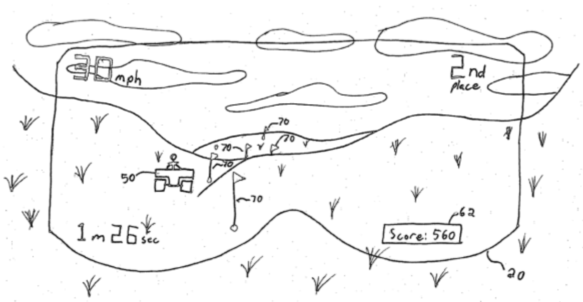


Fig. 6

(Levesque, Fig. 6, ¶¶34, 39.)

64. I will provide more information about Levesque in my discussion of the claim limitations below.

(a) Levesque Provisional Application

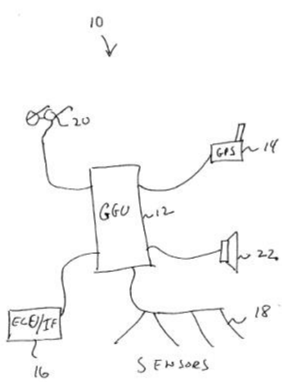
65. As noted, Levesque claims priority to a provisional application filed on December 4, 2002 ("Levesque Provisional") (**EX1010**). I understand that Levesque qualifies as prior art to the '243 patent even without relying on this provisional application because it was both filed (on December 4, 2003) and published (on June 10, 2004) before the September 1, 2004 priority date of the '243 patent. I have nevertheless been asked to examine the Levesque Provisional to determine if Levesque is entitled to its earlier filing date. As I will explain below, it is.

66. I am informed by counsel and understand that for Levesque to be considered prior art as of the filing date of the Levesque Provisional, two requirements must be satisfied: (1) the portions of Levesque cited for invalidity must be supported by disclosures in the Levesque Provisional, and (2) at least one claim issued in Levesque must be supported by the disclosure in the Levesque Provisional, i.e., the Levesque Provisional must disclose the subject matter of the claim and enable a person of ordinary skill in the art to make and use the claim. The Levesque Provisional satisfies both requirements.

67. The first requirement is met because the disclosures in Levesque that I cite in my analysis were contained, often identically, in the Levesque Provisional. Attached is Exhibit 1011, which is a redline document that shows all differences in the written descriptions between the Levesque Provisional and Levesque. As shown in the redline, any disclosures that I cite in Levesque that are not contained substantially identically in the Levesque Provisional are cumulative of disclosures in the Levesque Provisional. For example, paragraph 0037 of Levesque describes multi-player gaming, but multi-player gaming is also described in paragraphs 0024, 0039, and 0040, which correspond to paragraphs 0020, 0033 and 0034 of the Levesque Provisional. (Levesque Provisional, ¶¶0020 ("Optionally, multiple independent heads-up displays could be connected to video interface **38.** In this way, two or more users could jointly participate in game play using device **10.**"), 0033 ("Conveniently, scores of multiple players (each playing within a separately defined and enforced boundary) may be maintained by gaming device **10** or alternatively communicated by way of network interface **34 (FIG. 2)** to other gaming units or to a centralized network site."), 0034 ("Similarly treasures, enemies, targets, other players and the like may be simulated (and thus for example, hidden or blended) with the existing natural backdrop seen through heads-up display 20, with reference to the existing topography.").) The figures in both, although

sometimes rendered differently, are also substantively the same for purposes of my analysis.

68. With respect to the second requirement, the Levesque Provisional provides sufficient written description and support for at least claim 1 of Levesque, as shown in the table that I have provided below:

Levesque, claim 1	**Exemplary Disclosures from Levesque Provisional**
1[p] An electronic video gaming device, comprising:	"FIG. 1 illustrates a mobile electronic video gaming device 10 exemplary of an embodiment of the present invention." (Levesque Provisional, ¶14.)  FIG-1 (Levesque Provisional, Fig. 1.)

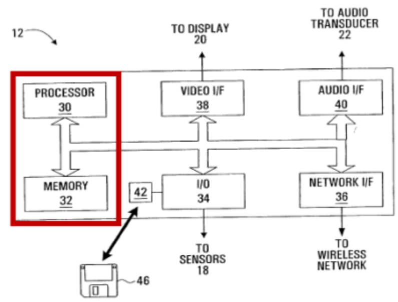
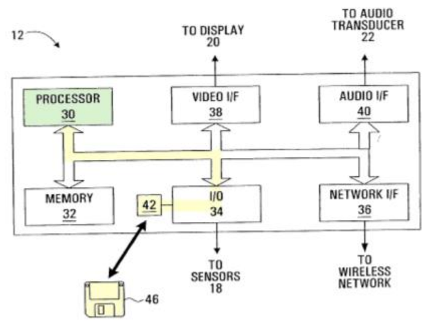
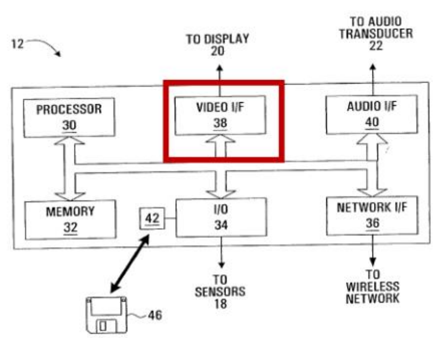
<table>
<tr><th>Levesque, claim 1</th><th>Exemplary Disclosures from Levesque Provisional</th></tr>
<tr><td>1[a] a processor in communication with processor readable memory;</td><td>

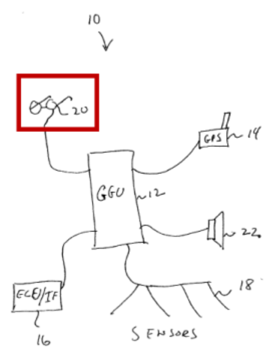
FIG. 2

(Levesque Provisional, Fig. 2 (annotation added).)

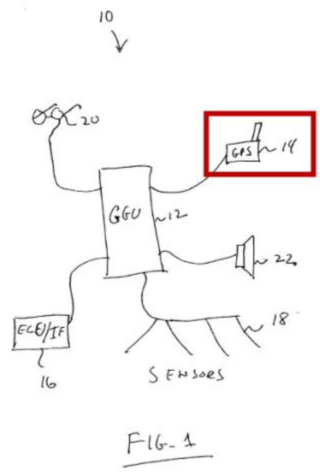
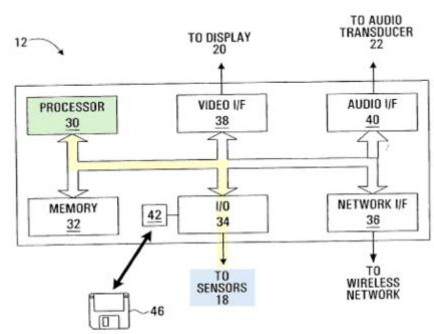
“As such, gaming unit 12 includes a <u>central processor 30 in communication with memory 32</u>, a video interface 38, an audio interface 40, an input/output interface 34 and optionally a network interface 36. Gaming device 10 further includes a memory reader 42. Memory reader 42 may be a CD-ROM, DVD diskette or similar drive, ROM slot, or the like for <u>loading gaming software for processing by device 10 from a computer readable medium 46</u>.” (Levesque Provisional, ¶15 (emphasis added).)

“Central gaming unit 12 is further preloaded with <u>video game software read from computer readable medium 46</u>, exemplary of embodiments of the present invention.” (Levesque Provisional, ¶24 (emphasis</td></tr>
</table>

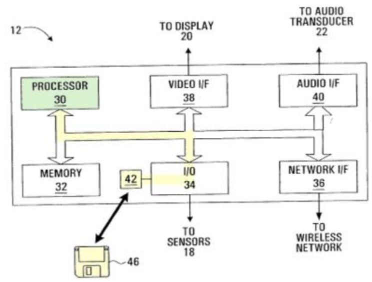
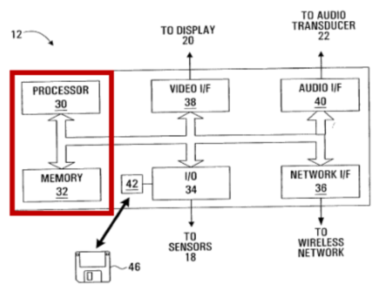
Levesque, claim 1	Exemplary Disclosures from Levesque Provisional
	added).)  FIG. 2 (Levesque Provisional, Fig. 2 (highlighting added).)
1[b] a video interface;	"As such, gaming unit 12 includes a central processor 30 in communication with memory 32, **<u>a video interface 38</u>**, an audio interface 40, an input/output interface 34 and optionally a network interface 36." (Levesque Provisional, ¶15 (emphasis added).)  FIG. 2 (Levesque Provisional, Fig. 2 (annotation added).)

Levesque, claim 1	Exemplary Disclosures from Levesque Provisional
1[c] a heads-up display;	"As illustrated, exemplary mobile gaming device 10 includes a central electronic gaming unit 12 interconnected with a location sensor 14; a vehicle electronic control unit interface (ECU/IF) 16; a plurality of sensors 18; **a heads-up display 20**; and an audio output transducer 22." (Levesque Provisional, ¶14 (emphasis added).)  FIG-1 (Levesque Provisional, Fig. 1 (annotation added).)
1[d] a location sensor for sensing a geographic location of said device, said location sensor in communication with said processor to provide data indicative of said geographic location to said processor;	"As illustrated, exemplary mobile gaming device 10 includes a central electronic gaming unit 12 interconnected with a **location sensor 14**; a vehicle electronic control unit interface (ECU/IF) 16; a plurality of sensors 18; a heads-up display 20; and an audio output transducer 22." (Levesque Provisional, ¶14 (emphasis

Levesque, claim 1	Exemplary Disclosures from Levesque Provisional
	added).) "**Location sensor 14 is preferably a conventional global positioning system (GPS) satellite receiver that provides an indication of sensed geographic location to gaming unit 12 via suitable port that may for example form part of input/output interface 34**. Typically data indicative of sensed latitude, longitude, and optionally altitude (or elevation) is provided to central gaming unit 12." (Levesque Provisional, ¶21 (emphasis added).) "Unlike conventional gaming software however, gaming software exemplary of the embodiments of **the present invention processes inputs taken from one or more of location sensor 14**, external sensors 18 and ECU interface 16, as described below." (Levesque Provisional, ¶24 (emphasis added).)

Levesque, claim 1	**Exemplary Disclosures from Levesque Provisional**
	 (Levesque Provisional, Fig. 1 (annotation added).)  FIG. 2 (Levesque Provisional, Fig. 2 (highlighting added).)
1[e] said processor readable memory storing gaming software, to present a video game on said heads-up display, wherein play of said video game is at least partially controlled by said data from said location sensor.	"As such, gaming unit 12 includes a central processor 30 in communication with **<u>memory 32</u>**, a video interface 38, an audio interface 40, an input/output interface 34 and optionally a network interface 36. Gaming device 10 further includes a memory reader 42. Memory

Levesque, claim 1	Exemplary Disclosures from Levesque Provisional
	reader 42 may be a CD-ROM, DVD diskette or similar drive, ROM slot, or the like for **loading gaming software for processing by device 10 from a computer readable medium 46**." (Levesque Provisional, ¶15 (emphasis added).) "Central gaming unit 12 is further preloaded with **video game software read from computer readable medium 46**, exemplary of embodiments of the present invention." (Levesque Provisional, ¶24 (emphasis added).) "Memory 32 may be any combination of computer readable memory and may include persistent storage memory in the form of a hard disk drive, random access memory, static memory, and the like." (Levesque Provisional, ¶16.) "Inputs controlling play of the video game, however, are provided at least in part by actual operation of the vehicle through sensors 18, **location sensor 14**, and ECU interface 16." (Levesque Provisional, ¶28 (emphasis added).)

Levesque, claim 1	**Exemplary Disclosures from Levesque Provisional**
	 FIG. 2 (Levesque Provisional, Fig. 2 (highlighting added).)  FIG. 2 (Levesque Provisional, Fig. 2 (annotation added).)

69. As shown in the table above, the Levesque Provisional provides disclosures supportive of at least issued claim 1 of Levesque. The table above shows examples of support in the Levesque Provisional for each limitation of at least claim 1; I may provide additional detail should it be required to address arguments by Patent Owner. Additionally, the disclosures in the Levesque Provisional would have provided sufficient detail to enable an ordinarily skilled artisan to have

implemented the subject matter of at least claim 1 without undue experimentation. The underlying technologies used to carry out the claimed techniques in Levesque, such as heads-up displays and location sensors, were well known and commercially available, and implementing the techniques would have involved the routine and conventional application of those technologies.

70. In my opinion, therefore, the disclosures in the Levesque Provisional show that the inventor was in possession of at least claim 1 as of December 4, 2002 (the filing date of the Levesque Provisional), and those disclosures would have enabled an ordinarily skilled artisan to have made and used the subject matter of at least claim 1, without undue experimentation.

2. Ronzani (EX1004)

71. **Ronzani**, U.S. Patent Application Publication No. 2002/0163486A1, is entitled "Head-Mounted Display System." I am informed that Ronzani qualifies as prior art because it was both filed (on May 16, 1997) and published (on November 7, 2002) before the earliest priority date of the '243 patent.

72. Ronzani discloses "systems and methods for mounting display and electronic systems on the human body for numerous applications including commercial, industrial and entertainment purposes." (Ronzani, ¶5.)

73. For example, Ronzani discloses a "head-mounted computer

architecture" in its Figure 35 embodiment:

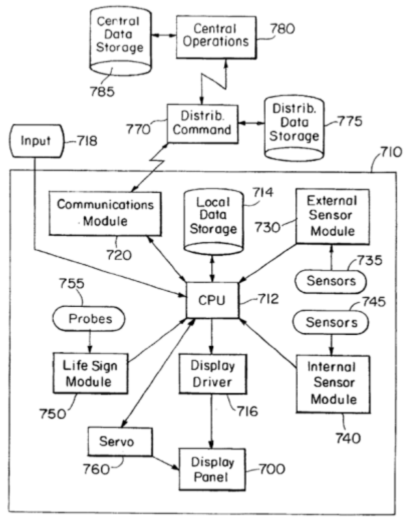


Fig. 35

(Ronzani, Fig. 35, ¶¶162-171.) The head-mounted computer in Ronzani's Figure 35 embodiment includes a CPU **712**, a local data storage device **714**, and communication module **720**. (*Id.*, ¶¶162, 165-166.)

74. Ronzani discloses that "the head-mounted computer **710** can be adapted for use in many real world situations[,]" and it is "especially advantageous … where the wearer desires or needs auxiliary sensory input." (Ronzani, ¶173.) Ronzani provides various examples of such adaptations, including head-mounted computer architectures adapted for firefighters, police officers, chemical workers, and other use cases. (*Id.*, Figs. 35-45, ¶¶162-205.)

75. For example, Ronzani's Figure 37 head-mounted computer

embodiment is adapted for use by firefighters.

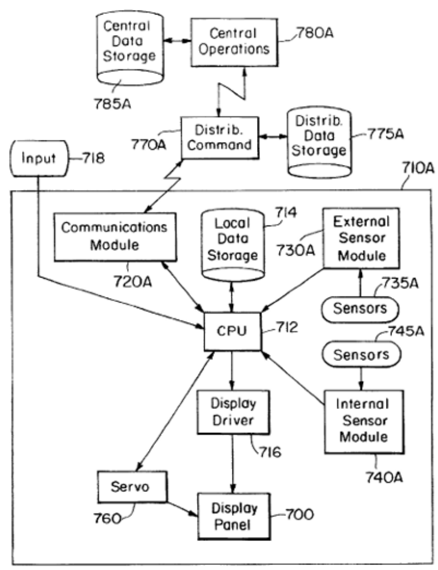


Fig. 37

(Ronzani, Fig. 37, ¶¶174-178.) In this embodiment, "the communication module includes a global positioning satellite (GPS) sensor or other position sensor for accurately determining the position of the firefighter." (*Id.*, ¶176.)

76. I will provide more information about Ronzani in my discussion of the claim limitations below.

3. Fager (EX1005)

77. **Fager**, U.S. Patent Application Publication No. 2004/0104934 A1, is entitled "Device and a Method for Creating an Environment for a Creature." I am informed that Fager qualifies as prior art because it was filed (on February 7, 2002) before the earliest priority date of the '243 patent.

78. Fager discloses systems for presenting a user a "milieu"—i.e., an augmented reality environment—"comprising both at least one part of the real environment and at least one fictitious phenomenon," where properties of the milieu depend on the "position and/or orientation" of a user. (Fager, ¶1; *see also id.*, ¶9 (explaining that the term "milieu" corresponds to "augmented reality").) Further, Fager discloses such systems comprising "two or more devices connected to a network[.]" (Fager, ¶1.)

79. One of Fager's embodiments is the tennis game shown in Figure 5:

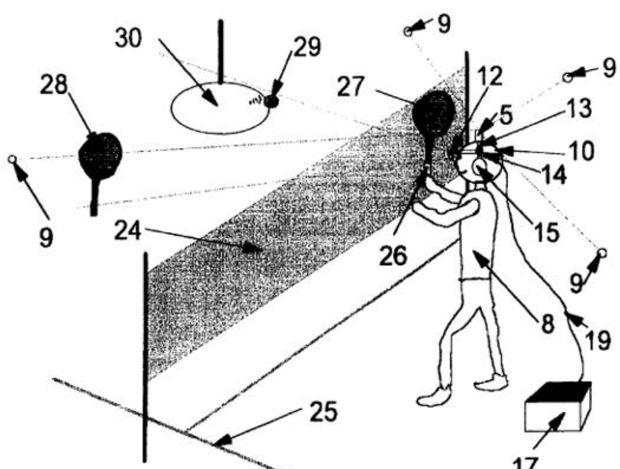


Fig 5

(Fager, Fig. 5.) Fager discloses that "[a] person **8**, the player, in one embodiment of the invention, carries on the head **10** a means in the form of a so-called headset **13**, by which the head **10** of the player is connected to the device according to the invention." (*Id.*, ¶77.)

80. Fager discloses that the system presents a tennis game to the user. Fager discloses that in the tennis game embodiment the position and orientation of a user's head are tracked to determine "where and how the pictures of the fictitious net **24**, the fictitious ball **29**, the fictitious lines and the fictitious racket **28** of the simulated opponent are to be generated[.]" (Fager, ¶81.)

81. Further, Fager discloses that "the player holds a component **26** in his hand. Said component is intended to constitute a tool for performing the actual playing act, to hit a ball in tennis, for instance." (*Id.*, ¶79.) Fager discloses that "[t]he tool is designed as a handle of an ordinary tennis racket and includes a further transducer which is arranged to determine its position and/or orientation relative to the real environment in six degrees of freedom, and which is mechanically fixed connected to the component otherwise freely movable and to an effecting means for communication of information to the control- and calculating unit **17**." (*Id.*)

82. Fager also discloses that the player can play against a real opponent, who "may be equipped with a similar device" as the player. (Fager, ¶86.) Fager discloses a system for matching up the playfields on which each player plays the tennis game, when the two players are located in different places. Each player's device has an "obtaining means," which obtain information about each player's environment. (*Id.*, ¶88.) Fager discloses the devices then "use an algorithm … to

compare how great part of the respective environment that has sufficient properties in common to be used as a court in common, starting from a minimal starting environment." (*Id.*) The algorithm "increases the area gradually and compares which stationary objects that are found in each step of increasing the area." (*Id.*) When an obstacle is found in an environment, "it is investigated if a corresponding obstacle is present in the other environment." (*Id.*) Fager discloses that "[t]he algorithm is repeated until no way to increase the area remains." (*Id.*) Fager discloses the result:

> The courts obtained in this way then constitute a meeting place between two worlds for playing games, which may give possibilities to experiences of the kind which are increased to a substantial extent compared to the previous mentioned tennis case where only different pieces of scenery for the respective player are created.

(*Id.*)

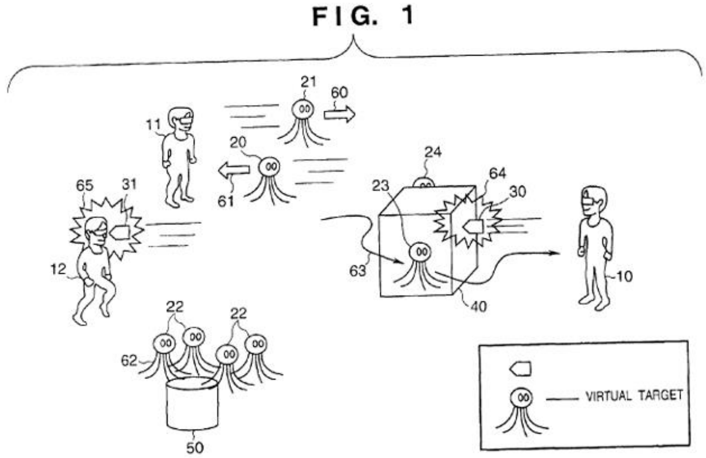
4. Ohshima (EX1006)

83. **Ohshima**, U.S. Patent No. 6,951,515 B2, is entitled "Game Apparatus for Mixed Reality Space, Image Processing Method Thereof, and Program Storage Medium." I am informed that Ohshima qualifies as prior art because it was both filed (on February 17, 2000) and published (on February 13, 2003) before the earliest priority date of the '243 patent.

84. Ohshima discloses a game in which virtual characters change their behavior depending on the location of real players and objects. (Ohshima, 1:65-2:3, 1:9-14.) For example, Ohshima discloses that "the virtual objects that appear in the game system of this embodiment make actions such as collision, explosion, movement, dodge, and the like in consideration of the presence, location, layout, and behavior of the real objects or the location, behavior, and line of sight of the player." (Ohshima, 6:12-17.)

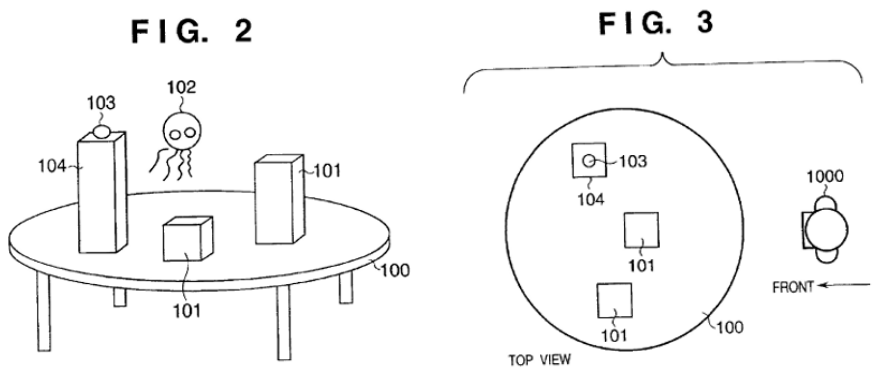
85. Examples are shown in Ohshima's Figure 1:

FIG. 1



(Ohshima, Fig. 1.) Ohshima discloses that a "spaceman runs away (**60**) by sensing the presence of the player **11**" or "comes on or chases the player **11** (**61**)." (Ohshima, 6:1-4.) Further, Ohshima discloses that "[t]he plurality of targets **22** gather around the real object **50** (**62**). The target **24** hides behind the real object **40** by sensing the presence of the player **10**." (*Id.,* 6:5-10; *see also id.,* 8:21-29.)

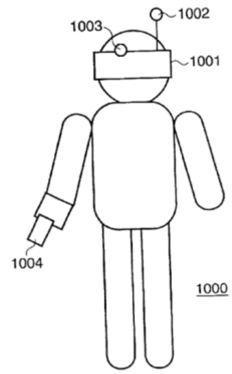
86. Ohshima discloses that the locations of players or real objects in the game can be determine based on real-world locations. For example, Ohshima discloses "movable real object **104**" which "changes its location" and "has a location sensor **103**." (Ohshima, 6:29-33.) These elements are shown in Figures 2 and 3 of Ohshima:



(Ohshima, Figs. 2-3.)

87. Ohshima further discloses embodiments where "the player **1000** wears an HMD **1001** on his or head, and a controller **1004** having a gun shape on his or her hand." (Ohshima, 6:45-47.) "When the HMD **1001** is attached to the head of the player, the head location/posture sensor **1002** outputs a signal representing the head location/posture of the player **1000**." (*Id.,* 6:49-52.) Such an embodiment is shown in Ohshima's Figure 4:

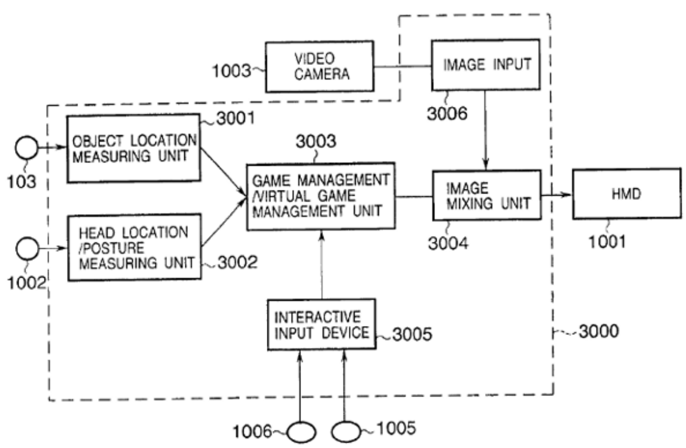
FIG. 4



(*Id.*, Fig. 4.)

88. Figure 5 of Ohshima discloses a "single-player game system" including "[a] location/posture measuring unit **3002** measures the location/posture of the head of the player[.]" (Ohshima, 7:4-12.)

FIG. 5



(*Id.*, Fig. 5.)

B. Ground 1: Claims 1, 6-8, 17, 24-28, and 30 Are Obvious Over Levesque in view of Ronzani

1. Independent Claim 1: "A location based game system comprising:" (Claim 1[pre])

89. The preamble of claim 1 recites "[**a**] **location based game system comprising**." Assuming the preamble provides a claim limitation, it is disclosed by Levesque.

90. For example, Levesque discloses "a video gaming device includes a central gaming unit in communication with a heads-up display and a location sensing sensor." (Levesque, ¶8.) The location sensor provides location information to the gaming unit, allowing the gaming unit to "be aware of the current location and speed" of the user's vehicle. (*Id.*, ¶¶33, 25.) This enables games to be "controlled by the data from the location sensor[,]" allowing for games where a user changes his or her real-world location to, for example, interact with opponents, avoid enemy fire, and more. (*Id.*, ¶¶9, 34; *see also id.*, ¶¶18, 23, 28, 32, 34, 36, 39, 40-42.) Accordingly, Levesque discloses a "**location based game system**," because it discloses a system that provides a game controlled based on a user's real-world location.

(a) "a head-mounted device operable to provide a location based game in a semi-visible environment in which a user of said head-mounted device can simultaneously view at least a portion of a real-world environment around said user as well as virtual indicia for said location based game, said virtual indicia comprising at least one of a virtual game character and a virtual interactive object;" (Claim 1[a])

91. Levesque's video gaming device includes "**a head-mounted device**." For example, Levesque's video gaming device includes a head-mounted device comprising "integrated eye glasses" or a "helmet visor" that includes a "heads-up display **20**." (Levesque, ¶24; *see also id.*, Figs. 1, 3, 4, 6, 8.) Figure 3 of Levesque shows heads-up display **20** as glasses mounted to a user's head:

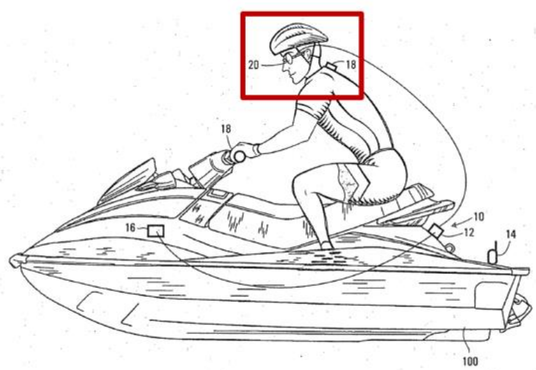


FIG. 3

(*Id.*, Fig. 3 (annotation added), ¶¶30-31.)

92. Levesque's head-mounted device is "**operable to provide a location based game**." As discussed above for the preamble to claim 1, Levesque discloses a location based game system that includes "a heads-up display and a location

sensing sensor." (Levesque, ¶8.) Location information from the location sensor allows for games in which a user can change their real-world location to, for example, interact with opponents, avoid enemy fire, and more. (*Id.*, ¶¶9, 34; *see also id.*, ¶¶18, 23, 28, 32, 34, 36, 39, 40-42.) Figure 4 of Levesque illustrates one example of a location based game provided by a user's head-mounted display (e.g., "heads-up display **20**"):

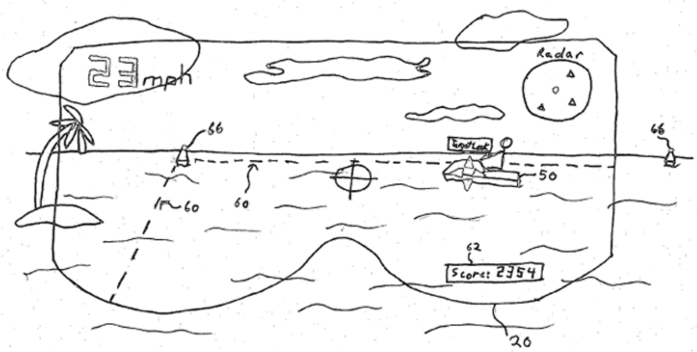


Fig. 4

(*Id.*, Fig. 4, ¶¶34 ("Images of craft(s) representing the opponents 50 are presented to the user on display 20."), 24.) Figure 4 is only an example; Levesque makes clear that its system supports a wide variety of games. (Levesque, ¶¶40 ("wide variety of simulated games"), 33 ("any variety of games may be defined"); *see also id.*, Fig. 6, ¶39 (describing game involving an obstacle course).) Levesque therefore discloses "**a head-mounted device operable to provide a location based game**" as claimed.

93. Turning to the next portion of claim 1[a], Levesque's head-mounted

device is operable to provide a location based game "**in a semi-visible environment in which a user of said head-mounted device can simultaneously view at least a portion of a real-world environment around said user as well as virtual indicia for said location based game**." This is depicted in Figure 4 of Levesque, in which the display of the head-mounted device allows the user to simultaneously view both "**a portion of a real-world environment**" (e.g., the ocean and sky) as well as "**virtual indicia**" for the location-based game, including virtual boundary **60**, simulated opponent **50**, score **62**, speed, crosshairs, and radar display:

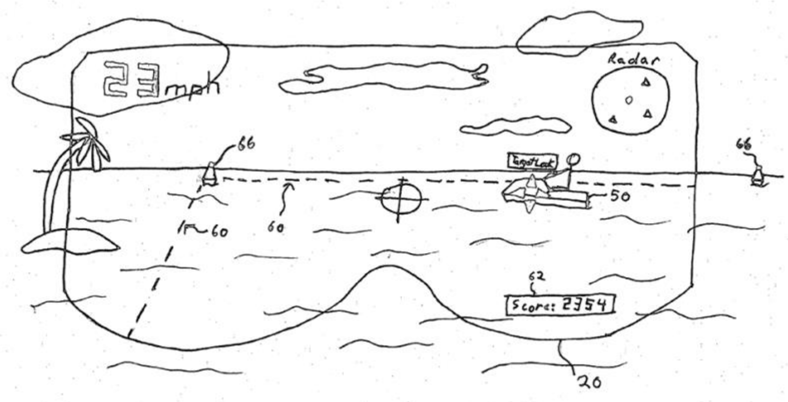


Fig. 4

(*Id.*, Fig. 4, ¶34.)

94. More generally, Levesque discloses that heads-up display **20** is "a video display device that allows an operator to view an image without diverting his or her eyes from their normal point of focus." (Levesque, ¶24 (emphasis added).) On Levesque's heads-up display **20**, "computer generated images displayed by way of

display **20** are overlayed on a user's view of the real world[,]" such that a user can "view an electronically presented image without unduly obstructing the user's view" of the real world. (*Id.*; *see also id.*, Figs. 4, 6, 8, ¶¶20 (video interface **38** "represent[s] images that may be superimposed on a background representing a real-world environment"), 31 ("heads-up display allowing the operator or passenger to view the path of the vehicle while viewing an image presented by mobile gaming device **10**"), 40 ("treasures, enemies **50**, targets, other players and the like may be simulated (and thus for example, hidden or blended) with the existing natural backdrop seen through heads-up display **20**").)

95. Accordingly, Levesque's head-mounted device provides "**a semi-visible environment in which a user of said head-mounted device can simultaneously view at least a portion of a real-world environment**" (the user's real-world surroundings) "**as well as virtual indicia for said location based game**" (computer-generated images).

96. **<u>District Court Litigation Claim Construction Issue.</u>** I understand that Petitioner is asserting in district court litigation that the term "**semi-visible**

environment" is indefinite as to its full scope.[1] I also understand that Petitioner is asserting that while the full bounds of the claim scope are indefinite, there are example scenarios that would be included in the claim scope. For example, I understand Petitioner stated that such an example scenario is "a display half-filled with virtual objects persistently blocking a user of average vision from seeing the corresponding real-world objects 'behind' them[.]" (EX1012 (Meta claim construction brief), p.0018.) In my opinion, Levesque's disclosures satisfy the "semi-visible environment" claim term for such a subset of the full claim scope as Petitioner has described. For example, Levesque's Figures 4, 6, and 8 show displays in which virtual indicia persistently block a user of average vision from seeing the corresponding real-world objects behind them, per Petitioner's provided example scenario. (Levesque, Figs. 4, 6, 8, ¶¶34, 38-42.) Figure 6, for instance, shows virtual indicia indicating user speed that blocks the user's view of a real-world cloud:

[1] I have not been asked to consider the accuracy of the proposed claim constructions or the question of whether such terms are indefinite, but with respect to Petitioner's proposed constructions, I agree that Levesque's disclosures teach the elements of the claims, as described in further detail in my declaration.

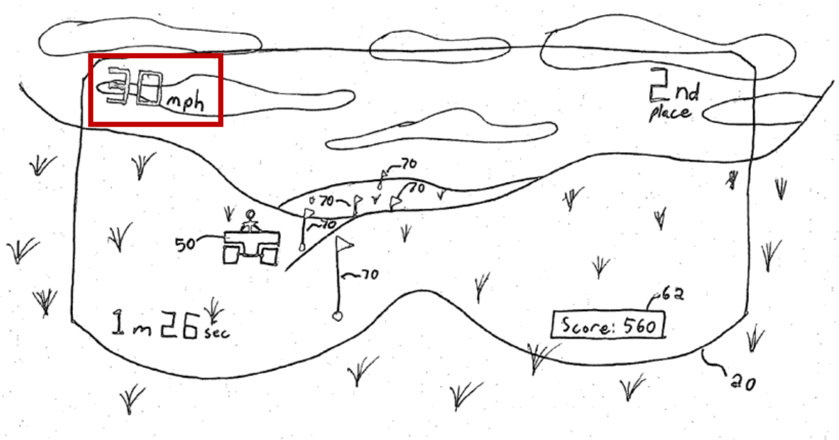


Fig. 6

(*Id.*, Fig. 6 (annotation added).) Levesque also discloses "allowing the user to view an electronically presented image without unduly obstructing the user's view." (*Id.*, ¶24.)

97. Turning to the last portion of claim 1[a], Levesque's head-mounted device is operable to provide "**virtual indicia comprising at least one of a virtual game character and a virtual interactive object**." Levesque discloses that "computer generated images displayed by way of display **20** are overlayed on a user's view of the real world." (Levesque, ¶24.) The computer generated images include both "**virtual game character**[s]" and "**virtual interactive object**[s]."

98. With respect to "**virtual game character**[s]," Levesque describes virtual (or simulated) opponents, such as "virtual opponents **50**" shown in Figure 4:

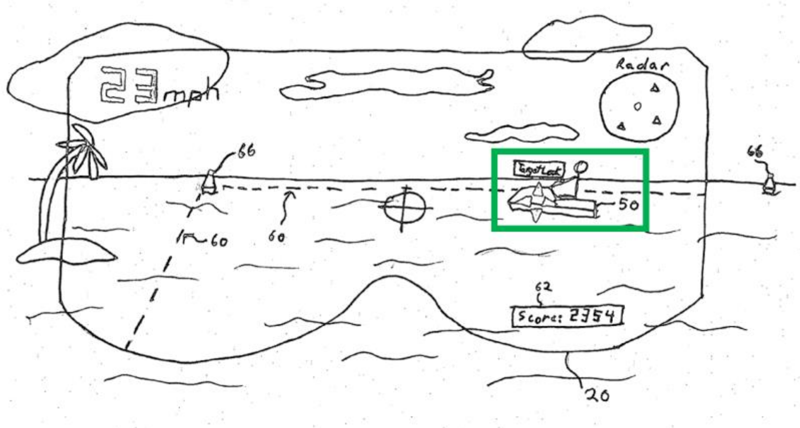


Fig. 4

(Levesque, Fig. 4 (annotation added), ¶34; *see also id.*, ¶40, Figs. 5-6.)

99. With respect to "**virtual interactive object**[s]," Levesque further discloses, for example, "weapon fire from opponents **50**" and virtual obstacles **70** with which the user can interact. (Levesque, ¶¶34, 39 ("An operator of the vehicle may steer the vehicle to avoid collision with the presented obstacles **70**."), Figs. 4-6, 8; *see also id.*, ¶¶35, 38, 42.) Levesque explains that "weapon fire from opponents **50** may be simulated on display **20**" and that a user can interact with weapon fire from opponents **50**, using "[a]ctual motion of the vehicle to avoid launched weapons[.]" (*Id.*, ¶34.) Similarly, for virtual obstacles **70** (shown below in Figure 6), Levesque describes how "[a]n operator of the vehicle may steer the vehicle to avoid collision with the presented obstacles **70**."

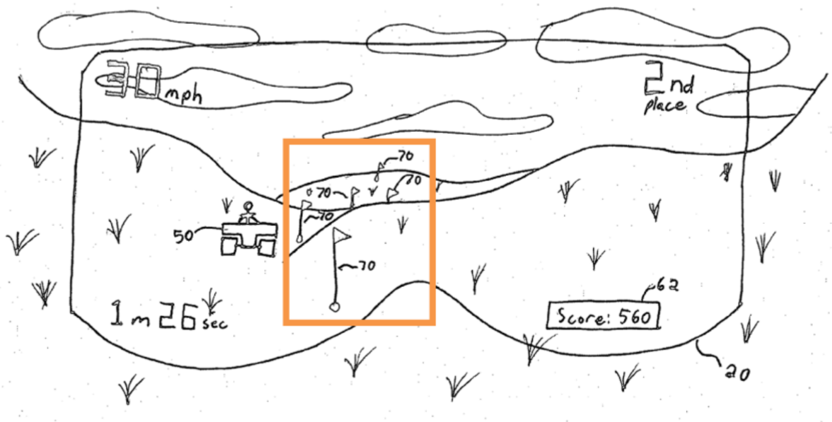


Fig. 6

(*Id.*, Fig. 6 (annotation added), ¶39.) Therefore, both weapon fire from opponents **50** and virtual obstacles **70** disclose "**virtual interactive object**[s]" that can be viewed via the heads-up display **20** of Levesque's video gaming device.

100. **District Court Litigation Claim Construction Issue.** I understand that Petitioner is asserting in district court litigation that the term "**virtual**" should be construed as "not real world." (EX1012 at pp.0007-0011.) Levesque satisfies the claim language regardless of whether Petitioner's proposed construction is adopted. In my opinion, Levesque's disclosures satisfy the "virtual indicia," "virtual game character," and "virtual interactive object" requirements under Petitioner's proposed construction. As discussed above, the "virtual" elements Levesque discloses are part of the game provided by video gaming device. Accordingly, these elements are "not real world," per Petitioner's construction in the district court

litigation.

(b) "processing circuitry in said head-mounted device;" (Claim 1[b])

101. As explained below, Levesque discloses "**processing circuitry**" and it would have been obvious, in view of **Ronzani**, for the processing circuity to be located in Levesque's head-mounted device ("**said head-mounted device**").

102. Levesque's video gaming device includes "**processing circuitry**." For example, Levesque discloses that heads-up display **20** is connected to gaming unit **12** containing a processor **30**, as shown in Figure 2:

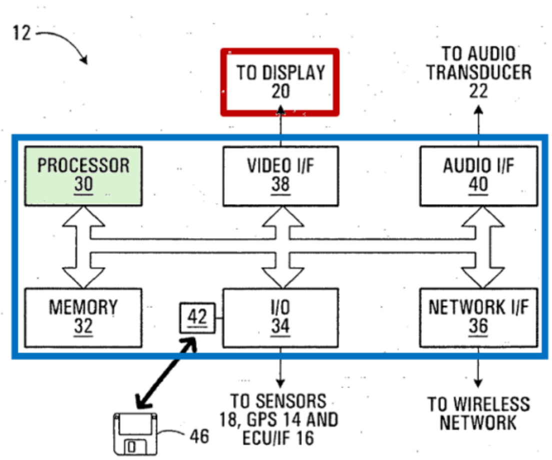


FIG. 2

(Levesque, Fig. 2 (highlighting and annotation added), ¶¶19-20.) Levesque discloses that the processor in its video game device is "in communication with processor readable memory" (which contains gaming software), and a location sensor—so that it can "present a video game whose play is controlled by location of the gaming device, as sensed by the location sensor." (*Id.*, ¶10; *see also id.*, ¶19 ("gaming unit **12** includes a central processor **30** in communication with memory **32**").) Processor **30** is "any suitable processor capable of processing processor executable instruction of sufficient complexity and at sufficient speed to present a near real-time gaming environment to an end-user." (*Id.*, ¶20.)

103. Levesque discloses that gaming unit **12** including processor **30** and other components would be located on a vehicle—for example, near the seat of a watercraft as shown in Figure 3:

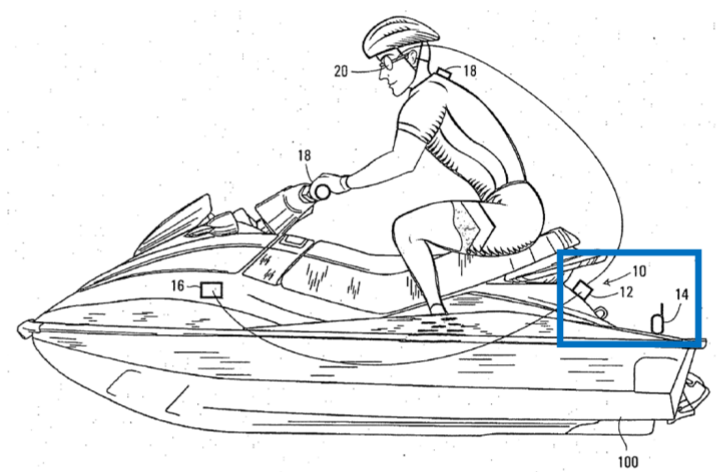


FIG. 3

(Levesque, Fig. 3 (annotation added).) Although Levesque illustrates the placement of the gaming unit near the seat of a watercraft as shown in Figure 3, a POSITA would have been motivated to place a processor and other hardware components inside a head-mounted device in light of **Ronzani**.

104. For example, Ronzani discloses various head-mounted displays containing hardware such as a processor, memory, and first and second locating device. (*See, e.g.*, Ronzani, Figs. 35-45, ¶¶162-205.) Ronzani generally discloses that "[t]he computer and associated electronic components used to load programs, load and store data and communicate or network with other systems by wire or wireless operation can be mounted on the head-piece[.]" (Ronzani, ¶7 (emphasis added).) Ronzani further discloses that a head-mounted display can be fully "self-contained," where hardware is contained in a head-mounted unit. (*See* Ronzani, ¶94.) Ronzani discloses many embodiments of such head-mounted displays. (*See* Ronzani, Figs. 32A, 32B, 33, 34A-D, 35-45, ¶¶150-151, 154-156, 159-166, 169, 172-176, 179-183, 186-197, 200-202, 205.) For example, Ronzani discloses the "head-mounted computer architecture" shown in Figure 35, reproduced below, which includes "head-mounted computer **710**":

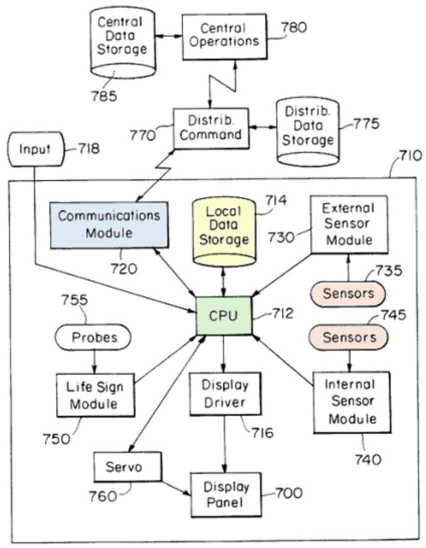


Fig. 35

(Ronzani, Fig. 35 (highlighting added), ¶¶162-171.) Ronzani further discloses various ways in which the "general purpose" head-mounted computer **710** can be adapted "for use in many real world situations," including the embodiments shown in, for example, Figures 37-45. (*Id.*, ¶¶173-205.)

105. Ronzani's head-mounted computer **710** includes CPU **712**. (Ronzani, ¶162, Fig. 35; *see also id.*, Figs. 36-45, ¶¶172, 176-178, 184-187, 192-193, 197-199, 201-204.) In light of such disclosures in Ronzani, a person of ordinary skill would have been motivated to include "**processing circuitry in [the] head-mounted device**" of Levesque's video gaming device.

106. I provide further analysis for components that would have been obvious for a person of ordinary skill to include in the head-mounted device of Levesque's

video gaming device for additional claim limitations below—*e.g.*, claims 1[c], 1[d], 1[e], 17, and 24.

107. A person of ordinary skill would have found it obvious to have sensors and hardware for Levesque's video gaming device in a head-mounted device, such that a user's line of sight and location could be tracked as the user moves around the real world, including by walking or running without the use of a vehicle. Levesque already discloses mounting certain sensors worn on a user's person, including to detect a user's line of sight. (Levesque, ¶26; *see also id.*, ¶¶ 34, 42.) Furthermore, Levesque discloses heads-up display **20** that a user carries around on his or her head. (*Id.*, ¶24.) These wearable devices disclosed by Levesque would have motivated a person of ordinary skill to consider what other components could be placed in a head-mounted unit.

108. **Rationale and Motivation to Combine (Levesque and Ronzani)**: It would have been obvious to a person of ordinary skill in the art to combine Ronzani's teachings regarding a head-mounted device that includes a processor, memory storing computer programming capable of execution by said processing circuitry, and GPS sensor with Levesque. The combination would have involved the straightforward incorporation of hardware components of Levesque's video gaming device (including processor, memory, and sensors) into the head-mounted part of

Levesque's video gaming device and would have predictably resulted in a self-contained head-mounted video gaming device. The combination therefore discloses and renders obvious a "**processing circuitry in said head-mounted device**," among other limitations as discussed throughout my declaration.

109. Levesque and Ronzani are both analogous references to the '243 patent. Like the '243 patent, both Levesque and Ronzani are in the field of portable user-worn devices for providing location-based entertainment. ('243, 2:28-51 ("Summary of the Invention" section discussing "an actual, reality-based video game in which a user's physical (actual) location on a playfield, reflects a virtual game character's virtual location in a video game environment" and "displays" for "location-based games"), 1:22-23 ("This invention relates to video games and video game systems."); Levesque, ¶¶2 ("The present invention relates to video games, and more particularly to mobile electronic video games."), 8 ("Summary of the Invention" section discussing "a video gaming device [that] includes a central gaming unit in communication with a heads-up display and a location sensing sensor"); Ronzani, ¶5 ("The present invention relates generally to systems and methods for mounting display and electronic systems on the human body for numerous applications including commercial, industrial and entertainment purposes."); *see also id.*, ¶2.) Further, both Levesque and Ronzani would have been

reasonably pertinent to problems facing the ’243 patent inventor, including components and features to include in a head-mounted display device for various applications including generating and displaying virtual elements.

110. For example, a person of ordinary skill would have been motivated to place a processor and other hardware components inside the head-mounted part of Levesque’s video gaming device to allow use of the device without a vehicle—*e.g.*, when a user is walking around. Levesque itself discloses that “nearly an infinite variety of gaming software” can take advantage of a system comprised of “display **20**, location sensor **14** and sensors **18**”—without indicating that a vehicle is necessary to such gaming software. (Levesque, ¶43.) Levesque further discloses the use of video games with “sports and exercise activity.” (*Id.*, ¶6.) Allowing Levesque’s video gaming device to be used without a vehicle would allow many additional sports and exercise games. A person of ordinary skill would have been motivated to allow Levesque’s video gaming device to be used without a vehicle to increase the number of use cases for the device. (*See id.*, ¶¶2 (relating to “mobile electronic video games”), 7 (“[T]here is a need for an improved video game that interacts with other forms of amusement, preferably presenting some form of simulated reality.”), 6 (indicating that, in the prior art, “the sports and exercise activity is often constrained to accommodate use of the video game”).)

111. Further, a person of ordinary skill would have been motivated to place a processor and other hardware components inside the head-mounted part of Levesque's video gaming device to enable its use with *different* vehicles. Figure 3 of Levesque shows gaming unit **12** (where processor **30** and other hardware is located per Figure 2 of Levesque) as part of a "personal watercraft." (Levesque, Figs. 2-3, ¶¶19-20, 30.) However, a person of ordinary skill would have understood that placing such hardware on a particular vehicle would limit Levesque's gaming system to use with that specific vehicle. A person of ordinary skill would have been motivated to enable use of Levesque's video gaming device with different vehicles. For example, a person of ordinary skill would have been motivated by Levesque's disclosure of different types of vehicles Levesque's video gaming device could be used with, including "a recreational vehicle in the form of a snowmobile, all terrain vehicle or personal watercraft." (Levesque, ¶8; *see also id.*, ¶¶24 (disclosing use with "an automobile"), 30 ("Example vehicles include a Bombardier® Ski-Doo® Rev™ snowmobile; a Bombardier™ DS650™ all-terrain vehicle; or a Bombardier® Sea-Doo® XP® personal watercraft."), 36, 41, 2 (relating to "mobile electronic video games"), 7 ("[T]here is a need for an improved video game that interacts with other forms of amusement, preferably presenting some form of simulated reality.").)

112. A person of ordinary skill would have looked to Ronzani for details on how to implement a head-mounted video gaming system like Levesque discloses without the use of a vehicle. For starters, Ronzani explains that its head-mounted displays have broad application, including for "entertainment purposes." (Ronzani, ¶5.) A person of ordinary skill in the art would have therefore appreciated the clear applicability of Ronzani's teachings to Levesque's gaming system. Moreover, even putting aside Ronzani's express recognition that its head-mounted displays were suitable for "entertainment purposes," a person of ordinary skill in the art would have appreciated the applicability of embodiments described in the context of commercial and industrial applications, such as firefighting and military use. After all, as anyone knows, there may be little or no difference between what one considers "work" and another considers "fun." This was famously and humorously illustrated in a 1998 episode of *The Simpsons* in which children happily play a virtual reality "yard work simulator" (see figure at right). For example, with respect to Ronzani, a person of ordinary skill in the art would have recognized

that military use could involve simulated "war games." The '243 patent appears to similarly suggest this connection, disclosing that a user's controller could take the form of a gun. ('243, 19:36-39.) Indeed, a person of ordinary skill would have been aware of the popularity of "first-person shooter" video games, including military simulations.

113. Ronzani moreover discloses a variety of head-mounted display designs that are entirely self-contained, allowing a user to move around while carrying all the necessary hardware in the head-mounted display. (Ronzani, ¶94; *see also id.*, Figs. 35-45, ¶¶162-205.) Furthermore, Ronzani discloses that its designs are "light-weight," "compact," and "non-intrusive," which would have motivated a person of ordinary skill to look to Ronzani for details on how to implement the video gaming device of Levesque in a more flexible form. (*Id.*, ¶¶4, 8.) Ronzani also discloses that its head-mounted display can be "adapted for use in many real world situations[,]" which "typically involve applications where the wearer desires or needs auxiliary sensory input." (*Id.*, ¶173.) A person of ordinary skill would have understood that Levesque's location-based games represent such an application where "the wearer desires or needs auxiliary sensory input"—*i.e.*, the auxiliary sensory input of virtual objects presented alongside real-world elements in Levesque's location-based games. (*See* Levesque, Figs. 3-6, ¶¶30-39.)

114. A person of ordinary skill would have looked to combine Levesque with embodiments of Ronzani that include all components necessary for running a location-based game like Levesque discloses within Ronzani's self-contained design. For example, a person of ordinary skill would have looked to Ronzani's Figure 37 embodiment, which is a head-mounted display that includes a head-mounted computer **710A**, local data storage **714**, and GPS sensor in communication module **720A**, among other components:

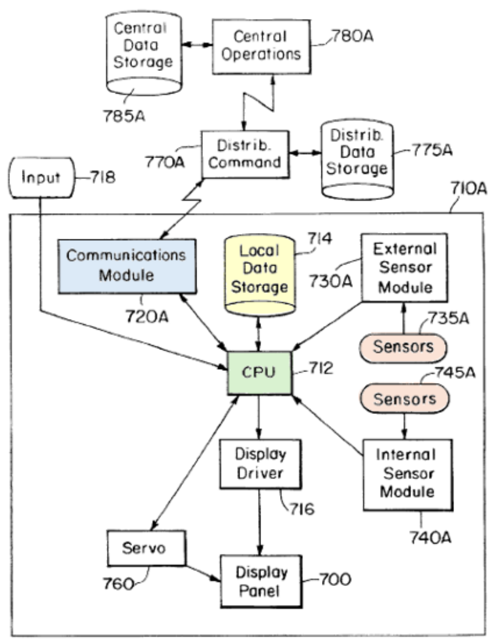


Fig. 37

(Ronzani, Fig. 37 (highlighting added), ¶¶174-178.) A person of ordinary skill would have understood that a position-tracking device like Ronzani's Figure 37 embodiment (which Ronzani discloses for use by firefighters to help with navigation through a burning building) would be well-suited to implementing Levesque's location-based gaming device, since both applications involve continuous tracking of a wearer's position. (*Id.*, ¶176; Levesque, ¶¶25-26, 28, 33.)

115. The combination would have involved the use of a known technique (incorporating hardware into a self-contained head-mounted display) to improve a similar device (Levesque's vehicle-based video gaming device) in the same way. Moreover, because the details of implementing a self-contained video gaming device are not a focus of Levesque, a person of ordinary skill in the art, seeking to implement and adapt Levesque's teachings for use with a self-contained head-mounted display, naturally would have turned to Ronzani for its complementary applicable teachings and motivations.

116. A person of ordinary skill would have had a reasonable expectation that the combination would have been successful. Ronzani discloses that its head-mounted display "can be adapted for use in many real world situations." (Ronzani, ¶173.) Similarly, Levesque discloses that its basic structure of "display **20**, location sensor **14** and sensors **18**" could make possible "nearly an infinite variety of gaming software[.]" (Levesque, ¶43.)

(c) "memory in said head-mounted device storing computer programming capable of execution by said processing circuitry;" (Claim 1[c])

117. Like claim 1[b], this limitation is obvious over Levesque in view of Ronzani.

118. Levesque's video gaming device includes a "**memory … storing computer programming capable of execution by said processing circuitry**." For example, Levesque discloses that within gaming unit **12**, processor **30** is connected to memory **32**, which consists of "any combination of computer readable memory[,]" as shown in Figure 2:

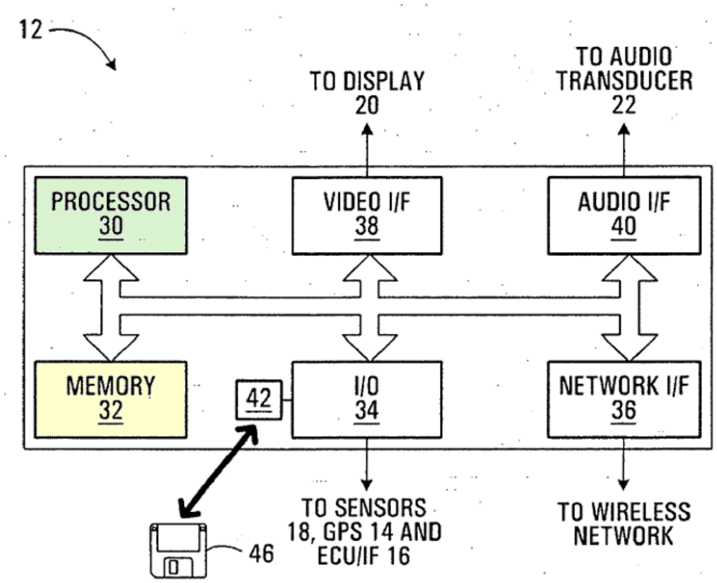


FIG. 2

(Levesque, Fig. 2 (highlighting added), ¶20.) Levesque discloses that "[t]he memory stores gaming software, to present a video game on the heads-up display[.]" (*Id.*,

¶9; *see also id.*, ¶10.) Levesque also discloses that game software can be stored on a computer readable medium **46** and read by memory reader **42** in Levesque's system, where the computer readable medium can be "a CD-ROM, DVD or the like; magnetic memory in the form of a diskette or the like; or a solid state memory such as a ROM cartridge." (*Id.*, ¶19; *see also id.*, ¶10.) Levesque discloses that games may be "loaded from a computer readable medium," which a person of ordinary skill would have understood would occur by loading software from computer readable medium **46** to memory **32**. (*Id.*, ¶43; *see also id.*, ¶19.)

119. As discussed above for claim 1[b], it would have been obvious to place the hardware components of Levesque in a head-mounted device in light of **Ronzani**. For example, it would have been obvious to place Levesque's **memory in said head-mounted device**. Ronzani's head-mounted computer **710** includes local data storage **714**.

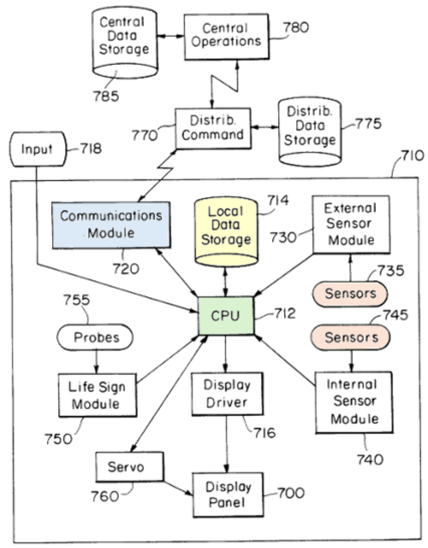


Fig. 35

(Ronzani, ¶162, Fig. 35 (highlighting added); *see also id.*, Figs. 36-45, ¶¶172, 174, 176, 180, 182, 190, 195, 197, 200-201.) Ronzani discloses that the local data storage **714** in its head-mounted computer **710** "includes software applications for execution by the CPU **712**." (*Id.*, ¶172; *see also id.*, ¶174 (local data storage **714** includes "application software").) In light of such disclosures in Ronzani, a person of ordinary skill would have been motivated to implement Levesque's video gaming device with a "**memory in said head-mounted device storing computer programming capable of execution by said processing circuitry**," including based on the motivations to combine I discuss above (regarding claim 1[b]) for incorporating hardware elements into a self-contained head-mounted device.

(d) "a first locating device in said head-mounted device for providing a first control signal for said location based game;" (Claim 1[d])

120. Like claim 1[b], this limitation is obvious over Levesque in view of Ronzani.

121. Levesque's video gaming device includes "**a first locating device**." For example, Levesque discloses that heads-up display **20** is connected through video gaming unit **12** to location sensor **14**, as shown in Figure 2:

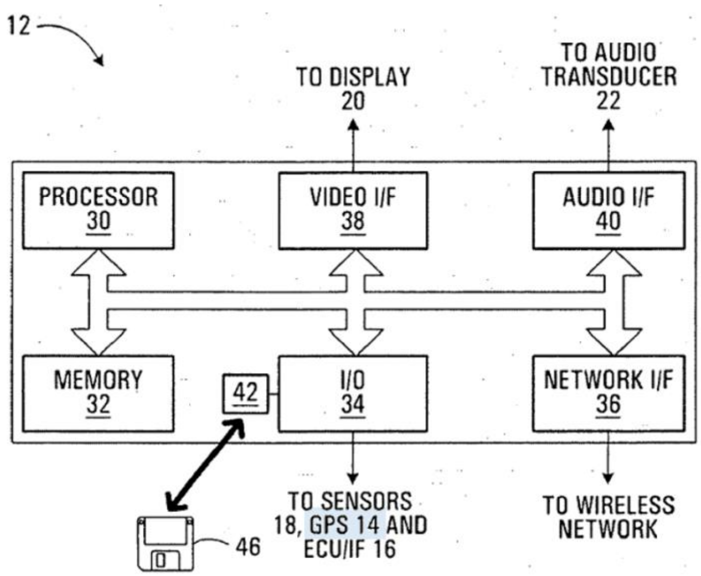


FIG. 2

(Levesque, Fig. 2 (highlighting added), ¶18; *see also id.*, Fig. 3, ¶¶32-33.) Levesque discloses that location sensor **14** is "preferably a conventional global positioning system (GPS) satellite receiver[.]" (*Id.*, ¶25.) The '243 patent indicates that a first locating device could be a device that determines location, including a GPS sensor.

(*See* '243 patent, Abstract ("a locating device (e.g., a GPS system)"), 4:5-9 ("a GPS device (or any type of locating device)"), 15:25-27 ("locating devices **701** (e.g., a GPS receiver or an accelerometer)"), 3:43-48, 7:6-8, 18:36-42, cl. 4 ("said first locating device comprises a positioning receiver operable to be utilized in determining a position of said head-mounted device"), cl. 32 ("at least one of said first locating device and said second locating device comprises a global positioning system); *see also id.*, cl. 43, 68, 79, 104, 115, 139.)

122. The location sensor **14** in Levesque's video gaming device is "**for providing a first control signal for said location based game**." Levesque discloses that location sensor **14** can be a GPS receiver that "provides an indication of sensed geographic location to gaming unit **12**[.]" (Levesque, ¶25.) A person of ordinary skill would have understood that a GPS satellite receiver like Levesque discloses would output geographic location information in the form of a digital **signal**. (*See id.*, ¶25 ("For example, Motorola's Instant GPS, SiGe Semiconductor's SE1400 GPS IC or RF Micro Devices' RF8000 could be used in suitable GPS receivers.").) Consistent with that understanding, Levesque discloses that location sensor **14** provides this information through input/output interface **34**, which contains "suitable ports for connection of sensors **18**, location sensor **14**, and ECU interface **16**" consisting of "one or more optical, electrical or wireless ports." (*Id.*,

¶23.)

123. Levesque further discloses that the output signal from location sensor **14** is used as a "**control signal for said location based game**." Levesque discloses that "[i]nputs controlling play of the video game . . . are provided at least in part by actual operation of the vehicle through … location sensor **14**[.]" (*Id.*, ¶32; *see also id.*, ¶¶9 ("play of the video game is controlled by the data from the location sensor"), 10-11, 42-43, 33-36, 40.)

124. As discussed above for claim 1[b], it would have been obvious to place the hardware components of Levesque in a head-mounted device in light of **Ronzani**. For example, it would have been obvious to place Levesque's **first locating device in said head-mounted device**. Ronzani's head-mounted computer **710** includes communication module **720**.

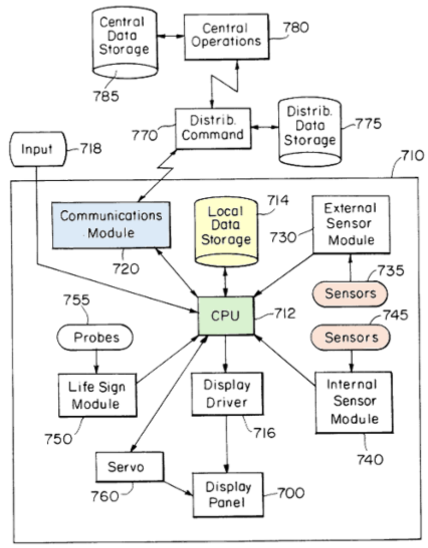


Fig. 35

(Ronzani, ¶165, Fig. 35 (highlighting added); *see also id.*, Figs. 36-45, ¶¶162, 171-172, 175-176, 181, 183, 188, 191, 196, 201.) Ronzani discloses that its communication module "includes a global positioning satellite (GPS) sensor or other position sensor" for determining the position of the head-mounted computer. (*Id.*, ¶176; *see also id.*, ¶¶181, 183, 191, 201.) In light of such disclosures in Ronzani, a person of ordinary skill would have been motivated to implement Levesque's video gaming device with "**a first locating device in [the] head-mounted device for providing a first control signal for said location based game**," including based on the motivations to combine I discuss above (regarding claim 1[b]) for incorporating hardware elements into a self-contained head-mounted device.

(e) "a second locating device in said head-mounted device for providing a second control signal for said location based game; and" (Claim 1[e])

125. Levesque's video gaming device includes a "**second locating device in said head-mounted device**." For example, Levesque discloses that heads-up display **20** is connected through video gaming unit **12** to sensors **18**, which can include "sensors to sense the position (e.g. tilt and rotation) of the user's head relative to the user's torso." (Levesque, ¶¶26, 34 ("Any motion of the user's head, as sensed by one of external sensors **18** may be taken into account."), 42 ("the user's line of sight (as determined through sensors **18**)"), Figs. 1-3.) Any of these sensors for determining the position of a user's head constitute a **second locating device**.

126. Example sensors **18** in Levesque's Figure 3 are shown mounted on a user's shoulders:

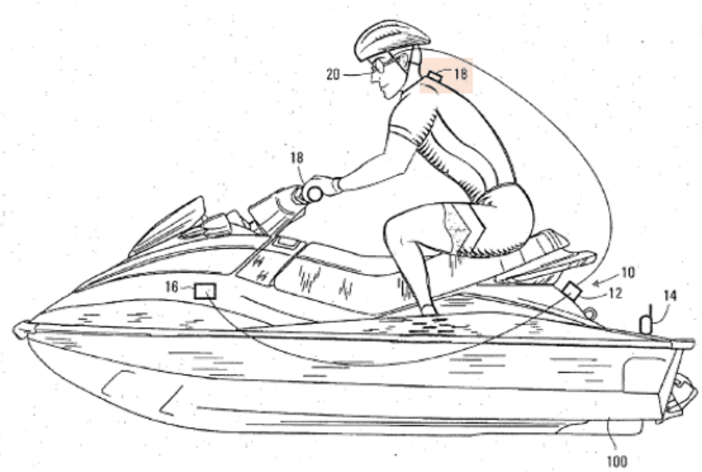


FIG. 3

(Levesque, Fig. 3 (highlighting added).) A person of ordinary skill in the art would have understood that sensors for detecting the tilt and rotation of a user's head would be implemented as accelerometers and/or gyroscopes in Levesque's heads-up display **20**. The '243 patent indicates that devices for determining acceleration and head tilt or rotation of a user can be a "locating device." ('243 patent, 15:25-27 ("locating devices **701** (e.g., a GPS receiver or an accelerometer)"), 4:15-20 (locating device can provide "signals representative of the direction that the user's head is pointed towards"), 7:15-20 ("devices that measure movement (e.g., an accelerometer) may be utilized as a locating device"), 14:52-15:8, 18:38-42.)

127. The head-tracking external sensors **18** in Levesque's video gaming device are "**for providing a second control signal for said location based game**." For example, Levesque discloses that sensors **18** "provide a suitable electronic sensing signal, in analog or digital form, to central gaming unit **12** by way of, for example, input/output interface **34**." (Levesque, ¶26.) The signals from these sensors **18** are used by Levesque's gaming unit **12** as control signals for the location based game. For example, Levesque discloses that inputs from sensors **18** "control[] play of the video game[.]" (*Id.*, ¶32; *see also id.*, ¶¶34 ("Any motion of the user's head, as sensed by one of external sensors **18** may be taken into account."), 23, 28, 32, 42-43, Figs. 1-4, 6, 8.)

128. To the extent there is any question whether Levesque's sensors for measuring user head tilt and rotation are **in said head-mounted device**, as discussed above for claim 1[b], it would have been obvious to place the hardware components of Levesque in a head-mounted device in light of **Ronzani**. For example, it would have been obvious to place Levesque's **second locating device in said head-mounted device**. Ronzani's head-mounted computer **710** includes external sensors **735** and internal sensors **745**. (Ronzani, ¶¶166-167, Fig. 35; *see also id.*, Figs. 37-45, ¶¶177-178, 181, 184-187, 192-193, 197-198, 202-203.) Ronzani describes the external sensors **735** as "provid[ing] data representing the external environment around the wearer[,]" including "a position sensor to locate the relative position of an astronaut from a fixed reference data point, such as a landing craft." (*Id.*, ¶¶166, 197.) Ronzani describes the internal sensors **745** as "provid[ing] information regarding the wearer's local environment." (*Id.*, ¶167.) In light of such disclosures in Ronzani, a person of ordinary skill would have been motivated to implement Levesque's video gaming device with "**a second locating device in said head-mounted device for providing a second control signal for said location based game**," including based on the motivations to combine I discuss above (regarding claim 1[b]) for incorporating hardware elements into a self-contained head-mounted device.

(f) "a display provided on said head-mounted device, wherein said head-mounted device is a portable device and said processing circuitry is operable to execute said computer programming to cause said display to display said location based game based on a location, direction, and pitch associated, at least in part, with said first control signal and said second control signal, said display of said location based game comprising display of said virtual indicia in a manner that blocks part of, but not all of, said user's view of said real-world environment around said user, and" (Claim 1[f])

129. Levesque's video gaming device includes "**a display provided on said head-mounted device**," such as "heads-up display **20**," which Levesque discloses can "take the form of monocular or binocular viewers that may, for example, be in the form of integrated eye glasses, … allowing the user to view an electronically presented image without unduly obstructing the user's view." (Levesque, ¶24.) Levesque also discloses that "heads-up display **20** may form part of a helmet visor." (*Id.*; *see also id.*, ¶¶31, 42, 8-11, 18, 20).

130. Levesque discloses that its "**head-mounted device is a portable device**." For example, Levesque describes its video gaming device as a "mobile electronic video gaming device." (Levesque, ¶¶18, 30, Title ("Mobile electronic video game"), 2 ("The present invention relates to video games, and more particularly to mobile electronic video games."); *see also id.*, ¶6.) Furthermore,

Levesque discloses that its video gaming device can be used as a person operates a "moving vehicle," including "a recreational vehicle in the form of a snowmobile, all terrain vehicle or personal watercraft." (*Id.*, ¶¶11, 8; *see also id.*, Figs. 1-6, 8, Abstract, ¶¶26, 30-32, 34-36, 39.) A person of ordinary skill would have considered such a mobile video gaming system to be a **portable device**.

131. To the extent there is any argument that a "**portable device**" is a device that a person can hold or wear as the person walks around, a person of ordinary skill would have found it obvious to implement Levesque's video gaming device as a standalone head-mounted device in light of **Ronzani**, as I discuss above for claim 1[b].

132. Levesque discloses that "**said processing circuitry is operable to execute said computer programming to cause said display to display said location based game based on a location, direction, and pitch associated, at least in part, with said first control signal and said second control signal**."

133. Using inputs from location sensor **14** (the **first control signal** as discussed above for claim 1(d)), Levesque discloses displaying a game based on **location**. Levesque discloses "presenting a video game on a heads-up display; sensing a geographic location of the video gaming device; [and] controlling play of the video game based on the sensed geographic location." (Levesque, ¶11; *see also*

id., ¶¶8, 25, 26.) For example, Levesque discloses a game in which, "as the opponents **50** are approached, their size may be magnified on display **20**, much in the same way a user would view actual opponents." (*Id.*, ¶34; *see also* ¶¶25, 40, 41 ("gaming device **10** may use information about the geography to present targets and obstacles as a realistic backdrop to the remaining scenery"), 42 ("data about scenery, visual through heads-up display **20** may be obtained using knowledge of the gaming device's location (as determined by location sensor **14**)"), Figs. 1-3, 6, 8.)

134. Furthermore, using inputs from sensors **18** (the **second control signal** as discussed above for claim 1(e)), Levesque discloses displaying a game based on **direction** and **pitch**. For example, Levesque discloses a game in which "[a]ny motion of the user's head, as sensed by one of external sensors **18** may be taken into account." (*Id.*, ¶34; *see also id.*, ¶¶26 (sensors **18** include "sensors to sense the position (e.g. tilt and rotation) of the user's head relative to the user's torso"), 42 (presenting information based on "the user's line of sight (as determined through sensors **18**)."), 40, Figs. 1-3, 6, 8.)

135. Levesque discloses that such display of a location-based game is provided by **processing circuitry [] operable to execute said computer programming**. For example, Levesque discloses that "gaming software exemplary of the embodiments of the present invention processes inputs taken from one or more

of location sensor **14** [and] external sensors **18**[.]" (Levesque, ¶28; *see also id.*, ¶¶9 ("the location sensor in communication with the processor to provide data indicative of the geographic location to the processor"), 10, 19.) Further, Levesque discloses that processor **30** causes heads-up display **20** to display games. (*Id.*, ¶20 ("Processor **30** may be any suitable processor capable of processing processor executable instruction of sufficient complexity and at sufficient speed to present a near real-time gaming environment to an end-user."); *see also id.*, cl. 1 ("said processor readable memory storing gaming software, to present a video game on said heads-up display, wherein play of said video game is at least partially controlled by said data from said location sensor"), cl. 16.)

136. Levesque discloses that in its video gaming device, "**said display of said location based game comprising display of said virtual indicia in a manner that blocks part of, but not all of, said user's view of said real-world environment around said user**." For example, Levesque discloses that "computer generated images displayed by way of display **20** are overlayed on a user's view of the real world[,]" such that a user can "view an electronically presented image without unduly obstructing the user's view" of the real world. (Levesque, ¶24; *see also id.*, ¶¶20 (video interface **38** "represent[s] images that may be superimposed on a background representing a real-world environment"), 31 ("heads-up display

allowing the operator or passenger to view the path of the vehicle while viewing an image presented by mobile gaming device **10**"), 40, Figs. 4, 6, 8.) Accordingly, Levesque's video gaming device displays **said virtual indicia** (computer-generated images) **in a manner that blocks part of, but not all of, said user's view of said real-world environment** (real-world background) **around said user**. Such simultaneous viewing of the real-world environment and virtual indicia is shown in Figure 6 of Levesque, where virtual indicia (including simulated opponent **50**, score **62**, speed, and other text ("2nd place")) block part of, but not all of, the user's view of the real-world environment (*e.g.*, hills and sky). For example, the speed information in the upper left corner of Figure 6 is shown blocking part of a real-world cloud:

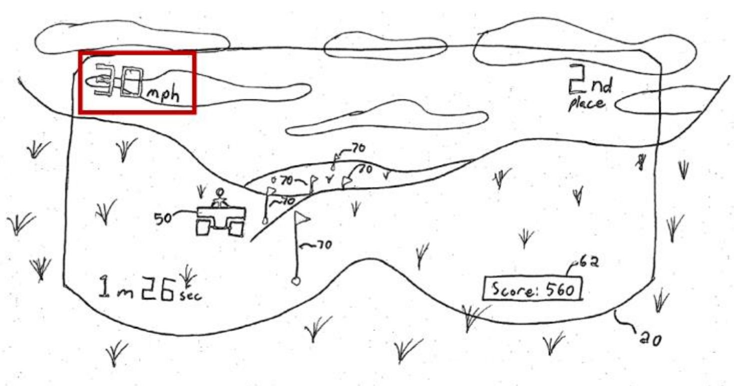


Fig. 6

(*Id.*, Fig. 6 (annotation added), ¶¶34, 39; *see also id.*, Figs. 4, 8.)

(g) "wherein said processing circuitry is operable to execute said computer programming to allow said user of said head-mounted device to manually set one or more boundaries for said location based game." (Claim 1[g])

137. Levesque's video gaming device includes "**processing circuitry [] operable to execute said computer programming to allow said user of said head-mounted device to manually set one or more boundaries for said location based game**." For example, Levesque discloses that a game can have "a virtual boundary **60**," which is "enforced … to ensure safe game play." (Levesque, ¶35; *see also id.*, ¶¶34, 38, 39, Figs. 4-6, 8.) Levesque discloses that virtual boundary **60** is a **boundar[y] for [the] location based game**. For example, Levesque discloses:

> Once the boundary **60** is defined and stored at central gaming unit **12**, gaming unit **12** may react to an operator crossing the defined virtual boundary **60** (as sensed through location sensor **14**) with the vehicle by disabling or slowing the vehicle's engine through ECU interface **16** or alternatively sending a necessary warning to the operator by way of display **20** to shut down the vehicle and/or disable the game, thereby maintaining a level of safety.

(*Id.*, ¶35.) Further, Levesque discloses a game that "present[s] simulated opponents **50** within a virtual boundary **60**." (*Id.*, ¶34.)

138. Levesque further discloses that its video gaming device includes

"**processing circuitry [] operable to execute said computer programming to allow [a] user of [the] head-mounted device to manually set**" virtual boundary **60**. For example, Levesque discloses that its video gaming device provides a "configuration screen" shown in Figure 5 that allows virtual boundary **60** to "defin[e]" a virtual boundary **60**:

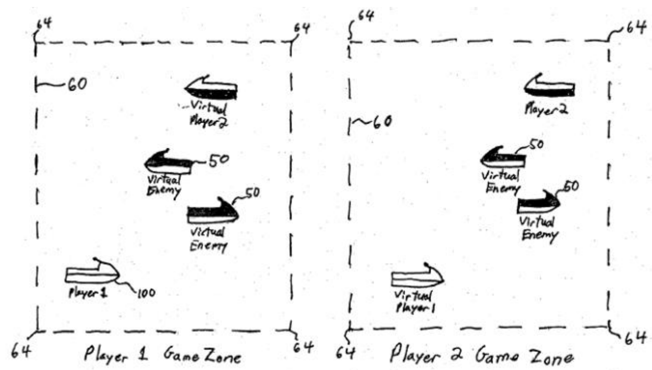


Fig. 5

(Levesque, Fig. 5, ¶35.) The configuration screen allows a user to "travel to the corners **64** of the boundary using vehicle **100** and providing an input by way of one of sensors **18**, for example in the form of a button on the player's uniform or on vehicle **100**." (*Id.*, ¶35, Fig. 5.) Levesque also discloses that a user can place buoys **66** at the corners **64** of the virtual boundaries **60** to define the virtual boundaries. (*Id.*, ¶38, Fig. 4.) Setting boundaries via sensor **18** inputs or placing buoys each represent ways that Levesque discloses a user **manually set[ting]** virtual boundary or boundaries **60**. A person of ordinary skill would have understood that such a boundary setting user interface would be provided by **processing circuitry**—*i.e.*, processor **30**. For example, Levesque discloses that a set boundary can be "stored within memory **32** for later use[,]" which a person of ordinary skill would have understood would be performed by processor **30**. (*Id.*, ¶¶35, 9-10 ("a processor in communication with processor readable memory"), 20, Fig. 1.)

2. Claim 6: "The location based game system of claim 1, wherein said location based game is operable to be played on a physical playfield that correlates to a virtual playfield and said processing circuitry is operable to execute said computer programming to set one or more physical boundaries for said physical playfield that correlate to one or more virtual location boundaries of said virtual playfield for said location based game."

139. Levesque discloses claim 6.

140. Levesque discloses that "**said location based game is operable to be played on a physical playfield that correlates to a virtual playfield**." For example, Levesque discloses that a user can play a game on the video gaming device **on a physical playfield**—*i.e.*, in a real world environment (*e.g.*, on open water). (Levesque, Figs. 4-6, 8, ¶¶ 8, 9, 11, 20, 24, 34-39, 42.)

141. __**District Court Litigation Claim Construction Issue.**__ I understand that Petitioner is asserting in district court litigation that the term "physical" should be construed as "real world." (EX1012 at pp.0007-0011.) Levesque satisfies the

claim language regardless of whether Petitioner's proposed construction is adopted. In my view, Levesque discloses that its video gaming device is operable to be played on a "**physical playfield**" under Petitioner's prior proposed construction because, as discussed above, Levesque discloses playing a video game in a real world environment. (Levesque, Figs. 4-6, 8, ¶¶34-39, 42.)

142. Further, Levesque discloses that the **physical playfield [] correlates to a virtual playfield**. For example, Levesque discloses that a user's movements in the real world correlate to movements in the virtual world. Levesque discloses that its video gaming device uses inputs from location sensor **14** to "simulate interaction with the[] virtual opponents **50**" in the game:

> For example, as the opponents **50** are approached, their size may be magnified on display **20**, much in the same way a user would view actual opponents. Any motion of the user's head, as sensed by one of external sensors **18** may be taken into account. To enhance game play, movement of the enemies in three-dimensional space, within defined boundaries may be simulated. The position and speed of the vehicle **100** may be taken into account when presenting the simulated images on display **20**…. Optionally, weapon fire from opponents **50** may be simulated on display **20**. Actual motion of the vehicle to avoid launched weapons may also be accounted for. Inputs received from location sensor **14** may be used to assess the

> vehicle's relative position to any virtual opponents **50** as well as vehicle speed and the like.

(Levesque, ¶34.) Accordingly, Levesque discloses that its gaming device can provide a game where actual and virtual playfields are correlated so that the user's real-world location can be used to interact with virtual elements.

143. As another example, Levesque discloses that elements of the virtual environment provided by the video gaming device can correlate to elements on the real-world physical playfield. Levesque discloses simulating a game "with reference to a map based on known geography of an area[,]" where "[m]ap information may be correlated to measured location as sensed by location sensor **14**." (Levesque, ¶40.) For example, Levesque discloses that the game may provide "[o]bstacles **70** in the form of islands, houses, and the like … with reference to knowledge of the existing topography" of the user's real-world surroundings. (*Id.*)

144. Levesque also discloses that "**said processing circuitry is operable to execute said computer programming to set one or more physical boundaries for said physical playfield that correlate to one or more virtual location boundaries of said virtual playfield for said location based game**." For example, Levesque discloses that its video gaming device provides a configuration screen that allows a user to define a boundary **60** at a real-world location. (Levesque, Fig. 5, ¶35.)

Boundary **60** is shown in Figure 4 of Levesque, where it serves as a physical boundary—*i.e.*, a boundary in the real world:

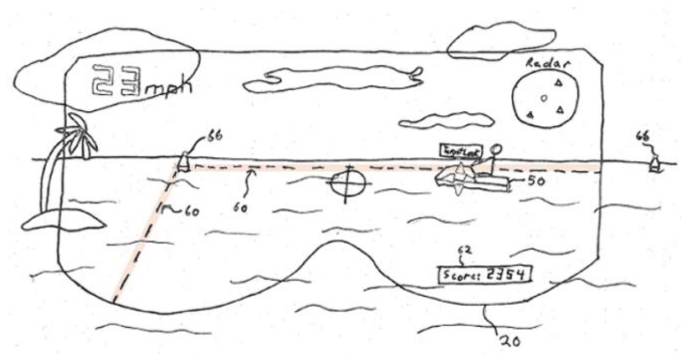


Fig. 4

(Levesque, Fig. 4 (highlighting added).) Levesque discloses that when a real-world vehicle crosses boundary **60**, "gaming unit **12** may react … by disabling or slowing the vehicle's engine through ECU interface **16** or alternatively sending a necessary warning to the operator by way of display **20** to shut down the vehicle and/or disable the game, thereby maintaining a level of safety." (*Id.*, ¶35.) Accordingly, Levesque discloses that its video gaming device is operable to **set one or more physical boundaries for said physical playfield**—*i.e.*, a boundary in the real world that limits the area in which a user can play the game.

145. To the extent there is any argument that a "**physical boundar[y]**" must be a real-world object, Levesque discloses that boundary **60** can be delineated by real-world buoys **66**, and that these buoys can be physically connected "by way of a

rope or string[.]" (Levesque, ¶38.) Accordingly, Levesque's video gaming device **sets one or more physical boundaries for said physical playfield**—*i.e.*, it sets the boundaries delineated by real-world buoys, rope, and/or string.

146. **District Court Claim Construction Issue.** I understand that Petitioner is asserting in district court litigation that the term "physical" should be construed as "real world." (EX1012 at pp.0007-0011.) Levesque satisfies the claim language regardless of whether Petitioner's proposed construction is adopted. In my view, Levesque discloses "**one or more physical boundaries for said physical playfield**" per Petitioner's previously proposed construction. Boundary **60** constitutes a "real world" boundary, as shown in Figure 4 of Levesque, for example. (Levesque, Fig. 4, ¶38.) Furthermore, Levesque discloses that boundary **60** can be delineated by real-world objects like buoys, ropes, and string. (*Id.*)

147. Levesque further discloses that the one or more physical boundaries "**correlate to one or more virtual location boundaries of said virtual playfield for said location based game**." Levesque's boundary **60** serves as a virtual boundary within the virtual environment of a provided game. For example, Levesque discloses a game that "present[s] simulated opponents **50** within a virtual boundary **60**." (Levesque, ¶34; *see also id.* ("[M]ovement of the enemies in three-dimensional space, within defined boundaries may be simulated.").) Due to these

limitations on the presentation and movement of enemies to virtual boundary **60**, the "**physical boundaries for said physical playfield**" in Levesque's video gaming device "**correlate to one or more virtual location boundaries of said virtual playfield for said location based game**."

148. Furthermore, Levesque discloses that different real-world players can play a game together in multiple different real-world areas, and the game will "assimilate[]" their information "and present images representing players outside a current player's zone in that player's heads up display." (*Id.*, ¶37.) Levesque discloses that "[i]n this way, the multiple players may play against each other without occupying the same physical space." (*Id.*) In this embodiment, the real-world boundaries of each player's physical playfield "**correlate[s] to one or more virtual location boundaries of said virtual playfield for said location based game**"—*i.e.*, a shared virtual playfield containing all players.

149. <u>**District Court Litigation Claim Construction Issue.**</u> I understand that Petitioner is asserting in district court litigation that the term "virtual" should be construed as "not real world." (EX1012 at pp.0007-0011.) Levesque satisfies the claim language regardless of whether Petitioner's proposed construction is adopted. In my opinion, Levesque's disclosures satisfy the "virtual location boundaries" and "virtual playfield" requirements under Petitioner's proposed construction. As

discussed above, the "virtual" elements Levesque discloses are part of the game provided by video gaming device. Accordingly, these elements are "not real world," per Petitioner's construction in the district court litigation.

3. Claim 7: "The location based game system of claim 6, wherein said processing circuitry is operable to execute said computer programming to allow said user of said head-mounted device to manually set dimensions for said physical playfield for said location based game."

150. Levesque discloses claim 7.

151. For example, as discussed above for claim 1[g], Levesque discloses that its video gaming device provides a configuration screen allowing a user to manually set boundary **60** by "travel[ing] to the corners **64** of the boundary using vehicle **100** and providing an input by way of one of sensors **18**, for example in the form of a button on the player's uniform or on vehicle **100**." (Levesque, Fig. 5, ¶35.) Furthermore, Levesque discloses that boundary **60** can be manually set using buoys, rope, or string. (*Id.*, ¶38.) A person of ordinary skill would have understood that Levesque's system allows a user of the video gaming device to place the buoys, rope, or string. Boundary **60** establishes the "**dimensions for said physical playfield for said location based game**" by determining the real world boundaries within which the user can play the game in the real world. (*Id.*, ¶¶35, 38, 39.)

4. Claim 8: "The location based game system of claim 7, wherein said processing circuitry is operable to execute said computer programming to provide a graphical user interface for display on said display of said head-mounted device to allow said user of said head-mounted device to manually set said dimensions for said physical playfield for said location based game."

152. Levesque discloses claim 8.

153. For example, as discussed above for claims 1[g] and 7, Levesque discloses that its video gaming device provides a configuration screen allowing a user to manually set boundary **60**. (Levesque, Fig. 5, ¶35.) This configuration screen, shown in Figure 5 reproduced below, is a "**graphical user interface for display on said display of said head-mounted device to allow said user of said head-mounted device to manually set said dimensions for said physical playfield for said location based game**":

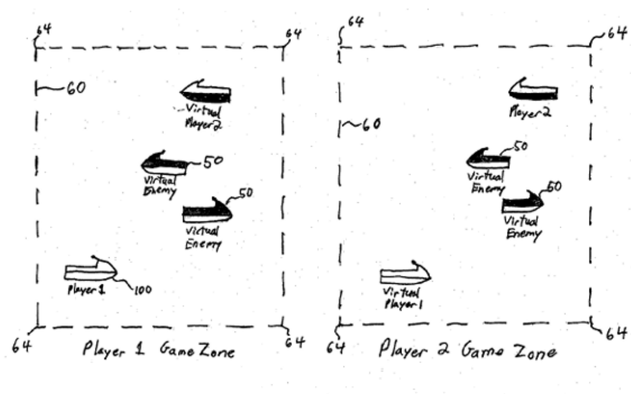


Fig. 5

(Levesque, Fig. 5, ¶35.)

5. Claim 17: "The location based game system of claim 1, wherein said system further comprises a controller operable to communicate with said head-mounted device."

154. Levesque discloses claim 17.

155. Levesque discloses a "**controller**." For example, Levesque discloses "one of sensors **18** may take the form of a simulated pistol, rifle or the like." (Levesque, ¶41.) Levesque discloses that such a controller allows a user to play a game where "an image such as a target, deer, an opponent, etc." is presented on the side of the road, and a user can engage in "[c]apture, stunning or killing of the target[.]" (*Id.*) The '243 patent contemplates such a simulated gun as a controller, indicating that a controller "may take the form of a gun." ('243, 19:34-36; *see also id.*, 25:43-45, 28:43-45, 31:49-51, 34:54-56.)

156. As another example, Levesque discloses that its video gaming device can be in communication with sensors **18**, which can include "one or more button or trigger sensors, connected to suitable buttons/triggers allowing a user to provide deliberate control inputs." (Levesque, ¶¶26, 35.) Figure 3 of Levesque discloses sensors **18** on the handlebars of a personal watercraft, where such buttons or triggers could be located:

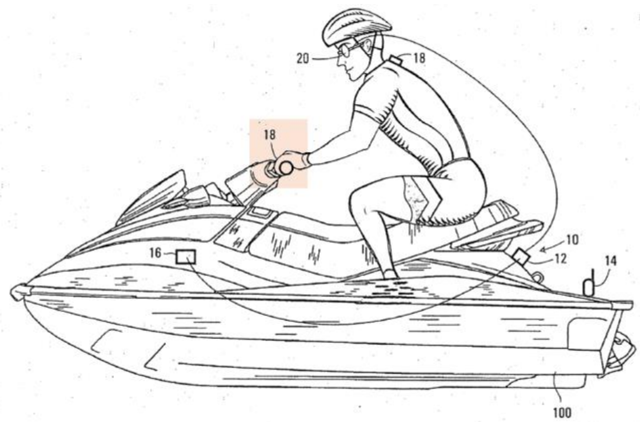


FIG. 3

(*Id.*, Fig. 3 (highlighting added), ¶¶30, 35.)

157. The specification of the ’243 patent indicates that such buttons or triggers mounted on a vehicle or elsewhere constitute a “**controller**.” For example, the ’243 patent specification indicates that “controller **1351** may include manual controls **1352**,” which “may take the form of manual buttons, such as a trigger.” (’243, 19:34-35 (emphasis added); *see also id.*, 13:8-14 (“controller such as … control buttons on a gaming device”), 19:44-47 (“[C]ontroller **1351** may take any shape. For example, controller **1351** may take the shape of a steering wheel, baseball bat, golf-club, sword, glove, or any other shape a user can interact with.”), 4:41-44 (“manual controls may be, for example, buttons”), 10:38-43, 20:1-10, 25:43-45, 28:43-45, 31:49-51, 34:54-56.)

158. Levesque discloses a “**controller operable to communicate with said head-mounted device**.” For example, Levesque discloses that “sensors provide a

suitable electronic sensing signal, in analog or digital form, to central gaming unit **12**[,]" and such signals are "used to control game play." (Levesque, ¶¶26, 32.) The central gaming unit **12** provides the game to heads-up display **20** for display, so the **controller [is] operable to communicate with said head-mounted device** by controlling gameplay. (*Id.*, ¶¶8 ("central gaming unit in communication with a heads-up display"), 9, 18-19, Figs. 1-2.)

159. To the extent there is any argument that the claims require a controller to communicate directly with the head-mounted device, it would have been obvious to implement Levesque's system such that a controller communicates directly with Levesque's heads-up display in light of **Ronzani**.

160. As discussed above for claim 1[b], it would have been obvious to a person of ordinary skill (in light of Ronzani) to implement Levesque's video gaming device as a standalone head-mounted device with all necessary hardware components contained in the head-mounted device. In such an implementation of Levesque's video gaming device, it would have been obvious to a person of ordinary skill that a controller (like the buttons and triggers Levesque discloses as example sensors **18**) would communicate directly with the head-mounted device. For example, Levesque indicates that sensors **18** communicate through input/output interface **34** with the processor in Levesque's central gaming unit **12**. (Levesque,

¶19, Fig. 2.) Since it would have been obvious to place the processor in Levesque's central gaming unit **12** in a head-mounted device in light of Ronzani (as discussed above for claim 1[b]), it would naturally follow that it would have been obvious to connect sensors **18** directly to the processor located in the standalone head-mounted device—*i.e.*, a "**controller operable to communicate with said head-mounted device**."

161. A person of ordinary skill in the art would have been further motivated to implement Levesque's video gaming device as a standalone head-mounted device with a controller communicating directly with the head-mounted device based on Ronzani's disclosures. For example, Ronzani discloses that the head-mounted computer architecture in its Figure 35 embodiment could use an input device **718**, including "a keyboard, a mouse, a joystick, a pen, a track ball, a microphone for voice activated commands, a virtual reality data glove, an eyetracker, or other suitable input devices." (Ronzani, ¶170 (also disclosing a "portable collapsible keyboard" and a "wrist-mounted keypad" as input devices); *see also id.*, ¶7.) Ronzani discloses that such input devices **718** would be connected directly to head-mounted computer **710**, as shown in Figure 35:

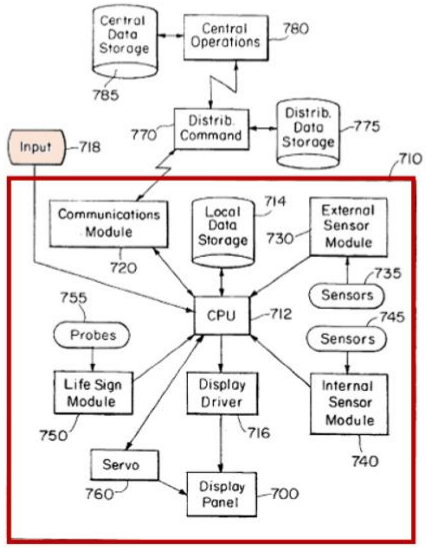


Fig. 35

(*Id.*, Fig. 35 (highlighting and annotations added), ¶¶170 ("The wearer can control the operation of the CPU **712** through the input device **718**."), 164; *see also id.*, Figs. 36-45.) The input devices **718** disclosed by Ronzani are consistent with the example "controllers" disclosed in the specification of the '243 patent. ('243, 13:8-12 ("controller such as an instruction glove or control buttons on a gaming device"); 19:44-47 ("Controller **1351** may take any shape. For example, controller **1351** may take the shape of a steering wheel, baseball bat, golf-club, sword, glove, or any other shape a user can interact with.").)

6. Claim 24: "The location based game system of claim 1, wherein said head-mounted device further comprises a communications device operable to communicate with a remote server."

162. Claim 24 is disclosed and obvious based on Levesque in light of Ronzani.

163. Levesque's video gaming device includes a "**communications device operable to communicate with a remote server**." For example, Levesque discloses that heads-up display **20** is connected to gaming unit **12** containing a network interface **36**, as shown in Figure 2:

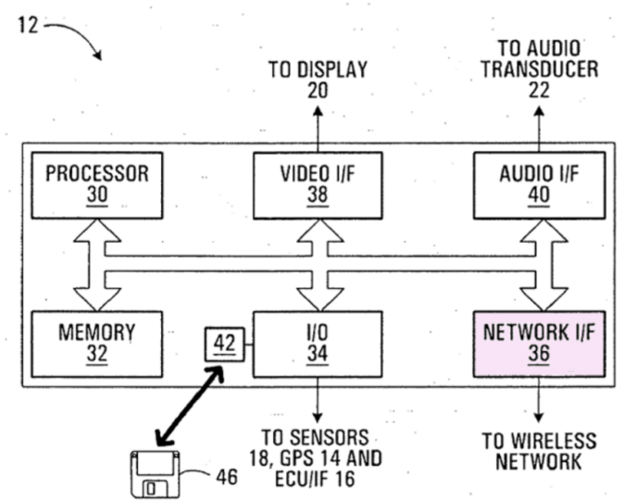


FIG. 2

(Levesque, Fig. 2 (highlighting added), ¶22.) Levesque discloses that network interface **36** "may allow communication of gaming unit **12** with a server[.]" (*Id.*, ¶22.) Furthermore, Levesque discloses that network interface **36** can "communicate[] wirelessly … to a centralized network site," which a person of ordinary skill would have understood to involve communicating with a server. (*Id.*, ¶39.)[2] A person of ordinary skill would have understood that network interface **36** would communicate with a **remote server**. Levesque discloses using its video gaming device in outdoor environments like on open water, so a person of ordinary skill would have understood that any server would need to be located remotely from the video gaming device.

164. It would have been obvious to a person of ordinary skill to locate network interface **36** within Levesque's video gaming device in the head-mounted part of Levesque's video gaming device in light of **Ronzani**, as discussed above for claim 1[b]. In addition to the motivations to combine I discussed there, a person of ordinary skill would have been motivated to incorporate Levesque's communications device into the head-mounted part of Levesque's video gaming device based on, for example, Ronzani's disclosure of communication module **720** in its head-mounted computer architecture, as shown below in Ronzani's Figure 35.

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[2] Paragraph 39 of Levesque appears to contain a typo—referencing "network interface **34**," when the rest of Levesque's specification refers to "network interface **36**." (Levesque, Fig. 2, ¶¶19, 22, 37, 38, 42.) A person of ordinary skill would have recognized that this was a typo and understood paragraph 39 of Levesque to refer to network interface **36**.

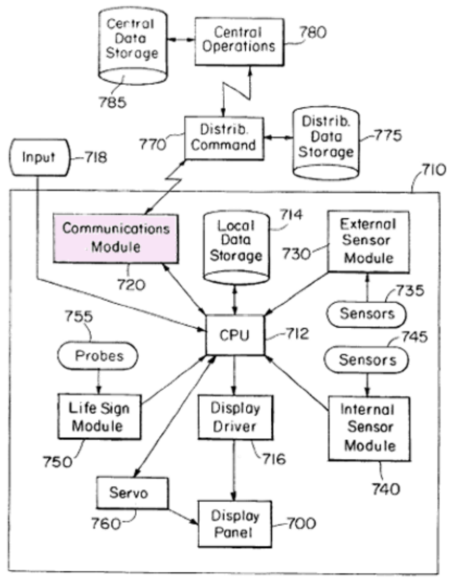


Fig. 35

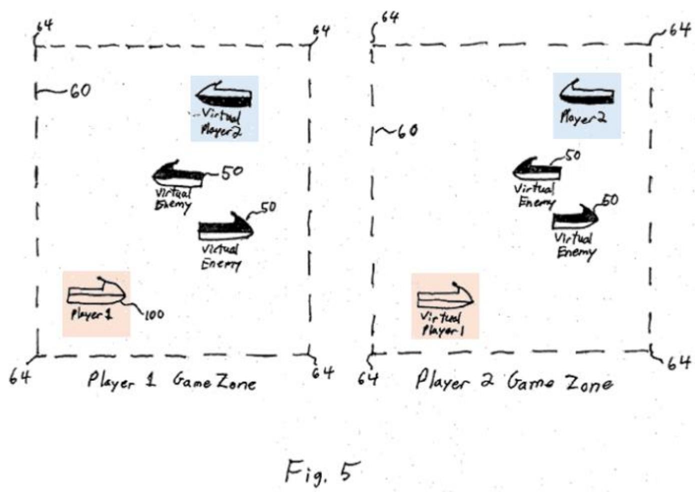
(Ronzani, Fig. 35 (highlighting added), ¶165.) Ronzani discloses that communication module **720** "includes a wireless transducer for transmitting and receiving digital audio, video and data signals," including in communication with a "distributed command computer **770**[.]" (*Id.*, ¶¶165, 171; *see also id.*, ¶¶172, 175, 181, 183, 188, 191, 196, 201, Figs. 36-45.)

7. Claim 25: "The location based game system of claim 24, wherein said location based game is a multiplayer game and said communications device of said head-mounted device is operable to communicate with said remote server in order to enable said multiplayer game."

165. Levesque discloses claim 25.

166. Levesque discloses that "**said location based game is a multiplayer**

game[.]" Levesque discloses that, using its video gaming devices, "multiple players may play against each other[.]" (Levesque, ¶37; *see also id.*, ¶¶24 ("two or more users could jointly participate in game play"), 39 ("scores **62** of multiple players (each playing within a separately defined and enforced boundary) may be maintained"), 40 ("other players and the like may be simulated").) This is shown in Figure 5 of Levesque, where information regarding two players (player 1 and player 2) is combined so that each appears as a character in the other player's game:



(*Id.*, Fig. 5 (highlighting added), ¶¶35, 37.)

167. Levesque discloses that "**said communications device of said head-mounted device is operable to communicate with said remote server in order to enable said multiplayer game**." Levesque discloses that its disclosed multiplayer game functionality is enabled through communication over a wireless network. For

example, Levesque discloses that "[i]nformation about the players may be shared between multiple gaming devices **10** (as for example by way of network interface **36**)[.]" (Levesque, ¶37; *see also id.*, ¶39 (scores of multiple players can be "communicated wirelessly … to a centralized network site").) A person of ordinary skill would have understood that typically, such information exchange between video gaming devices would be mediated by a remote server, and communication would occur back and forth between each gaming device and the server. Indeed, Levesque discloses that "network interface **36** may allow communication of gaming unit **12** with a server or other similar proximate central gaming units, either by way of data or voice." (*Id.*, ¶22 (emphasis added); *see also id.*, ¶39.) Accordingly, Levesque discloses that **said communications device of said head-mounted device** (network interface **36**) **is operable to communicate with said remote server in order to enable said multiplayer game**.

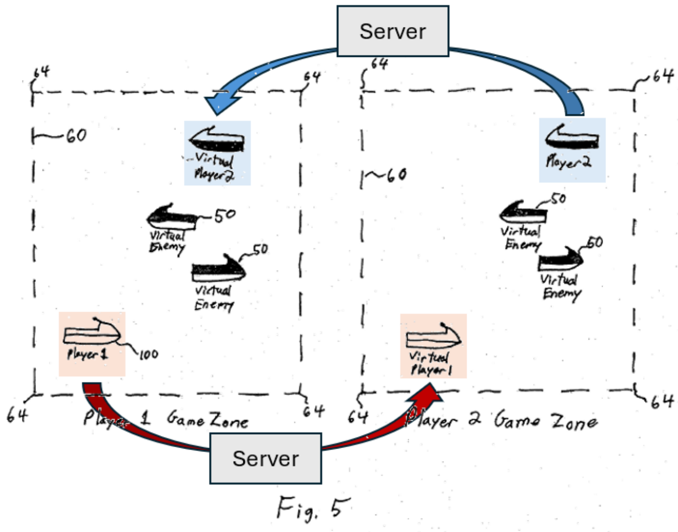
8. Claim 26: "The location based game system of claim 25, wherein said communications device of said head-mounted device is operable to communicate location information regarding said head-mounted device to said remote server."

168. Levesque discloses claim 26.

169. As discussed above for claim 1, Levesque discloses that its video gaming device tracks location as a control input for a location-based game. (*See*,

e.g., Levesque, ¶¶8, 33, 25, 9, 34.) For a multiplayer game, Levesque discloses that players can play in different real-world areas and "information about multiple players each playing within his/her own non-overlapping virtual boundaries **60** may be assimilated." (*Id.*, ¶37.) Levesque discloses that to facilitate this assimilation process, information is shared over a "**communications device**"—*i.e.*, network interface **36**. Levesque discloses that "[i]nformation about the players may be shared between multiple gaming devices **10** (as for example by way of network interface **36**) and each gaming device **10** may superimpose the multiple game zones, and present images representing players outside a current player's zone in that player's heads up display." (*Id.*; *see also id.*, ¶¶39, 40.)

170. A person of ordinary skill would have understood that the information shared between multiple gaming devices would include "**location information regarding [each] head-mounted device**." For example, Figure 5 of Levesque shows that player 1's location in his or her game zone is used to present a "virtual player 1" in the game zone of player 2, and vice versa. This indicates that player 1's location information has been communicated to the network via network interface **36**, and so has player 2's location information—as shown by the following demonstrative diagram:



(Levesque, Fig. 5 (annotations added), ¶37; *see also id.*, ¶40.)

171. As discussed above for claim 25, a person of ordinary skill would have understood that typically, such information exchange between video gaming devices would be mediated by a remote server, and communication would occur back and forth between each gaming device and the server, as shown in the above demonstrative diagram. Indeed, Levesque discloses that "network interface **36** may allow communication of gaming unit **12** with a server or other similar proximate central gaming units, either by way of data or voice." (*Id.*, ¶22 (emphasis added).) Accordingly, Levesque discloses that **said communications device of said head-mounted device** (*e.g.*, network interface **36**) is **operable to communicate location information** (*e.g.*, player 1/2 location information) **regarding said head-mounted device to said remote server** (*e.g.*, to enable multiplayer gaming functionality).

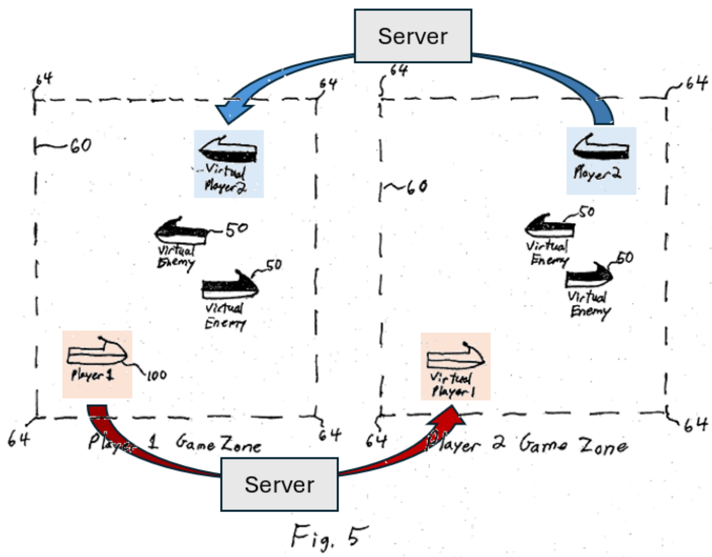
9. Claim 27: "The location based game system of claim 26, wherein said communications device of said head-mounted device is operable to receive location information regarding a device of another player in said multiplayer game from said remote server."

172. Levesque discloses claim 27.

173. As discussed above for claim 26, Levesque discloses communicating location information for individual video gaming devices over network interface **36** to enable multiplayer gaming functionality. (*See*, *e.g.*, Levesque, ¶¶37, 39, 40, 42, 22, Fig. 5.) As part of this process, Levesque discloses that each video gaming device "**is operable to receive location information regarding a device of another player in said multiplayer game from said remote server**."

174. Levesque discloses that each video gaming device "**is operable to receive location information regarding a device of another player in said multiplayer game**[.]" For example, Levesque discloses that "[i]nformation about the players may be shared between multiple gaming devices **10** (as for example by way of network interface **36**) and each gaming device **10** may superimpose the multiple game zones, and present images representing players outside a current player's zone in that player's heads up display." (*Id.*, ¶37.) Levesque's Figure 5 shows that this process involves exchange of location information. (*Id.*, Fig. 5, ¶37; *see also id.*, ¶40.) The location of one player's video gaming device on that player's

physical playfield (*e.g.*, Player 1's location on the "Player 1 Game Zone") determines where a virtual version of that player (*e.g.*, "Virtual Player 1") appears for a different player (*e.g.*, the location of "Virtual Player 1" in the "Player 2 Game Zone"). (*Id.*) This is shown in the following demonstrative diagram:



(Levesque, Fig. 5 (annotations added), ¶¶37, 22.)

175. Further, as discussed above, a person of ordinary skill would have understood that such exchange of location information between video gaming devices would have typically been mediated by a remote server, so each device would "**receive location information regarding a device of another player in said multiplayer game from said remote serve**r," as shown in the above demonstrative diagram. Indeed, Levesque discloses that "network interface **36** may allow

communication of gaming unit **12** with a server or other similar proximate central gaming units, either by way of data or voice." (*Id.*, ¶22 (emphasis added); *see also id.*, ¶39.)

10. Claim 28: "The location based game system of claim 25, wherein said head-mounted device is operable to allow said user of said head-mounted device to talk to another player during said multiplayer game."

176. Levesque discloses claim 28.

177. Levesque discloses that "**said head-mounted device is operable to allow said user of said head-mounted device to talk to another player during said multiplayer game**." For example, Levesque discloses that its video game device allows players using Levesque's multiplayer gaming functionality to talk to each other while playing the game. Further, Levesque discloses that "to facilitate play between multiple players, voice data may be exchanged between players by way of network interface **36**, or otherwise." (Levesque, ¶¶37, 22 ("network interface **36** may allow communication of gaming unit **12** with a server or other similar proximate central gaming units, either by way of data or voice"); *see also id.*, ¶¶24, 40.)

11. Claim 30: "The location based game system of claim 1, wherein:" (Claim 30[pre])

178. As discussed above, the combination of Levesque and Ronzani

discloses and renders obvious the preamble of claim 30.

(a) "said location based game is operable to be played on a physical playfield that correlates to a virtual playfield;" (Claim 30[a])

179. As discussed above for claim 6, Levesque discloses claim 30[a].

(b) "said location based game comprises said virtual game character and said virtual game character is computer controlled;" (Claim 30[b])

180. Levesque discloses claim 30[b].

181. As discussed for claim 1[a], Levesque discloses a location based game that comprises a "**virtual game character**," such as "simulated opponents **50**[.]" (Levesque, ¶34; *see also id.*, ¶40, Figs. 4-6.) These simulated opponents 50 are "**computer controlled**." Levesque discloses that "movement of the enemies in three-dimensional space, within defined boundaries may be simulated." (*Id.*, ¶34.) Furthermore, Levesque discloses that "weapon fire from opponents **50** may be simulated on display **20**." (*Id.*) A person of ordinary skill would have understood that the behavior of simulated opponents **50** is controlled by the gaming software running on processor **30**. (*Id.*, ¶¶20 (processor "present[s] a near real-time gaming environment"), 9 ("[t]he memory stores gaming software"), 34.) Accordingly, a person of ordinary skill would have understood that simulated opponents **50** are "**computer controlled**."

(c) "said location based game comprises a second virtual game character and said second virtual game character is user controlled; and" (Claim 30[c])

182. Levesque discloses claim 30[c].

183. Levesque discloses that "**said location based game comprises a second virtual game character and said second virtual game character is user controlled**[.]" For example, Levesque discloses that a user of a particular video gaming device controls his or her *own* "**second virtual game character**" in the game. For example, Figure 5 shows an example "configuration screen" for a game played on Levesque's video gaming device. (Levesque, ¶35.) This configuration screen represents player 1's position in the form of item **100**—*i.e.*, a **virtual game character** that is **user controlled** (*e.g.*, it is controlled by the user's real-world location):

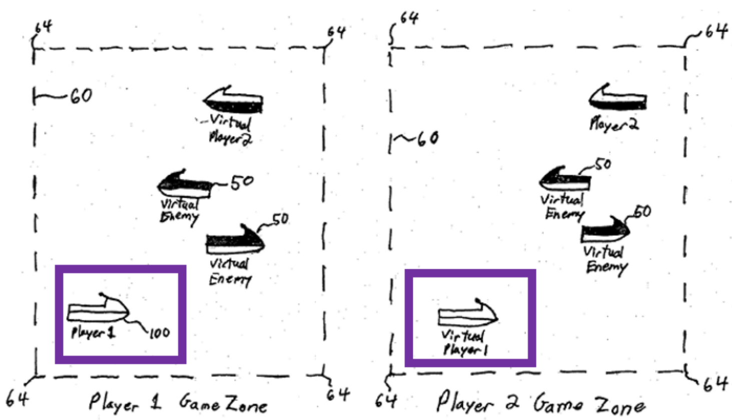


Fig. 5

(*Id.*, Fig. 5 (annotations added), ¶35.)

184. Furthermore, Levesque discloses that a user's real-world actions control the actions of a virtual character in the game. For example, Levesque discloses that "[i]nputs received by way of external sensors **18** and location sensor **14** allows gaming device **10** to simulate interaction with these virtual opponents **50**"—in other words, interaction by a virtual game character representing the user in the game. (Levesque, ¶34.) Further, Levesque discloses that a user views the virtual game world via the perspective of an in-game character. For example, Levesque discloses that "as the opponents **50** are approached, their size may be magnified on display **20**, much in the same way a user would view actual opponents." (*Id.*) Similarly, the in-game character perspective changes based on motion of a user's head. (*Id.*)

185. As another example of **"a second virtual game character**" that is **"user controlled**," Levesque discloses that a game can show virtual characters controlled by *other* users. Levesque discloses that its video gaming device can receive information about other players using network interface **36** "and present images representing players outside a current player's zone in that player's heads up display." (Levesque, ¶37.) As a result, "multiple players may play against each other without occupying the same physical space." (*Id.*) Figure 5 shows the user

controlled characters alongside simulated opponents **50**:

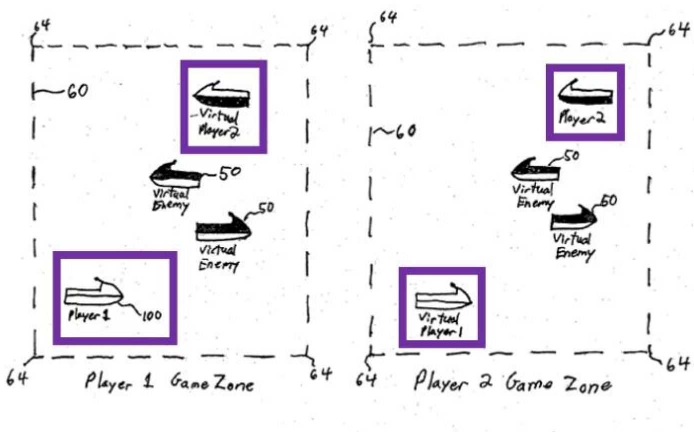


Fig. 5

(*Id.*, Fig. 5 (annotations added), ¶¶35, 37.)

(d) "said processing circuitry is operable to execute said computer programming to cause said user of said head-mounted device to lose control of said second virtual game character when said user travels through a location on a physical playfield correlating to a virtual boundary of said virtual playfield, and to regain said control of said second virtual game character when said user returns to said location on said physical playfield." (Claim 30[d])

186. Levesque discloses that "**said processing circuitry is operable to execute said computer programming to cause said user of said head-mounted device to lose control of said second virtual game character when said user travels through a location on a physical playfield correlating to a virtual boundary of said virtual playfield**[.]" For example, Levesque discloses that when

a user's real-world location indicates that he or she has crossed virtual boundary **60** in the virtual game world, the video gaming device causes the user to **lose control of [the] second virtual game character**. Levesque discloses:

> Once the boundary **60** is defined and stored at central gaming unit **12**, gaming unit **12** may react to an operator crossing the defined virtual boundary **60** (as sensed through location sensor **14**) with the vehicle by disabling or slowing the vehicle's engine through ECU interface **16** or alternatively sending a necessary warning to the operator by way of display **20** to shut down the vehicle and/or disable the game, thereby maintaining a level of safety.

(Levesque, ¶35.) Since Levesque indicates that a user controls the **second virtual game character** by controlling a vehicle, Levesque's disclosure of "disabling or slowing the vehicle's engine" constitutes "**los[ing] control of said second virtual game character**." Furthermore, since Levesque discloses this as a reaction to an operator "crossing the defined virtual boundary **60** (as sensed through location sensor **14**," Levesque discloses that the loss of control takes place "**when said user travels through a location on a physical playfield correlating to a virtual boundary of said virtual playfield**[.]"

187. A person of ordinary skill would have further understood that Levesque's system would allow a user to "**regain said control of said second**

virtual game character when said user returns to said location on said physical playfield." Levesque discloses playing games within boundary **60**. (Levesque, ¶¶34 (game is presented "within a virtual boundary **60**"), 35, 38.) Figure 5 of Levesque, for instance, shows users playing a game within virtual boundary **60**. (*Id.*, Fig. 5, ¶35.) Accordingly, a person of ordinary skill would have understood that when a user returns to a position within boundary **60** (*e.g.*, the location where that user crossed boundary **60**), the user would regain control over the vehicle and the game.

188. A person of ordinary skill would have understood that "**said processing circuitry is operable to execute said computer programming**" to perform the loss and regaining of vehicle control for Levesque's video gaming device. For example, Levesque discloses that the location sensor of its video gaming device is "in communication with the processor to provide data indicative of the geographic location to the processor[.]" (Levesque, ¶9; *see also id.*, ¶10.) Accordingly, a person of ordinary skill would understand that processor **30** would implement the functionality of losing and regaining control based on inputs from location sensor **14**. (*Id.*, ¶35.) Furthermore, Levesque discloses that the processor **30** of a video gaming device communicates with ECU interface **16** to receive inputs and control operation of the vehicle. (*Id.*, Figs. 1-2.)

C. Ground 2: Claims 9, 10, and 22 Are Obvious Over Ground 1 Prior Art in Further View of Fager

1. Claim 9: "The location based game system of claim 6, wherein said processing circuitry is operable to execute said computer programming to:" (Claim 9[pre])

189. As discussed above (*e.g.*, for claim 1[b]), Levesque discloses **processing circuitry [] operable to execute said computer programming**."

(a) "provide default dimensions for said physical playfield for said location based game; and" (Claim 9[a])

190. Claim 9[a] would have been obvious based on Levesque's disclosures in light of **Fager**.

191. As discussed above for claims 1[g] and 6, Levesque discloses manually setting boundaries for the dimensions of a physical playfield, including in a multiplayer game where users are located at different physical locations. (Levesque, Fig. 5, ¶35.) Fager discloses a location-based tennis game where a user can play a tennis video game against another player in a different location, similar to the multiplayer location based games disclosed in Levesque. (Fager, Fig. 5, ¶¶77-95.) Fager discloses a "means for establishing a smallest common court" for the players of the tennis game. (*Id.*, ¶88.) A device for "obtaining information about an environment" to each user implements an algorithm to:

> compare how great part of the respective environment that has

> sufficient properties in common to be used as a court in common, starting from a minimal starting environment. The algorithm increases the area gradually and compares which stationary objects that are found in each step of increasing the area. When an obstacle is found in some of the environments, it is investigated if a corresponding obstacle is present in the other environment. In the latter case, if the obstacles have very similar properties, also the obstacle may be included, otherwise the iteration is stopped in the directions which the obstacles define. The algorithm is repeated until no way to increase the area remains. The courts obtained in this way then constitute a meeting place between two worlds for playing games, which may give possibilities to experiences of the kind which are increased to a substantial extent compared to the previous mentioned tennis case where only different pieces of scenery for the respective player are created.

(*Id*.) In other words, Fager discloses scanning the areas around the players and setting dimensions of a common court on which the players can play the tennis game. Fager further discloses that a player may "adjust different properties" of the virtual tennis court. (*Id.*, ¶93 (adjusting properties of "the fictitious lines **25** on the fictitious tennis court".)

192. In light of Fager's disclosures, it would have been obvious to a person of ordinary skill to implement Levesque's video gaming device (including as combined with Ronzani) such that it sets virtual boundaries for a location based

game using the physical surroundings of a user or users. It would have been obvious to use these initially set virtual boundaries as **default dimensions for said physical playfield**, such that a user could adjust the dimensions. For example, it would have been obvious to allow a user to manually set dimensions for the physical playfield *instead* of accepting the default dimensions—*e.g.*, if a user is not satisfied with the default dimensions.

193. It would have also been obvious to a person of ordinary skill to have the "**processing circuitry [] operable to execute said computer programming to**[] **provide default dimensions for said physical playfield for said location based game**," since it is the processing circuitry that manages boundary setting functionality in Levesque's video gaming device, as discussed above for claims 1[g] and 6.

194. **Rationale and Motivation to Combine (Levesque, Ronzani, and Fager)**: It would have been obvious to a person of ordinary skill in the art to combine Fager's teachings regarding setting default dimensions of a physical playfield with Levesque (and under the proposed combination with Ronzani). The combination would have involved the straightforward incorporation of Fager's environmental scanning to set the dimensions of the physical playfield of a location-based game into Levesque's system (as implemented as a standalone system in light

of Ronzani). The combination therefore discloses and renders obvious "**provid[ing] default dimensions for said physical playfield for said location based game**."

195. Levesque, Ronzani, and Fager are all analogous references to the '243 patent. I discussed my opinion that Ronzani and Levesque are analogous references to the '243 patent above in my discussion for claim 1[b]. Further, like the '243 patent, Fager is in the field of portable user-worn devices for providing location-based entertainment. ('243, 2:28-51 ("Summary of the Invention" section discussing "an actual, reality-based video game in which a user's physical (actual) location on a playfield, reflects a virtual game character's virtual location in a video game environment" and "displays" for "location-based games"), 1:22-23 ("This invention relates to video games and video game systems."); Fager, ¶¶1 ("Field of the Invention" section discussing augmented reality game involving "real environment and at least one fictitious phenomenon," where properties "depend[] on the position and/or orientation of the creature"), 77 (describing embodiment where a user "carries on the head **10** a means in the form of a so-called headset **13**"); *see also id.*, ¶¶78-95, Figs. 1, 4, 5.) Further, Levesque, Ronzani, and Fager would have been reasonably pertinent to problems facing the '243 patent inventor, including implementation of a multiplayer location based game.

196. A person of ordinary skill would have been motivated to combine

Levesque (in combination with Ronzani) and Fager including based on the similarity of the disclosed location-based games disclosed by Levesque and Fager. For example, both Levesque and Fager disclose providing a multiplayer location based game played by users in different environments where the opponent player is represented in each respective player's game. (Levesque, ¶37 ("[T]he multiple players may play against each other without occupying the same physical space."), Fig. 5; Fager, ¶¶77, 87-88 ("The courts obtained in this way then constitute a meeting place between two worlds for playing games[.]").) Thus, a person of ordinary skill would have considered the combination to be a straightforward application of a technique disclosed by Fager for a similar system disclosed by Levesque.

197. A person of ordinary skill would have been motivated to combine Levesque (in combination with Ronzani) and Fager to allow for more types of location based games to be played on Levesque's video gaming device (particularly as implemented as a standalone head-mounted device in light of Ronzani). Levesque discloses that "nearly an infinite variety of gaming software taking advantage of one or more of display **20**, location sensor **14** and sensors **18** may be possible," which would have motivated a person of ordinary skill to look for further games to implement on Levesque's device. (Levesque, ¶43.) A person of ordinary skill would have understood that Fager's environmental scanning for determining default

dimensions for a playfield would have enabled Levesque's video gaming device to be used for more games, including the tennis game disclosed by Fager. (Fager, ¶88 (describing "possibilities to experiences of the kind which are increased to a substantial extent compared to the previous mentioned tennis case where only different pieces of scenery for the respective player are created").) Furthermore, Levesque discloses that the prior art has included use of video games with "sports and exercise activity." (Levesque, ¶6.) Thus, a person of ordinary skill would have been particularly motivated to look to Fager's disclosure of a sports location-based game—*i.e.*, tennis.

198. It would have been obvious to a person of ordinary skill for Levesque to provide default dimensions for the physical playfield. As discussed above for claim 6, Levesque's physical playfield is defined by boundary **60**. (Levesque, Fig. 5, ¶35.) Levesque discloses a default *shape* for boundary **60**—"[p]referably the boundary region is <u>rectangular</u> in nature, thereby requiring only inputs of opposed corners **64**." (*Id.*, ¶35 (emphasis added).) It would have been obvious and straightforward to a person of ordinary skill to provide default *dimensions* for boundary **60** as well.

199. A person of ordinary skill would have been motivated to provide default dimensions for Levesque's boundary **60**, for example, to save the user's time.

Levesque discloses that a user manually inputs dimensions for boundary **60** by navigating to points in the real world. (Levesque, ¶35.) A person of ordinary skill would understand that it would be advantageous not to require a user to perform this manual configuration process every time the user plays a location based game. Instead, a person of ordinary skill would have recognized that its video gaming device could suggest default dimensions for boundary **60**, which a user could accept if such dimensions were satisfactory to a user—sparing the user from having to engage in much of the manual configuration process for the dimensions of boundary **60**. A person of ordinary skill would have been motivated to save the user's time in this fashion based on, for instance, Levesque's disclosure that "[p]referably the boundary region is rectangular in nature, thereby requiring only inputs of opposed corners **64**." (*Id.*, ¶35.) A person of ordinary skill would have understood based on this disclosure that minimizing the amount of user time required for boundary **60** configuration (*e.g.*, by requiring input only of boundary corners, rather than the entire boundary perimeter) is advantageous.

200. Further, a person of ordinary skill would have been motivated to implement Levesque's video gaming device to provide default dimensions to increase safety and user enjoyment. A person of ordinary skill would have had Levesque's video gaming device provide default dimensions for boundary **60** to

inform a user generally how much space a particular location based game would require—both to improve safety and enjoyment of the game. A person of ordinary skill would have understood such suggested dimensions to be particularly necessary in light of the numerous location based games Levesque discloses. (*Id.*, ¶¶43 (describing "nearly an infinite variety of gaming software"), 34 ("example games"), Figs. 4-8, 35-42.) A person of ordinary skill would have been motivated to improve safety based on Levesque's disclosure that boundary **60** is used "to ensure safe game play." (Levesque, ¶35.) Furthermore, a person of ordinary skill would have been motivated to improve enjoyment of Levesque's location based games, which Levesque describes as combining "enjoyment derived from operation of the vehicle with enjoyment derived from the game." (*Id.*, ¶¶6-8.)

201. The combination would have involved the use of a known technique (scanning a user's environment to determine default playfield dimensions) to improve a similar device (Levesque's video gaming device) in the same way.

202. A person of ordinary skill would have had a reasonable expectation that the combination would have been successful. Levesque discloses that its basic structure of "display **20**, location sensor **14** and sensors **18**" could make possible "nearly an infinite variety of gaming software." (Levesque, ¶43.) Similarly, Fager discloses that its disclosed embodiments "may be used for several purposes,"

including "the entertainment branch of industry, education, simulation and driving of vehicles[.]" (Fager, ¶2.)

(b) "allow said user of said head-mounted device to change said default dimensions." (Claim 9[b])

203. It would have been obvious based on Levesque (in combination with Ronzani) in light of Fager for a video gaming device to "**allow said user of said head-mounted device to change said default dimensions**."

204. As discussed above for claim 9[a], it would have been obvious to a person of ordinary skill in the art to implement Levesque's video gaming device such that once default playfield dimensions were established based on Fager's disclosures, a user would still be able to change the playfield dimensions to set his or her own preferred playfield dimensions. (*E.g.*, Levesque, Fig. 5, ¶35.) Accordingly, it would have been obvious based on Levesque in light of Fager to "**allow said user of said head-mounted device to change said default dimensions**.

205. Furthermore, it would have been obvious to a person of ordinary skill based on Fager's disclosures to change the physical playfield's default dimensions whenever a user changes his or her real-world environment. For example, the default dimensions disclosed by Fager are determined by "obtaining information about an environment" to each player. (Fager, ¶88.) Thus, a person of ordinary skill would

have understood that such default dimensions would be changed whenever either player changes locations. (*Id.*, ¶88; *see also id.*, ¶87 ("The game may take place in adjacent rooms as well as more distant rooms.").) It would have been obvious based on such disclosures to implement Levesque's video gaming device to provide the user new default playfield dimensions whenever a user changes their real-world environment. As discussed above, such an implementation would be managed through Levesque's boundary **60** configuration screen, allowing a user to set different boundaries than the defaults suggested by the video gaming device.

206. To the extent there is any argument that setting new playfield boundaries when a user changes environments does not meet claim 9, the '243 patent specification indicates that such functionality constitutes **changing default dimensions**. ('243, 6:34-40 ("Default dimensions for the physical playfield may be utilized by a video game and displayed to a user. Such dimensions may be changed during operation of the video game (e.g., a game may be PAUSED, taken to a different physical, playfield, and the physical playfield dimensions may be changed before the game is RESTARTED).") (emphasis added).)

2. Claim 10: "The location based game system of claim 9, wherein said processing circuitry is operable to execute said computer programming to provide a graphical user interface for display on said display of said head-mounted device to allow said user of said head-mounted device to change said default dimensions for said physical playfield for said location based game."

207. Claim 10 would have been obvious based on Levesque (in combination with Ronzani) in light of **Fager**.

208. For example, as discussed above for claim 9, it would have been obvious to implement Levesque's video gaming device in light of Fager to scan a user's environment and determine default dimensions for the playfield based on that scan, which a user could change through a configuration screen like the one Levesque discloses for its Figure 5 embodiment. (Levesque, ¶35, Fig. 5.)

209. Furthermore, as discussed above for claim 9, it would have been obvious to implement Levesque's video gaming device in light of Fager such that each time a user changes his or her physical environment, the video gaming device provides the user with new default dimensions (which the user can manage through a configuration screen). (Levesque, ¶35, Fig. 5.)

3. Claim 22: "The location based game system of claim 17, wherein said controller comprises at least one directional device for providing a control signal associated with a direction and/or a pitch of said controller for said location based game."

210. Claim 22 would have been obvious based on Levesque alone or in light of Fager.

211. It would have been obvious based on Levesque's disclosures to implement its video gaming device such that "**said controller comprises at least one directional device for providing a control signal associated with a direction and/or a pitch of said controller for said location based game**."

212. For example, as discussed above for claim 17, Levesque discloses a "**controller**"—*i.e.*, "one of sensors **18**" in the form of "a simulated pistol, rifle or the like." (Levesque, ¶41.) Levesque discloses that such a controller allows a user to play a game where "an image such as a target, deer, an opponent, etc." is presented on the side of the road, and a user can engage in "[c]apture, stunning or killing of the target[.]" (*Id.*)

213. Based on Levesque's disclosures, a person of ordinary skill would have been motivated to implement a simulated gun controller such that it contains sensors that provide a control signal based on the direction and pitch of the controller to Levesque's location based games. For example, a person of ordinary skill would

have understood that Levesque's simulated gun controller could be implemented with components like accelerometers and gyroscopes to determine the direction and pitch of the controller.

214. For example, a person of ordinary skill would have been motivated to implement Levesque's simulated gun controller such that it would be operated like a real gun, where the direction and pitch in which the gun is pointed determines where it shoots. A person of skill in the art would have been motivated to implement Levesque's simulated gun controller in this way to maximize realism. Indeed, Levesque discloses that the example game for which it contemplates use of a simulated gun controller could provide a "realistic" experience, disclosing that a video gaming device "may use information about the geography to present targets and obstacles as a realistic backdrop to the remaining scenery." (Levesque, ¶41 (emphasis added).) Furthermore, Levesque discloses that one of the limitations with the prior art is that "sports and exercise activity is often constrained to accommodate use of the video game." (*Id.*, ¶6.) To avoid such a limitation, a person of ordinary skill would have sought to implement a video gaming device that provided a more accurate version of the sport of shooting or hunting.

215. Furthermore, a person of ordinary skill would have been motivated to implement Levesque's simulated gun controller to provide a signal based on

direction and pitch of the controller to increase entertainment value of its video gaming device. Levesque discloses that "[s]ensor inputs may allow the deployment of simulated weapons to destroy the virtual opponents **50**." (Levesque, ¶0034.) A person of ordinary skill would have been motivated to allow a user to realistically aim a simulated weapon controller to destroy virtual opponents. A person of ordinary skill would have understood that a simulated gun controller that allowed a user to control it by aiming it like a real gun would be more entertaining for a user than a gun controller that did not allow for control by aiming. A person of ordinary skill would have been motivated to implement a more entertaining video gaming device, including based on Levesque's disclosure that prior art systems "have served more as a motivational tool than as a form of entertainment." (*Id.*, ¶6.)

216. To the extent there is any question whether claim 22 would have been obvious based on Levesque alone, it would have been obvious based on Levesque (in combination with Ronzani) in light of **Fager** to implement Levesque's video gaming device such that "**said controller comprises at least one directional device for providing a control signal associated with a direction and/or a pitch of said controller for said location based game**."

217. For example, Fager discloses a location-based game for simulating tennis that includes the use of a component **26** designed to feel like a tennis racket

that provides a control signal based on its direction and pitch, as shown in Figure 5 below:

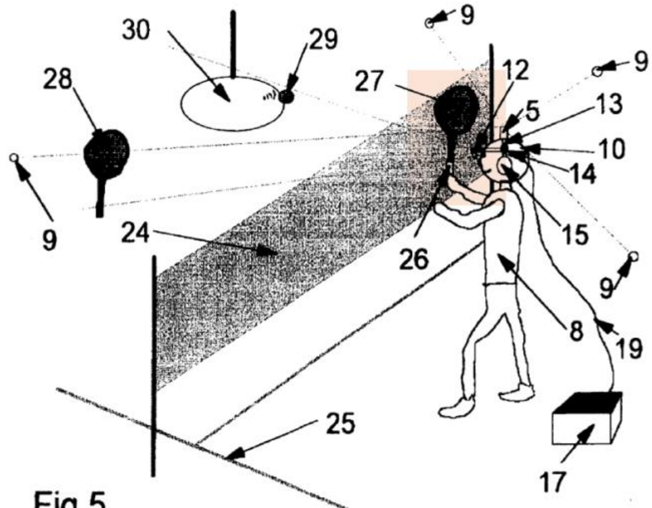


Fig 5

(Fager, Fig. 5 (highlighting added), ¶79.) Regarding component **26**, Fager discloses that "[t]he tool is designed as a handle of an ordinary tennis racket and includes a further transducer which is arranged to determine its position and/or orientation relative to the real environment in six degrees of freedom, and which is mechanically fixed connected to the component otherwise freely movable and to an effecting means for communication of information to the control- and calculating unit **17**." (*Id.*, ¶79 (emphasis added).)

218. It would have been obvious to a person of ordinary skill to use Fager's component **26** as a controller to Levesque's video gaming device as implemented as a standalone head-mounted device, either based on Levesque alone or in light of

Ronzani. In this combination, a controller like Fager's component **26** would have been incorporated as a sensor **18** connected directly to Levesque's head-mounted device. In this capacity, Fager's component **26** would constitute a **controller compris[ing] at least one directional device for providing a control signal associated with a direction and/or a pitch** (six degrees of freedom tracking) **of said controller for said location based game.**

219. In addition to the motivations to combine Levesque, Ronzani, and Fager discussed above regarding claim 9, a person of ordinary skill would have been motivated to combine Levesque's video gaming system (in combination with Ronzani) with Fager to enable a user to play sports location based games requiring interaction with a racket or bat, including the tennis game Fager discloses. Levesque discusses using video gaming devices in such sports and exercise applications. (Levesque, ¶¶6, 41.)

D. Ground 3: Claim 14 is Obvious Over Ground 1 Prior Art in Further View of Ohshima

1. Claim 14: "The location based game system of claim 1, wherein:" (Claim 14[pre])

220. As discussed above, the combination of Levesque and Ronzani discloses and renders obvious "**[t]he location based game system of claim 1**."

(a) "said location based game comprises said virtual game character and said virtual game character is computer controlled;" (Claim 14[a])

221. As discussed above for claim 30[b], Levesque discloses claim 14[a].

(b) "said location based game comprises a second virtual game character and said second virtual game character is user controlled; and" (Claim 14[b])

222. As discussed above for claim 30[c], Levesque discloses claim 14[b].

(c) "said processing circuitry is operable to execute said computer programming to utilize at least one of said first control signal from said first locating device and said second control signal from said second locating device for controlling, at least in part, said virtual game character that is computer controlled." (Claim 14[c])

223. Levesque discloses and renders obvious claim 14[c], either alone or in light of Ohshima.

224. For example, Levesque discloses that virtual characters can fire weapons in Levesque's location-based games. Levesque discloses that "weapon fire from opponents **50** may be simulated on display **20**." (Levesque, ¶34.) Furthermore, Levesque discloses that the user can make real-world motions with a vehicle to "avoid launched weapons" in the game. (*Id.*) It would have been obvious to person of ordinary skill based on Levesque's disclosures that simulated opponents **50** in Levesque's location-based games would fire their weapons *at the user's location in*

the game. Indeed, Levesque discloses that "[t]he position and speed of the vehicle **100** may be taken into account when presenting the simulated images on display 20[,]" where the simulated images include simulated opponents. (*Id.*) Since the user's location in the game is determined based on the user's real-world location based on location sensor **14**, this obvious implementation of Levesque's video gaming device would include "**computer programming to utilize at least one of said first control signal from said first locating device and said second control signal from said second locating device for controlling, at least in part, said virtual game character that is computer controlled**."

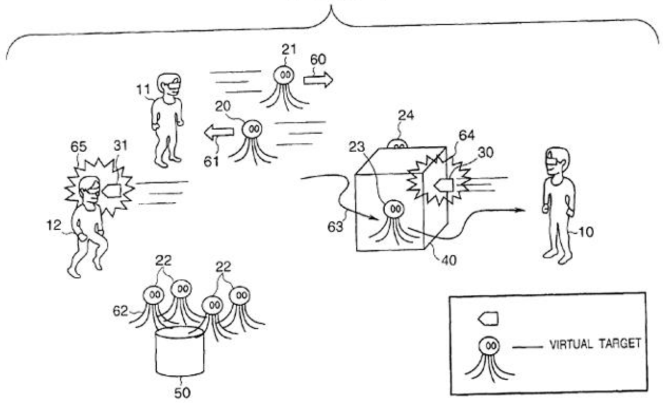
225. It would have been obvious to a person of ordinary skill to have simulated opponents **50** fire weapons at the user's location in the game to increase a user's enjoyment of the game. Levesque discloses that a user can avoid in-game enemy weapon fire by maneuvering a real-world vehicle. (Levesque, ¶34.) Accordingly, a person of ordinary skill would have understood based on Levesque's disclosures that avoiding virtual weapon fire constitutes entertaining gameplay. A person of ordinary skill would have also recognized that the entertainment value of such gameplay would be improved if simulated opponents **50** were programmed to fire toward the user's location in the game. A person of ordinary skill would recognize that such functionality would increase the chances that weapon fire would

come close enough to a user's in-game location that a user would need to make efforts to avoid the weapon fire. Thus, a person of ordinary skill in the art would have recognized that if simulated opponents **50** fire at the user, the location based game will be more entertaining.

226. To the extent there is any question as to whether Levesque discloses claim 14[c], it would have been obvious to a person of ordinary skill in view of **Ohshima** that "**said processing circuitry is operable to execute said computer programming to utilize at least one of said first control signal from said first locating device and said second control signal from said second locating device for controlling, at least in part, said virtual game character that is computer controlled**."

227. For example, Ohshima discloses that virtual characters are controlled by the computer to use the real-world posture and location of players to control enemy behavior. For example, Ohshima discloses that virtual characters "make actions such as collision, explosion, movement, dodge, and the like in consideration of the presence, location, layout, and behavior of the real objects or the location, behavior, and line of sight of the player." (Ohshima, 6:12-17.) Example behaviors are shown in Figure 1 of Ohshima:

FIG. 1



(Ohshima, Fig. 1.) For example, Figure 1 shows that the behavior of virtual characters **20** and **21** is dependent on the location of player **11**—*i.e.*, the virtual characters run toward and away from the player's location, respectively. (*Id.*, 6:2-4 ("the target **21** as a spaceman runs away (**60**) by sensing the presence of the player **11**. Or the target **21** comes on or chases the player **11** (**61**).").) Other virtual characters (**22**, **23**, and **24**) are shown behaving based on the locations of real objects **40** and **50**. (*Id.*, 6:5-11 ("The plurality of targets **22** gather around the real object **50** (**62**). The target **24** hides behind the real object **40** by sensing the presence of the player **10**.").) Ohshima discloses that the in-game location can be based on real-world location as determined by sensors. (*Id.*, 1:9-14 ("a virtual object that moves/acts in response to movements/actions of a real object"), 1:54-2:9, 6:29-33, 6:12-17.) Accordingly, Ohshima discloses that at least one locating device control signal is used for controlling virtual game characters.

228. Based on Ohshima's disclosures, it would have been obvious to a person of ordinary skill to implement Levesque's video gaming device such that virtual characters in its location based games react to the real-world location of the user as determined by Levesque's disclosed sensors. For example, it would have been obvious to a person of ordinary skill to implement computer programming for simulated opponents **50** in Levesque's video gaming device such that they move toward or away from a user, per Ohshima's disclosures.

229. **Rationale and Motivation to Combine (Levesque, Ronzani, and Ohshima)**: It would have been obvious to a person of ordinary skill in the art to combine Ohshima's teachings regarding virtual character behavior based on the location of real players and objects with Levesque (an under the proposed combination with Ronzani). The combination would have involved the straightforward incorporation of Ohshima's virtual character behaviors into Levesque's system (as implemented as a standalone system in light of Ronzani's teachings). The combination therefore discloses and renders obvious that "**said processing circuitry is operable to execute said computer programming to utilize at least one of said first control signal from said first locating device and said second control signal from said second locating device for controlling, at least in part, said virtual game character that is computer controlled**."

230. Levesque, Ronzani, and Ohshima are all analogous references to the ’243 patent. I discussed my opinion that Ronzani and Levesque are analogous references to the ’243 patent above in my discussion for claim 1[b]. Further, like the ’243 patent, Ohshima is in the field of portable user-worn devices for providing location-based entertainment. (’243, 2:28-51 (“Summary of the Invention” section discussing “an actual, reality-based video game in which a user’s physical (actual) location on a playfield, reflects a virtual game character’s virtual location in a video game environment” and “displays” for “location-based games”), 1:22-23 (“This invention relates to video games and video game systems.”); Ohshima, 1:9-14 (“[t]he present invention relates to a game apparatus which allows a player to play a game in a mixed reality space which includes both real and virtual objects”), 3:41-59 (describing “mixed reality environment[s]”), 1:53-2:17, Figs. 1-5.) Further, Levesque, Ronzani, and Ohshima would have been reasonably pertinent to problems facing the ’243 patent inventor, including implementation of a multiplayer location based game.

231. A person of ordinary skill would have been motivated to combine Levesque (in combination with Ronzani) with Ohshima, because a person of ordinary skill would have recognized that implementing virtual characters that behave based on real-world characteristics of a user would make Levesque’s

location based games more enjoyable. For example, Ohshima discloses that "since the movements/actions of a virtual object are determined in consideration of its relation with real objects (that can include a player) in a mixed reality space, the game becomes more fun to play." (Ohshima, 12:3-7.)

232. Furthermore, a person of ordinary skill would have understood that implementing Levesque's virtual characters based on Ohshima's teachings would have made the virtual characters more realistic simulations of real-world people. A person of ordinary skill would have been motivated to make its location based games more realistic. For example, Levesque discloses that its location based games comprise "simulated reality." (Levesque, ¶7; *see also id.*, ¶¶34 ("simulated opponents"), 41 (describing a "realistic backdrop to the remaining scenery").) Furthermore, Ohshima discusses that it is more fun to play a game that has a virtual object that acts "as if [it] had its own will." (Ohshima, 2:33-38; *see also id.*, 11:22-30.)

233. The combination would have involved the use of a known technique (controlling virtual characters based on a user's real-world location) to improve a similar device (Levesque's video gaming device) in the same way. Moreover, because the details of implementing a computer control of virtual characters are not a focus of Levesque, a person of ordinary skill in the art, seeking to implement and

adapt Levesque's teachings for use with computer controlled virtual characters, naturally would have turned to Ohshima for its complementary applicable teachings and motivations.

234. A person of ordinary skill would have had a reasonable expectation that the combination would have been successful. Levesque discloses that its basic structure of "display **20**, location sensor **14** and sensors **18**" could make possible "nearly an infinite variety of gaming software[.]" (Levesque, ¶43.) Similarly, Ohshima discloses that its "many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof[.]" (Ohshima, 12:8-12.)

V. NO SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

235. As explained in **Part III.B**, I understand that "secondary considerations" may be used as indicia of nonobviousness, provided that any such consideration has a nexus to the invention claimed. I understand from Petitioner's counsel that Patent Owner in the related district court litigation has not yet identified any evidence related to secondary considerations with a nexus to the claimed invention. Nor am I aware of information, such as commercial success, unexplained results, long felt but unsolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others,

suggesting that the claims addressed in this Declaration are not obvious. To the extent Patent Owner later provides information it claims relates to secondary considerations, I reserve the right to supplement my analysis and opinions to comment on it.

VI. CONCLUSION

236. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in this proceeding. If required, I will appear for cross-examination at the appropriate time. I reserve the right to offer opinions relevant to the invalidity of the challenged claims at issue and/or offer testimony in support of this Declaration.

237. I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Dated: April 6, 2025

Respectfully submitted,

Jeremy Cooperstock, Ph.D.
Sifnos, Greece

APPENDIX A

CURRICULUM VITAE

Jeremy R. Cooperstock

Version as of March 24, 2025

Contents

Biographical

Personal Data

Nationality	Canadian
Languages	English, French and Hebrew
Address	Department of Electrical and Computer Engineering, McGill University 3480 University Street, Montreal, QC, H3A 0E9, Canada
Telephone	(514) 398-5992
email	jer@cim.mcgill.ca

Education

Ph.D.	Electrical and Computer Engineering, University of Toronto, 1996. Thesis: "Reactive Environments and Augmented Media Spaces." (Nominated for NSERC Doctoral Dissertation Award) Advisors: Prof. K.C. Smith and Prof. W. Buxton
M.Sc.	Computer Science, University of Toronto, 1992. Thesis: "Neural Network Operated Vision-Guided Mobile Robot Arm for Docking and Reaching." Advisor: Prof. E. Milios.
B.A.Sc.	Electrical Engineering, Computer Engineering Option, University of British Columbia, 1990 (Honours)

Awards and Distinctions

2024	Best Poster Award, "Investigating Haptic Co-Creation with Reinforcement Learning", Eurohaptics [CP1]
2024-2029	Werner Graupe Distinguished Chair in Automation Engineering, McGill University ($15,000 plus research stipend of $30,000 per annum)
2022	Honorable Mention, "The Sound of Hallucinations: Toward a more convincing emulation of internalized voices" (top 5% of papers), Human Factors in Computing Systems (CHI) [C5]
2022	Finalist, Best Applications Paper Award, "Speaking Haptically: from Phonemes to Phrases with a Mobile Haptic Communication System", Transactions on Haptics [J4]
2019	Honorable Mention, "Detecting Perception of Smartphone Notifications using Skin Conductance Responses" (top 5% of papers), Human Factors in Computing Systems (CHI) [C34]
2019	San Diego Opera, Opera Hack award, Hamsafar! ($10,000, with 5 co-awardees)
2018	Best poster presentation award, "Enhanced Pressure-Based Multimodal Immersive Experiences", Augmented Human [CP12]

2015	Gerald W. Farnell Teaching Scholar, Faculty of Engineering ($12,500)
2014	US Ignite Best App in Education, Augmented Reality for Improved Training of First Responders
2013	Canadian National Institute for the Blind, Hochhausen Access Technology Research Award ($10,000)
2013	Best paper award, "Vibrotactile Rendering of Splashing Fluids", Transactions on Haptics [J17]
2013	Best use of sound award, "The Walking Straight Mobile Application: Helping the Visually Impaired Avoid Veering, International Conference on Auditory Displays [C62]
2012	Mozilla Foundation and NSF Gold Prize in the Mozilla Ignite Challenge (out of 305 submissions in the Brainstorming Round) ($5,000) for Real-Time Emergency Response
2012	Canadian Internet Registry Association .CA Impact Award (Applications category) for In-Situ Audio Services Project ($5,000)
2011	Best paper award, "What's around me? Spatialized audio augmented reality for blind users with a smartphone", Mobile and Ubiquitous Systems [C73]
2010	Best paper award, "Design of a Vibrotactile Display via a Rigid Surface", Haptics Symposium [C82]
2009, 2010	Nominee, NSERC Brockhouse Canada Prize
2009	Best paper award, "SoundPark: Exploring Ubiquitous Computing through a Mixed Reality Multi-player Game Experiment", 9e Conférence Internationale sur Les NOuvelles TEchnologies de la REpartition [C92]
2005	ACM/IEEE Supercomputing, Most Innovative Use of New Technology for Wide Screen Window on the World: Life Size HD Videoconferencing
2001	Audio Engineering Society Citation Award for pioneering the technology enabling collaborative multichannel performance over the broadband internet

Work Experience

Career Highlights

Haptic Information Delivery (2018-2021) My lab's haptics research has resulted in prominent visibility in the preeminent journal, IEEE Transactions on Haptics, and the two top-tier international conferences in the field, IEEE Haptics Symposium and IEEE World Haptics Conference, with a dozen publications in these forums between 2020 and 2021. Given my recognition in the field, I was invited to serve on the editorial boards of all of these bodies, in addition to the specialty section on haptics of the Frontiers Journal in Virtual Reality. Specific examples of significant contributions include the performance attained through use of our two-actuator apparatus and phonemic encoding for tactile communication of natural language [C31, J4, C9], which outperformed the previously cited best results on this task, achieved by Facebook Research Labs. A second contribution relates to the high recognition rates we attained for multi-dimensional tacton delivery (3 parameters, each at 3 levels), targeting clinical patient-monitoring scenarios. This work inspired studies of wearable vibrotactile devices for physiological monitoring of patients [C30, C19]. While our results were achieved initially using a set of three actuators [C44, C41, C32, C22], we subsequently demonstrated equivalent recognition performance via only a single vibrotactile actuator, with a novel parameter encoding scheme [C21]. We further demonstrated achievement of the highest information transfer rates reported in the literature for such a single-actuator device [C16].

Physiological Sensing (2017-2020) Our research for detection of smartphone notifications was recognized by an Honourable Mention (top 5% of papers) from the top-tier ACM Conference on Human Factors in Computing ([C34]), and led to a recent patent filing ([P1]). This work has the potential to serve as not only for more intelligent, context-sensitive notification delivery, but also, as a tool that can be exploited to combat the prevalent and adverse effects of Internet addiction, driven largely by "fear of missing out."

Real-Time Emergency Response (rtER) (2012-2013) provides an envisionment of the future of next-generation 911 (NG-911) technologies, supporting enhanced situational awareness for first responders through the use of citizen-supplied smartphone video streams and other relevant data [J15]. Our work was recognized by the *Gold Prize* from the Mozilla Ignite Fund, featured on the web site of the White House Office of Science and Technology, and prompted the launch of a funding program by the U.S. Department of Justice.

Autour (2009-2018) is an "eyes-free" app for the blind, which provides a rich, spatialized audio representation of one's environment [J22, C73, C64, C61]. The project further motivated a rigorous analysis of smartphone sensor reliability, resulting in what was the first comprehensive examination of practical limits on smartphone sensors, including the problems of gyro drift [C64].

Mobile Treatment Device for Amblyopia (2009-2012, in collaboration with ophthalmologist R. Hess) is a patented prototype Mobile Treatment Device for Amblyopia [P10] ("lazy eye"). Initial trials [J21], based on the popular Tetris game, provided highly promising early results [J29, J24], not only restoring the use of both eyes in a majority of patients but even resulting in binocular (3D) depth perception in some. Most significantly, the treatment has been found to work successfully on adult populations, whereas the prevailing wisdom had been that treatment was only possible on children. The technology has now been acquired by Novartis, who are commercializing the system.

Natural Interactive Walking (2008-2017) investigated multimodal interaction with virtual ground surfaces, resulting in important findings of tactile discrimination ability [J23] and the role of vibrotactile stimulation in perception of compliance [J30]. Our "Ecotile" prototype (patent [P7]) was showcased at numerous venues including SIGGRAPH, and led to related research involving limb modeling [C75, C59, C53], foot-water interaction [J17], and variable-friction walking interfaces [C69, C60, J8].

Ultra-Videoconferencing (2002-2006) is our low-latency, high-fidelity network transport, used for distance music teaching with Maestro Pinchas Zuckerman, cross-continental jazz jams, and remote sign language interpretation. The Globe and Mail described Cooperstock's 2001 demonstration as "a watershed event for the elite club of the world's computer network engineers." Ultra-Videoconferencing garnered my research group a prestigious Citation Award from the Audio Engineering Society and the Award for Most Innovative Use of New Technology from ACM/IEEE Supercomputing (2005). This research directly constituted the basis for subsequent funding of $2.2M from Valorisation Recherche Quebec and over $4M from Canarie, and influenced the designs of similar telepresence videoconferencing systems from Cisco, HP, and Polycom. Our follow-up work on **Open Orchestra** (with HQP N. Bouillot, A. Olmos, T. Knight, M. Tomiyoshi), resulted in an immersive simulator for orchestral training, used by professional and semi-professional musicians [J20].

Academic Experience

May 2024–present	**McGill University, Montreal, QC** Werner Graupe Distinguished Chair in Automation Engineering
Oct 2023–present	**McGill University, Montreal, QC** Associate Member, Biomedical Engineering
Dec 2022–present	**McGill University, Montreal, QC** Member, McGill Institute for Aerospace Engineering
May 2022–present	**McGill University, Montreal, QC** Member, International Laboratory on Learning Systems
Jan 2018–present	**McGill University, Montreal, QC** Full Professor, Electrical and Computer Engineering. Director, Shared Reality Lab Associate Member, Faculty of Music, Department of Theory Founding Member, Centre for Interdisciplinary Research in Music, Media and Technology Member, Centre for Intelligent Machines
Feb 2022–present	**York University, Ontario** Affiliate Member, Vision: Science to Applications (VISTA)
Sep 2018–Jun 2019	**Technion–Israel Institute of Technology, Haifa, Israel** Visiting Professor, Industrial Engineering and Management
Sep 2018–Jun 2019	**IDC, Herzliya, Israel** Visiting Professor, Department of Computer Science
May 2003–Dec 2017	**McGill University, Montreal, QC** Associate Professor, Electrical and Computer Engineering
Aug 2011–Jul 2012	**University of Auckland, New Zealand** Invited Professor, Department of Computer Science
May–June 2009	**Bang & Olufsen, Denmark** Visiting Professor, World Opera Project
Jan 2009–present	**Bielefeld University, Germany** Virtual Member, Center of Excellence Cognitive Interaction Technology (CITEC)
Feb 2008	**Arizona State University** Visiting Scholar, School of Arts, Media and Engineering
Sep 2004–Aug 2005	**Université de Paris VI, Paris France** Invited Professor, Laboratoire des Instruments et Systemes d'Ile-de-France
Nov 1997–May 2003	**McGill University, Montreal, QC** Assistant Professor, Electrical and Computer Engineering.

Industrial and Consulting Experience

Sep 2019–Oct 2021	**RedPill Canada VR, Montreal** Director and Advisor
Apr–Jun 2019	**(Confidential project as consulting expert)** Providing expert report on topics concerning Human-Computer Interaction.
Aug–Nov 2014	**Menya Solutions and DRDC-Valcartier** Providing expert advice related to human-computer interfaces, visualization, and collaboration.
Aug 2012	**Tamaggo Inc.** Provide guidance and advice on digital imagery
May 2012	**York University** Review draft application to Canada Excellence Research Chairs program
May 2002 –Nov 2003	**Solicitor General of Canada** Media streaming configuration and user interface design.
May 2001	**National Research Council** Instructor of short course in Soft Computing, Institut des Materiaux Industriels.
Jan–Sep 1999	**Audio Engineering Society** Technical leader of demonstration of multichannel and multimedia audio distribution
Jan–Aug 1999	**Ontario Science Center** Scientific Director of Timescape Millenium Exhibit
Jul 1998	**Nortel** Instructor of short course in videoconferencing systems for the Nortel International SL-1 User's Association (ILUA), Long Beach
Sep 1996–Oct 1997	**Sony Computer Science Laboratory** Visiting Researcher, Sony Computer Science Laboratory, Tokyo, Japan. Developed speech-interface controlled VCR with visual tape database functionality. Wrote two patent applications, one filed.
Jun–Aug 1990	**Fibronics Research** Visiting Researcher, Fibronics Advanced Research Center, Haifa, Israel. Developed and tested an FDDI-to-token ring bridge.
May–Aug 1989	**IBM T.J. Watson Research Center** Research Intern, IBM T.J. Watson Research Center, Yorktown Heights, NY. Improved implementation of a VLIW architecture simulator.

Litigation and Expert Witness Experience

Parties I represented are marked by an asterisk.

Jan 2025–ongoing **Earin AB v. Skullcandy, Inc.***
Case No. 1:24-cv-00275-RGA and related *Inter Partes* Review proceedings

Jan 2025–ongoing **Mullen Industries LLC v. Meta Platforms, Inc.***
Case No. 1:24-cv-00354 (W.D. Tex.) and related *Inter Partes* Review proceedings of U.S. Patent Nos. 8,585,476, 9,662,582, 9,744,448, 10,179,277, 10,828,559, 10,974,151, 11,376,493, 11,904,243, 11,947,716, and 12,019,791

Jul–Oct 2024 **Haptix Solutions LLC v. Microsoft Corp.***
Inter Partes Review proceedings of U.S. Patent No. 8,253,686

Apr 2024–Jan 2025 **e-Vision Smart Optics* v. various parties**
Litigation re U.S. Patent Nos. 8,708,483, 8,801,174, 8,905,541, 10,598,960, and 10,613,355

Jan–Apr 2024 **Immersion Corp. v. Valve Corp.***
Case No. 2-23-cv-00712 (W.D. Wash.) related to U.S. Patent Nos. 7,336,260, 8,749,507, 9,430,042, 9,116,546, 10,627,907, 10,665,067, and 11,175,738

Nov 2023–ongoing **Sitnet LLC v. Meta Platforms, Inc.***
United States District Court, S.D. New York, Case No. 1:23-cv-6389 (AS) and related *Inter Partes* Review proceedings of U.S. Patent Nos. 8,249,932, 8,332,454, 9,877,345, and 11,470,682. Deposition testimony on expert report

Aug 2023–ongoing **NEC Corporation* v. Peloton Interactive, Inc. et al.**
United States District Court, District of Delaware, Case No. 1:2022cv00987 and related *Inter Partes* Review proceedings of U.S. Patent Nos. 9,769,427 and 8,752,101. Deposition testimony on expert reports (3 depositions)

Aug 2023–ongoing **Resonant Systems, Inc. d/b/a RevelHMI v. Samsung Electronics Co., Ltd.* et al.**
United States District Court, Eastern District of Texas, Case No. 2:22-cv-00423-JRG

May 2023–Dec 2024 **LoganTree LP v. Fossil Group, Inc.***
United States District Court, District of Delaware Case No. 1:21-cv-00385-JDW and related *Inter Partes* Review proceedings. Deposition testimony on expert reports (2 depositions)

Feb–May 2023 **Immersion Corp. v. Meta Platforms, Inc.***
United States District Court, Western District of Texas Case No. 6:22-cv-00541-ADA and related *Inter Partes* Review proceedings of U.S. Patent Nos. 8,469,806, 8,896,524, 9,727,217, 10,248,298, 10,269,222, and 10,664,143

Feb–May 2023 **Playvuu, Inc. v. Snap Inc.***
United States District Court, Central District of California Case No. 2:22-cv-06019. Involved in litigation matters related to U.S. Patent No. 10,931,911.

Sep 2022 **Apple* v. Taction Technologies, Inc.**
Retained for *Reexamination Requests* of U.S. Patent Nos. 10,659,885 and 10,820,117 in the United States Patent and Trademark Office.

Aug 2022–Jun 2024 **Westwood One, LLC v. Local Radio Networks, LLC***
United States District Court, Northern District of Indiana, Case No. 1:21-cv-00088-HAB-SLC. Involved in litigation matters related to U.S. Patent Nos. 7,412,203 and 7,860,448

Jan–May 2022 **Peloton Interactive v. iFIT Inc. f/k/a ICON Health & Fitness***
United States District Court, District of Delaware, Civil Action No. 20-cv-1386-RGA. Prepared reports on patent invalidity and non-infringement.

Sep 2021–ongoing **Brazos* v. Google**
United States District Court, Western District of Texas Waco Division, Case Nos. 6:20-CV-00571-ADA through 6:20-CV-00585-ADA. Deposition testimony on expert reports (2 depositions)

Sep 2021–Aug 2022 **Allstate Insurance Co. v. Atos LLC***
Involved in *Inter Partes* Review, IPR2021-01118, of U.S. Patent No. 8,527,140, covering smartphone-based vehicle operation detection. Deposition testimony on expert report.

Jan 2021–Apr 2022 **GUI Global Products, Ltd. v. Apple***
United States District Court, Southern District of Texas, Case No. 4:20-cv-2652 and *Inter Partes* Review of U.S. Patent Nos. 10,259,020, 10,259,021, 10,562,077, and 10,589,320 in the United States Patent and Trademark Office. Deposition testimony on expert reports (2 depositions)

Dec 2020–Feb 2021 **Expert consultation re possible litigation in IT-related matter**
Work done on behalf of Sheridan Ross P.C.

Nov 2020–Jun 2022 **Koss v. Apple***
United States District Court, Western District of Texas Civil Action No. 6:20-cv-00665. Involved in *Inter Partes* Review of U.S. Patent Nos. 10,206,025, 10,469,934, 10,506,325, 10,491,982, and 10,298,451 before the United States Patent and Trademark Office. Deposition testimony on expert reports (4 depositions).

Oct 2020–Oct 2021 **Triller v. ByteDance* and TikTok***
Inter Partes Review of U.S. Patent No. 9,691,429 before the United States Patent and Trademark Office. Deposition testimony on expert report.

Sep 2020–Jan 2023	**Content Square v. Quantum Metric* and Decibel Insight*** United States District Court, Massachusetts District Court, Case No. 1-20-cv-11184 and Delaware District Court, Case No. 20-cv-00832. Involved in invalidity arguments and petitions for *Inter Partes* Review. Deposition testimony on expert reports (5 depositions).
Sep 2020	**Wiesel v. Apple*** United States District Court, Eastern District of New York, Case No. 1:19-cv-7261. Engaged for source code review of products related to the Apple Watch (case presently stayed).
Aug–Oct 2020	**Finish Time* v. Garmin** United States District Court, District of Maine, Case No. 2:20-cv-00184. Involved in review of infringement arguments, discovery, related to fitness applications.
Dec 2019–Nov 2022	**Pinn v. Apple*** United States District Court, Central District of California, Case No. 8:19-cv1805, *Inter Partes* Review IPR2020-00999, Post Grant Review PGR2020-00066 and PGR2020-00073. Involved in preparation of expert witness declarations, code analysis involving multiple products related to earbuds and charging circuitry. Deposition testimony on expert reports, in-court trial testimony.
Oct 2019	**Qualcomm v. Apple*** *Inter Partes* Review, IPR2018-01279. Deposition testimony on expert witness declaration related to multimedia messaging.
Mar 2019–Feb 2022	**Cruz Hernandez* v. Air Canada and Lufthansa** Canadian Transportation Agency Case no. 20-01712, Petitioner before the Agency regarding passengers' rights to compensation under EC 261/2014
May 2018–May 2019	**Immersion Incorporated v. Samsung Inc.*** Civil Action No. 2:18-cv-00055 in the Eastern District of Texas and *Inter Partes* Review, IPR2018-01499. Consulted on technical details and involved in preparation of two expert witness declarations related to haptic feedback effects and force feedback in a multimodal system. (Patent Nos. 6,429,846, 7,969,288, 7,982,720, 8,031,181, 9,323,332 and 8,619,051)
May 2016–Nov 2017	**Cooperstock* v. Air Canada** Petitioner before the Canadian Transportation Agency. Brought successful complaint against Air Canada for the airline's making false or misleading statements to the public, Decision No. 105-C-A-2017 (`otc-cta.gc.ca/eng/ruling/105-c-a-2017`)
Jan–May 2014	**St. Lewis v. Rancourt*** Provided expert report on web server location, Ontario Superior Court File No. 11-51657

Mar–Sep 2013	**Cooperstock* v. United Airlines** Brought and argued successful appeal regarding anti-SLAPP legislation before the Quebec Court of Appeal, Decision 2013 QCCA 1670 (goo.gl/pgz301). Argued appeal in person (September 26, 2013)
Nov 2012–Aug 2017	**United Airlines v. Cooperstock*** Pro se litigant, Federal Court File No. T-2084-12. Deposition as litigant (August 2013) and testified at trial (December 2016).
Nov 2012–Jan 2017	**United Airlines v. Cooperstock*** Pro se litigant, Quebec Superior Court File No. 500-17-074743-124. Deposition as litigant (October 2014) and testified at trial (April 2016).
Sep 2012	**Lukács* v. Air Canada** Provided expert report on database query and execution times, Canadian Transportation Agency File No. M4120-3/11-06673, Decision No. 204-C-A-2013
May 2007–Jan 2008	**Market Maker c. Brim Solutions*** Provided expert witness report and in-court testimony (October 2007) on software-related intellectual property case. Quebec Superior Court File No. 500-17-036750-076.
Feb–Oct 2004	**Crawford Adjusters Canada** Provided analysis of artifacts in high definition video
Jul 2002–May 2016	**Court of Quebec, Small Claims Division** Brought 14 consumer rights complaints before the Court, 11 of which were successful

Research Dissemination

Notes on publication strategy: In my research field, papers in the ACM CHI (H5-index=87), UIST (H5-index=46), DIS (H5-index=33), and Mobile HCI (H5-index=28) conferences are considered to be top-tier, archival publications, competitive with the top HCI journals in terms of impact and visibility. Overall acceptance rates for these conferences are typically in the 20-25% range. As a measure of research impact, my publications have garnered ∼5800 *citations to date (Google Scholar) with more one third since 2019, an h-index of 39, and i10-index of 115. HQP under my supervision (names in bold) are typically given first authorship on co-authored work.*

Articles in Refereed Publications

[J1] **A. Talhan**, **Y. Yoo**, and J. R. Cooperstock. "Soft Pneumatic Haptic Wearable to Create the Illusion of Human Touch." In: *IEEE Transactions on Haptics* 17.2 (June 2024), pp. 177–190. DOI: `10.1109/TOH.2023.3305495`. URL: `https://ieeexplore.ieee.org/document/10219022`.

[J2] **J. Regimbal**, **J. R. Blum**, **C. Kuo**, and J. R. Cooperstock. "IMAGE: An Open-Source, Extensible Framework for Deploying Accessible Audio and Haptic Renderings of Web Graphics." In: *ACM Transactions on Accessible Computing* (2024). DOI: `10.1145/3665223`. URL: `https://dl.acm.org/doi/10.1145/3665223`.

[J3] **N. Duarte**, R. K. Arora, G. Bennett, M. Wang, M. P. Snyder, J. R. Cooperstock, and C. E. Wagner. "Deploying wearable sensors for pandemic mitigation: a counterfactual modelling study of Canada's second COVID-19 wave." In: *PLOS Digital Health* PDIG-D-22-00126R1 (Sept. 2022). DOI: `10.1371/journal.pdig.0000100`. URL: `https://journals.plos.org/digitalhealth/article?id=10.1371/journal.pdig.0000100`.

[J4] **M. F. de Vargas**, **D. Marino**, **A. Weill–Duflos**, and J. R. Cooperstock. "Speaking Haptically: from Phonemes to Phrases with a Mobile Haptic Communication System." In: *Transactions on Haptics* 14.3 (July 2021), pp. 479–490. DOI: `10.1109/TOH.2021.3054812`. URL: `https://ieeexplore.ieee.org/document/9337220`. Finalist, Best Applications Paper Award.

[J5] **P. Vyas**, **F. Al-Taha**, **J. R. Blum**, **A. Weill–Duflos**, and J. R. Cooperstock. "Ten Little Fingers, Ten Little Toes: Can Toes Match Fingers for Haptic Discrimination?" In: *Transactions on Haptics* 13.1 (2020). DOI: `10.1109/TOH.2020.2966969`. URL: `https://ieeexplore.ieee.org/document/8960637`. Also presented at Haptics Symposium 2020.

[J6] **E. Sulmont**, E. Patitsas, and J. R. Cooperstock. "What Is Hard About Teaching Machine Learning to Non-Majors? Insights From Classifying Instructors' Learning Goals." In: *Transactions on Computing Education, Special Issue on Machine Learning Education* 19.4 (Aug. 2019). DOI: `10.1145/3336124`. URL: `http://dl.acm.org/authorize?N682238`.

[J7] **J. Blum**, **P. Fortin**, **F. Al-Taha**, **P. Alirezaee**, **M. Demers**, **A. Weill–Duflos**, and J. R. Cooperstock. "Getting Your Hands Dirty Outside the Lab: A Practical Primer for Conducting Wearable Vibrotactile Haptics Research." In: *IEEE Transactions on Haptics, Special Issue on Wearable and Hand-held Haptics* 12.3 (July 2019), pp. 232–246. DOI: 10.1109/TOH.2019.2930608. URL: https://ieeexplore.ieee.org/document/8770138.

[J8] **G. Millet**, **M. Otis**, **D. Horodniczy**, and J. R. Cooperstock. "Design of Variable-Friction Devices for Shoe-Floor Contact." In: *Mechatronics* 46 (2017), pp. 115–125. DOI: 10.1016/j.mechatronics.2017.07.005. URL: https://www.sciencedirect.com/science/article/abs/pii/S0957415817301034.

[J9] **P. Fortin** and J. R. Cooperstock. "Laughter and Tickles: Toward Novel Approaches for Emotion and Behavior Elicitation." In: *IEEE Transactions on Affective Computing* 8.4 (2017). TAFFCSI-2016-07-0124.R1, pp. 508–521. DOI: 10.1109/TAFFC.2017.2757491. URL: http://ieeexplore.ieee.org/document/8052511/.

[J10] E. Aguilera, J. J. Lopez, and J. R. Cooperstock. "Spatial Audio for Audioconferencing in Mobile Devices: Investigating the Importance of Virtual Mobility and Private Communication and Optimizations." In: *Journal of the Audio Engineering Society* 64.5 (May 2016), pp. 332–341. DOI: 10.17743/jaes.2016.0009. URL: http://www.aes.org/e-lib/browse.cfm?elib=18138.

[J11] **D. El-Shimy** and J. R. Cooperstock. "User-Driven Techniques for the Design and Evaluation of New Musical Interfaces." In: *Computer Music Journal* 40.2 (2016), pp. 35–46. DOI: 10.1162/COMJ_a_00357. URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00357.

[J12] **F. Tordini**, A. Bregman, and J. R. Cooperstock. "Prioritizing foreground selection of natural chirp sounds by tempo and spectral centroid." In: *Multimodal User Interfaces, Special Issue on Auditory Display* 10.3 (Sept. 2016). Ed. by B. Katz and G. Marentakis, pp. 221–234. DOI: 10.1007/s12193-016-0223-x. URL: http://link.springer.com/article/10.1007%2Fs12193-016-0223-x.

[J13] R. F. Hess, **L. To**, J. Zhou, **G. Wang**, and J. Cooperstock. "3D Vision: the haves and havenots." In: *i-Perception* 6.3 (July 2015). DOI: 10.1177/2041669515593028. URL: http://ipe.sagepub.com/content/6/3/2041669515593028.full.pdf+html.

[J14] **N. Hieda** and J. R. Cooperstock. "Digital Facial Augmentation for Interactive Entertainment." In: *EAI Endorsed Transactions on e-Learning* 15.8 (Aug. 2015). DOI: 10.4108/icst.intetain.2015.259444. URL: https://eudl.eu/doi/10.4108/icst.intetain.2015.259444.

[J15] **J. Blum**, **A. Eichhorn**, **S. Smith**, **M. Sterle-Contala**, and J. R. Cooperstock. "Real-Time Emergency Response: Improved Management of Real-Time Information During Crisis Situations." In: *Multimodal User Interfaces* 8.2 (July 2014). JMUI-D-13-00047R3, pp. 161–173. DOI: 10.1007/s12193-013-0139-7. URL: https://link.springer.com/article/10.1007/s12193-013-0139-7.

[J16] **D. Dansereau**, N. Brock, and J. R. Cooperstock. "A Particle Filter for Predicting an Orchestral Conductor's Baton Movements." In: *Computer Music J.* 37.2 (Apr. 2013), pp. 28–45. URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00173.

[J17] **G. Cirio**, M. Marchal, A. Lécuyer, and J. R. Cooperstock. "Vibrotactile Rendering of Splashing Fluids." In: *Transactions on Haptics* 6.1 (May 2013), pp. 117–122. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6226398. Best paper award.

[J18] F. Grond, **A. Olmos**, and J. Cooperstock. "Making Sculptures Audible through Participatory Sound Design (Artists' statement)." In: *Leonardo Music J.* 23 (Dec. 2013), pp. 12–13. DOI: doi:10.1162/LMJ_a_00140. URL: https://srl.mcgill.ca/publications/2013-LEONARDO.pdf.

[J19] **S. Pelletier** and J. R. Cooperstock. "Real-time free viewpoint video from a range sensor and color cameras." In: *Machine Vision and Applications* 24.4 (May 2013), pp. 739–751. URL: http://link.springer.com/article/10.1007%2Fs00138-012-0428-2.

[J20] **A. Olmos**, **N. Bouillot**, **T. Knight**, **N. Mabire**, **J.Redel**, and J. R. Cooperstock. "A High-Fidelity Orchestra Simulator for Individual Musicians' Practice." In: *Computer Music Journal* 36.2 (2012), pp. 55–73. URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00119.

[J21] J. M. Black, R. F. Hess, J. R. Cooperstock, **L. To**, and B. Thompson. "The measurement and treatment of suppression in amblyopia." In: *Visualized Experiments* 14.70 (Dec. 2012). DOI: 10.3791/3927. URL: http://www.jove.com/video/3927/the-measurement-and-treatment-of-suppression-in-amblyopia.

[J22] **D. El-Shimy**, F. Grond, **A. Olmos**, and J. R. Cooperstock. "Eyes-Free Environmental Awareness for Navigation." In: *Multimodal User Interfaces, Special Issue on Interactive Sonification* 5.3-4 (2012), pp. 131–141. DOI: 10.1007/s12193-011-0065-5. URL: http://www.springerlink.com/content/857h542884084ql2/.

[J23] B. L. Giordano, **Y. Visell**, H. Yao, V. Hayward, J. R. Cooperstock, and S. McAdams. "Identification of walked-upon materials in auditory, kinesthetic, haptic and audio-haptic conditions." In: *Acoustical Society of America* 131.5 (May 2012). URL: https://srl.mcgill.ca/publications/2012-JASA.pdf.

[J24] R. F. Hess, B. Thompson, J. M. Black, G. Maehara, P. Zhang, W. R. Bobier, **L. To**, and J. R. Cooperstock. "An iPod treatment for amblyopia: An updated binocular approach." In: *Optometry* 83.2 (Feb. 2012), pp. 87–94. URL: http://www.ncbi.nlm.nih.gov/pubmed/23231369.

[J25] **J. Blum**, **M. Bouchard**, and J. R. Cooperstock. "Spatialized audio environmental awareness for blind users with a smartphone." In: *Mobile Networks and Applications* 18.3 (Dec. 2012), pp. 295–309. DOI: 10.1007/s11036-012-0425-8. URL: https://srl.mcgill.ca/publications/2012-MONET.pdf.

[J26] **S. Pelletier** and J. R. Cooperstock. "Preconditioning for Edge-Preserving Image Super-Resolution." In: *IEEE Transactions on Image Processing* 21.1 (June 2012), pp. 67–79. URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5898412.

[J27] **Z. Qi** and J. R. Cooperstock. "Toward Dynamic Image Mosaic Generation With Robustness to Parallax." In: *IEEE Transactions on Image Processing* 21.1 (Jan. 2012), pp. 366–378. URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5959979.

[J28] J. R. Cooperstock. "Multimodal Telepresence Systems: Supporting Demanding Collaborative Human Activities." In: *IEEE Signal Processing* 28.1 (Jan. 2011). special issue on Immersive Communications, pp. 77–86. DOI: 10.1109/MSP.2010.939040.

[J29] **L. To**, B. Thompson, **J.R. Blum**, G. Maehara, R. Hess, and J. R. Cooperstock. "A game platform for treatment of amblyopia." In: *IEEE Transactions on Neural Systems and Rehabilitation Engineering* 19.3 (Feb. 2011), pp. 280–289. URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5713843.

[J30] **Y. Visell**, B. Giordano, **G. Millet**, and J. R. Cooperstock. "Vibration Influences Haptic Perception of Surface Compliance During Walking." In: *PLoS ONE* 6.3:e17697 (Mar. 2011). DOI: doi:10.1371/journal.pone.0017697. URL: http://dx.plos.org/10.1371/journal.pone.0017697.

[J31] **R. Pellerin**, **N. Bouillot**, **T. Pietkiewicz**, M. Wozniewski, Z. Settel, E. Gressier-Soudan, and J. R. Cooperstock. "SoundPark: Exploring Ubiquitous Computing through a Mixed Reality Multi-player Game Experiment." In: *Studia Informatica Universalis* 8.3 (2010). Special Issue: Best Papers from NOTERE 2009, 21 pages. URL: https://srl.mcgill.ca/publications/2009-NOTERE.pdf.

[J32] R. H. Ellaway, D. Topps, K. Lachapelle, and J. R. Cooperstock. "Integrating Simulation Devices and Systems." In: *Studies in Health Technology and Informatics* 142 (Jan. 2009). Ed. by J. D. Westwood, S. W. Westwood, R. S. Haluck, H. M. Hoffman, G. T. Mogel, R. Phillips, R. A. Robb, and K. G. Vosburgh, pp. 88–90. URL: https://srl.mcgill.ca/publications/2009-MMVR-Ellaway.pdf.

[J33] **G. Wang**, L. Mercier, D. L. Collins, and J. R. Cooperstock. "A Comparative Study of Monoscopic and Stereoscopic Display for a Probe-Positioning Task." In: *Studies in Health Technology and Informatics* 142 (Jan. 2009). Ed. by J. D. Westwood, S. W. Westwood, R. S. Haluck, H. M. Hoffman, G. T. Mogel, R. Phillips, R. A. Robb, and K. G. Vosburgh, pp. 417–419. URL: https://srl.mcgill.ca/publications/2009-MMVR-Wang.pdf.

[J34] V. N. Salimpoor, **M. Benovoy**, G. Longo, J. R. Cooperstock, and R. J. Zatorre. "The Rewarding Aspects of Music Listening are Related to Degree of Emotional Arousal." In: *PLoS ONE* 4.10:e7487 (2009). DOI: 10.1371/journal.pone.0007487. URL: http://dx.plos.org/10.1371/journal.pone.0007487.

[J35] **Y. Visell**, **A. Law**, and J. R. Cooperstock. "Touch Is Everywhere: Floor Surfaces as Ambient Haptic Interfaces." In: *IEEE Transactions on Haptics* 2.3 (July 2009), pp. 148–159. DOI: 10.1109/TOH.2009.31. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5166445.

[J36] **W. Sun** and J. R. Cooperstock. "An Empirical Evaluation of Factors Influencing Camera Calibration Accuracy Using Three Publicly Available Techniques." In: *Machine Vision and Applications Journal* 17.1 (Feb. 2006), pp. 51–67. DOI: 10.1007/s00138-006-0014-6. URL: http://www.springerlink.com/content/5824738r1w66v6wl/.

[J37] W. Woszczyk, J. R. Cooperstock, J. Roston, and W. Martens. "Shake, Rattle and Roll: Getting Immersed in Multisensory, Interactive Music via Broadband Networks." In: *Journal of the Audio Engineering Society* 53.4 (Apr. 2005), pp. 336–344. URL: http://www.aes.org/e-lib/browse.cfm?elib=13416.

[J38] **J. Yin** and J. R. Cooperstock. "Color Correction Methods with Applications to Digital Projection Environments." In: *Journal of Winter School of Computer Graphics* 12.3 (2004), pp. 499–506. URL: https://srl.mcgill.ca/publications/2004-WSCG-color.pdf.

[J39] L. R. Winer and J. R. Cooperstock. "The "Intelligent Classroom": Changing teaching and learning with an evolving technological environment." In: *Journal of Computers and Education* 38 (2002), pp. 253–266. URL: https://srl.mcgill.ca/publications/2002-CAE.pdf.

[J40] **A. Xu**, W. Woszczyk, Z. Settel, B. Pennycook, R. Rowe, P. Galanter, J. Bary, G. Martin, J. Corey, and J. R. Cooperstock. "Real-Time Streaming of Multichannel Audio Data over Internet." In: *Journal of the Audio Engineering Society* 48.7/8 (July 2000), pp. 627–641. URL: https://srl.mcgill.ca/publications/2000-JAES.pdf.

[J41] J. R. Cooperstock, S. S. Fels, W. Buxton, and K. C. Smith. "Reactive Environments: Throwing Away Your Keyboard and Mouse." In: *Communications of the ACM* 40.9 (Sept. 1997), pp. 65–73. URL: http://dl.acm.org/authorize?N06288.

[J42] J. R. Cooperstock and E. Milios. "Self-supervised learning for docking and target reaching." In: *Journal of Robotics and Autonomous Systems* 11 (1993), pp. 243–260. DOI: 10.1016/0921-8890(93)90029-C. URL: https://srl.mcgill.ca/publications/1993-JRAS.pdf.

Refereed Conference Publications

[C1] **D. Marino**, J. Dai, **P. Fortin**, **M. Henry**, and J. R. Cooperstock. "Co-Here: an expressive videoconferencing module for implicit affective interaction." In: *Graphics Interface*. Halifax, NS: ACM, June 2024. URL: https://openreview.net/forum?id=L90yPA3fzE.

[C2] **E. Bouzekri**, P. Fortin, and J. R. Cooperstock. "ChatGPT, Tell Me More About Pilots' Opinion on Automation." In: *Cognitive and Computational Aspects of Situation Management (CogSIMA)*. Montreal, Canada: IEEE, May 2024. DOI: 10.1109/CogSIMA61085.2024.10553726. URL: https://ieeexplore.ieee.org/document/10553726.

[C3] **D. Marino**, **M. Henry**, **P. Fortin**, **R. Bhayana**, and J. R. Cooperstock. "I See What You're Hearing: Facilitating The Effect of Environment on Perceived Emotion While Teleconferencing." In: *Computer-Supported Cooperative Work and Social Computing*. Minneapolis, MN: ACM, Oct. 2023. DOI: 10.1145/3579495. URL: https://dl.acm.org/doi/10.1145/3579495.

[C4] **M. F. de Vargas**, **D. Marino**, **A. Weill–Duflos**, and J. R. Cooperstock. "Training to understand complex haptic phrases: a longitudinal investigation." In: *World Haptics Conference*. Delft, Netherlands: IEEE, July 2023. DOI: 10.1109/WHC56415.2023.10224492. URL: https://ieeexplore.ieee.org/document/10224492.

[C5] **H. Lee**, **R. Jiang**, **Y. Yoo**, **M. Henry**, and J. R. Cooperstock. "The Sound of Hallucinations: Toward a more convincing emulation of internalized voices." In: *Human Factors in Computing Systems (CHI)*. New Orleans, LA: ACM, Apr. 2022. DOI: 10.1145/3491102.3501871. URL: https://dl.acm.org/doi/10.1145/3491102.3501871. Honorable Mention.

[C6] **J. Regimbal**, **J. R. Blum**, and J. R. Cooperstock. "IMAGE: A Deployment Framework for Creating Multimodal Experiences of Web Graphics." In: *Web4All 2022 - Accessibility in a Hybrid World*. virtual event, Apr. 2022. DOI: 10.1145/3493612.3520460. URL: https://dl.acm.org/doi/pdf/10.1145/3493612.3520460.

[C7] **P. Fortin** and J. R. Cooperstock. "Understanding Smartphone Notifications' Activity Disruption via In Situ Wrist Motion Monitoring." In: *Human Factors in Computing Systems (CHI), Late-Breaking Work (LBW) track*. New Orleans, LA: ACM, Apr. 2022. DOI: 10.1145/3491101.3519695. URL: https://dl.acm.org/doi/10.1145/3491101.3519695. acceptance rate: 36.1%.

[C8] **A. Rai**, **C. Ducher**, and J. R. Cooperstock. "Improved Attribute Manipulation in the Latent Space of StyleGAN for Semantic Face Editing." In: *International Conference on Machine Learning and Applications*. virtually online, Dec. 2021. DOI: 10.1109/ICMLA52953.2021.00014. URL: https://ieeexplore.ieee.org/document/9680017.

[C9] **D. Marino**, **M. F. de Vargas**, **A. Weill–Duflos**, and J. R. Cooperstock. "Conversing Using WhatsHap: a Phoneme Based Vibrotactile Messaging Platform." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517186. URL: https://ieeexplore.ieee.org/document/9517186. Acceptance rate: 55.7%.

[C10] **E. Waite**, **T. Fitz-Gerald**, **A. Sadaqa**, **Huaijin Shi**, **Pascal Fortin**, **A. Weill–Duflos**, and J. R. Cooperstock. "3D Printed Tactile Illusions and Demonstrations." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517237. URL: https://ieeexplore.ieee.org/document/9517237.

[C11] **M. Demers**, **P. Fortin**, **A. Weill–Duflos**, **Y. Yoo**, and J. R. Cooperstock. "Active Sampling for Efficient Subjective Evaluation of Tactons at Scale." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517257. URL: https://ieeexplore.ieee.org/document/9517257. Acceptance rate: 55.7%.

[C12] K. E. MacLean, V. Levesque, O. Schneider, P. Irani, A. Weill–Duflos, and J. R. Cooperstock. "CanHap 501: Learning Haptic UX Design in Remote Teams." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517152. URL: https://ieeexplore.ieee.org/document/9517152.

[C13] **N. J. A. Pollet**, **E. Uzan**, **P. B. Ruivo**, **T. Abravanel**, **A. Talhan**, **Y. Yoo**, and J. R. Cooperstock. "Multimodal Haptic Armrest for Immersive 4D Experiences." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517151. URL: https://ieeexplore.ieee.org/document/9517151.

[C14] **Y. Li**, **Y. Yoo**, **A. Weill–Duflos**, and J. R. Cooperstock. "Context-aware Automatic Haptic Effect Generation Algorithm for Improved Content Viewing Experience." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517148. URL: https://ieeexplore.ieee.org/document/9517148.

[C15] **Y. Li**, **Y. Yoo**, **A. Weill–Duflos**, and J. R. Cooperstock. "Towards Context-aware Automatic Haptic Effect Generation for Home Theatre Environments." In: *Virtual Reality Software and Technology*. Osaka, Japan: ACM, Dec. 2021. DOI: 10.1145/3489849.3489887. URL: https://dl.acm.org/doi/10.1145/3489849.3489887. Acceptance rate 26%.

[C16] **Y. Yoo**, **J. Regimbal**, and J. R. Cooperstock. "Identification and Information Transfer of Multidimensional Tactons Presented by a Single Vibrotactile Actuator." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517169. URL: https://ieeexplore.ieee.org/document/9517169. Acceptance rate: 55.7%.

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[C18] A. Farooq, H. Tan, **A. Weill–Duflos**, J. R. Cooperstock, and R. Raisamo. "Embedded Haptic Waveguides to Improve Tactile Feedback: Designing a Custom 3D-Printed Surface to Enhance Signal Mediation." In: *Sensors*. Oct. 2020. DOI: 10.1109/SENSORS47125.2020.9278770. URL: https://ieeexplore.ieee.org/document/9278770.

[C19] M. Gellert, N. Katzman, J. P. Klein, A. Frenkel, M. Klein, J. R. Cooperstock, J. J. Schlesinger, and Y. Bitan. "Comparing auditory and tactile cues to inform clinicians of patients' vital signs." In: *Annual Meeting of the Human Factors and Ergonomics Society*. Chicago, IL, USA, Oct. 2020. DOI: 10.1177/2327857920091015. URL: https://journals.sagepub.com/doi/abs/10.1177/2327857920091015.

[C20] **J. R. Blum**, J. Cauchard, and J. R. Cooperstock. "Habituation to Pseudo-Ambient Vibrotactile Patterns for Remote Awareness." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. DOI: 10.1109/HAPTICS45997.2020.ras.HAP20.153.550dbcba. URL: https://ieeexplore.ieee.org/document/9086336/. Acceptance rate: 38%.

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[C22] **P. Alirezaee**, **A. Weill–Duflos**, J. Schlesinger, and J. R. Cooperstock. "Exploring the Effectiveness of Haptic Alarm Displays for Critical Care Environments." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. DOI: 10.1109/HAPTICS45997.2020.ras.HAP20.156.6c3cc0bf. URL: https://ieeexplore.ieee.org/document/9086328. Acceptance rate: 38%.

[C23] **P. Fortin**, **J. Blum**, **A. Weill–Duflos**, and J. R. Cooperstock. "Contact Force Estimation from Raw Photoplethysmogram Signal." In: *Sensors*. Oct. 2020. DOI: 10.1109/SENSORS47125.2020.9278658. URL: https://ieeexplore.ieee.org/document/9278658.

[C24] **P. Vyas**, **F. Al-Taha**, **J. R. Blum**, **A. Weill–Duflos**, and J. R. Cooperstock. "Ten Little Fingers, Ten Little Toes: Can Toes Match Fingers for Haptic Discrimination?" In: *Haptics Symposium (also appears in Transactions on Haptics)*. Washington DC, USA: IEEE, Mar. 2020. DOI: 10.1109/TOH.2020.2966969. URL: https://ieeexplore.ieee.org/document/8960637. Acceptance rate: 38%.

[C25] **P. Vyas**, **F. Al-Taha**, **J. R. Blum**, and J. R. Cooperstock. "HapToes: Vibrotactile Numeric Information Delivery via Tactile Toe Display." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. DOI: 10.1109/HAPTICS45997.2020.ras.HAP20.34.8ad689d4. URL: https://ieeexplore.ieee.org/document/9086321. Acceptance rate: 38%.

[C26] **A. Weill–Duflos**, **F. Al-Taha**, **P. Fortin**, and J. R. Cooperstock. "BarryWhaptics: Towards Countering Social Biases Using Real-Time Haptic Enhancement of Voice." In: *World Haptics Conference*. Tokyo, Japan, June 2019. DOI: 10.1109/WHC.2019.8816153. URL: https://ieeexplore.ieee.org/document/8816153. Acceptance rate: 46%.

[C27] **E. Sulmont**, E. Patitsas, and J. R. Cooperstock. "Can You Teach Me To Machine Learn?" In: *Special Interest Group on Computer Science Education Technical Symposium*. Minneapolis, MN, Feb. 2019. DOI: 10.1145/3287324.3287392. URL: http://dl.acm.org/authorize?N682231.

[C28] **G. Yin**, M. Otis, **P. Fortin**, and J. R. Cooperstock. "Evaluating Multimodal Feedback for Accomplishing Assembly Tasks in a Virtual Environment." In: *Engineering Interactive Computing Systems*. Valencia, Spain: ACM SIGCHI, June 2019. DOI: 10.1145/3331163. URL: http://dl.acm.org/authorize?N682239.

[C29] **J. Blum** and J. R. Cooperstock. "Single-Actuator Vibrotactile Numeric Information Delivery in the Face of Distraction." In: *World Haptics Conference*. Tokyo, Japan, June 2019. DOI: 10.1109/WHC.2019.8816082. URL: https://ieeexplore.ieee.org/document/8816082. Acceptance rate: 46%.

[C30] N. Katzman, M. Gellert, J. J. Schlesinger, T. Oron-Gilad, J. R. Cooperstock, and Y. Bitan. "Evaluation of tactile cues for simulated patients' status under high and low workload." In: *International Meeting*. Seattle, WA, USA: Human Factors and Ergonomics Society (HFES), Oct. 2019. DOI: 10.1177/1071181319631285. URL: https://journals.sagepub.com/doi/10.1177/1071181319631285.

[C31] **M. F. de Vargas**, **A. Weill–Duflos**, and J. R. Cooperstock. "Haptic Speech Communication Using Stimuli Evocative of Phoneme Production." In: *World Haptics Conference*. Tokyo, Japan, June 2019. DOI: 10.1109/WHC.2019.8816145. URL: https://ieeexplore.ieee.org/document/8816145. Acceptance rate: 46%.

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[C33] **P. Fortin**, **D. Huang**, and J. R. Cooperstock. "Exploring the Use of Fingerprint Sensor Gestures for Unlock Journaling: A Comparison with Slide-to-X." In: *Mobile HCI*. Taipei, Taiwan: ACM, Oct. 2019. DOI: 10.1145/3338286.3340135. URL: http://dl.acm.org/authorize?N684389.

[C34] **P. Fortin**, **E. Sulmont**, and J. R. Cooperstock. "Detecting Perception of Smartphone Notifications using Skin Conductance Responses." In: *Human Factors in Computing (CHI)*. Glasgow, Scotland: ACM, Apr. 2019. DOI: 10.1145/3290605.3300420. URL: http://dl.acm.org/authorize?N682230. 🏆 Honorable mention.

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[C42] **J. Anlauff**, J. Fung, and J. R. Cooperstock. "VibeWalk – Foot-Based Tactons During Walking and Quiet Stance." In: *World Haptics Conference*. Munich, Germany, June 2017. DOI: 10.1109/WHC.2017.7989977. URL: https://ieeexplore.ieee.org/document/7989977/. Acceptance rate: 59%.

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[C59] **J. Anlauff**, J. Fung, and J. R. Cooperstock. "Augmented Feedback for Learning Single-Legged Stance on a Slackline." In: *International Conference on Virtual Rehabilitation*. Philadelphia, PA, Aug. 2013.

[C60] **M. Otis**, **G. Millet**, and J. R. Cooperstock. "Vibration-Induced Friction Control for Walkway Locomotion Interface." In: *Systems, Man, and Cybernetics, Part SMC: Human-Machine*. Manchester, UK: IEEE, Oct. 2013, 6 pgs. URL: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6722429.

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[C64] **J. Blum**, **D. Greencorn**, and J. R. Cooperstock. "Smartphone sensor reliability for augmented reality applications." In: *Mobile and Ubiquitous Systems (Mobiquitous)*. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Beijing, China: Springer, Dec. 2012. URL: https://srl.mcgill.ca/publications/2012-MOBIQUITOUS.pdf.

[C65] K. Kim, J. Bolton, A. Girouard, J. Cooperstock, and R. Vertegaal. "TeleHuman: Effects of 3D Perspective on Gaze and Pose Estimation with a Life-size Cylindrical Telepresence Pod." In: *Human Factors in Computing Systems (CHI)*. Austin, Texas: ACM Press/Addison-Wesley Publishing Co., May 2012, pp. 2531–2540. URL: http://dl.acm.org/authorize?N06274. Acceptance rate: 23%.

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[C67] **A. Olmos**, P. Rushka, D. Ko, G. Foote, W. Woszczyk, and J. R. Cooperstock. "Where do you want your ears? Comparing performance quality as a function of listening position in a virtual jazz band." In: *Sound, Music and Computing*. July 2011, 6 pgs. URL: https://srl.mcgill.ca/publications/2011-SMC.pdf.

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[C69] **G. Millet**, **M. Otis**, **G. Chaw**, and J. R. Cooperstock. "Initial Development of a Variable-Friction Floor Surface." In: *Canadian Medical and Biological Engineering Conference*. Festival of International Conferences on Caregiving, Disability, Aging and Technology, June 2011, 4 pgs.

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[C71] **I. Garcia-Dorado** and J. R. Cooperstock. "Automatic multi-projector calibration with an uncalibrated camera." In: *International Workshop on Projector-Camera Systems*. Colorado Springs: IEEE, June 2011, pp. 29–36.

[C72] **J. Blum**, **H. Sun**, **A. Olmos**, and J. R. Cooperstock. "End-User Viewpoint Control of Live Video from a Medical Camera Array." In: *International Conference on Distributed Smart Cameras*. Ghent, Belgium, Aug. 2011, pp. 1–6. URL: https://srl.mcgill.ca/publications/2011-ICDSC.pdf.

[C73] **J. Blum**, **M. Bouchard**, and J. R. Cooperstock. "What's around me? Spatialized audio augmented reality for blind users with a smartphone." In: *Mobile and Ubiquitous Systems (Mobiquitous)*. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Copenhagen, Denmark: Springer, Dec. 2011. URL: https://srl.mcgill.ca/publications/2011-MOBIQUITOUS.pdf. 🏆 Best paper award.

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[CP6] J. Cooperstock and **J.R. Blum**. "Touch me like it matters: exploring location and encodings for explicit and implicit communication." In: *Haptics Symposium, Interactive Session associated with the Cross-Cutting Challenge on Using the Skin as a Medium of Communication*. Washington, DC, Mar. 2020.

[CP7] N. Katzman, M. Gellert, T. Oron-Gilad, J. R. Cooperstock, Y. Bitan, and J. J. Schlesinger. "Wearable haptic devices to monitor soldiers' physiology–discreet sensory input improves safety and monitoring in hostile low-light and high-noise conditions." In: *Military Health System Research Symposium*. Department of Defense, 2020. URL: https://mhsrs.health.mil/SitePages/Home.aspx.

[CP8] **P. Fortin**, **J. Blum**, and J. R. Cooperstock. "Towards Consistent Haptic Coupling with HaptiStrap: Doing Better than "Tight yet Comfortable"." In: *User Interface Software and Technology (UIST)*. New Orleans, USA: ACM, Oct. 2019. DOI: 10.1145/3332167.3357118. URL: https://dl.acm.org/doi/10.1145/3332167.3357118. Acceptance rate: 48.8%.

[CP9] **F. Al-Taha**, **P. Fortin**, **A. Weill–Duflos**, and J. R. Cooperstock. "Reversing Voice-Related Biases Through Haptic Feedback." In: *User Interface Software and Technology (UIST)*. Berlin, Germany: ACM, Oct. 2018. DOI: 10.1145/3266037.3266101. URL: http://dl.acm.org/authorize?N682233.

[CP10] **F. Tordini**, A. Bregman, and J. R. Cooperstock. "Effects of global brightness on salience and auditory foreground perception." In: *Speech in Noise Workshop*. Glasgow, Scotland, Jan. 2018. URL: https://spin2018.eu/?p=program&id=66.

[CP11] **J. Blum** and J. R. Cooperstock. "Exploring the Limits of Vibrotactile Numeric Information Delivery." In: *Ubicomp*. Singapore: ACM, Oct. 2018. DOI: 10.1145/3267305.3267658. URL: http://dl.acm.org/authorize?N682245.

[CP12] **T. Kim** and J. R. Cooperstock. "Enhanced Pressure-Based Multimodal Immersive Experiences." In: *Augmented Human*. Seoul, Korea: ACM, Feb. 2018. DOI: 10.1145/3174910.3174928. URL: http://dl.acm.org/authorize?N682247. Best poster presentation award, Acceptance rate: 34%.

[CP13] **P. Fortin**, **J. Blum**, and J. R. Cooperstock. "Raising the Heat: Electrical Muscle Stimulation for Simulated Heat Withdrawal Response." In: *User Interface Software and Technology (UIST)*. Quebec City, Canada: ACM, Oct. 2017. DOI: 10.1145/3131785.3131828. URL: http://dl.acm.org/authorize?N682248. Acceptance rate: 23%.

[CP14] **J. Anlauff**, J. Fung, and J. R. Cooperstock. "Modular Haptic Belt for Augmented Balance Feedback." In: *International Society for Posture and Gait Research*. Seville, Spain, June 2015.

[CP15] **D. El-Shimy** and J. R. Cooperstock. "EmbodiComp: Embodied Interaction for Mixing and Composition." In: *Sound and Music Computing Conference (ICMC — SMC)*. Athens, Greece, Sept. 2014. URL: http://hdl.handle.net/2027/spo.bbp2372.2014.052.

[CP16] **F. Tordini** and J. R. Cooperstock. "Auditory salience modeling via streaming: A behavioural view." In: *Milestones in Music Cognition: BKN 25*. Montreal, Canada, July 2014.

[CP17] **D. Glesser**, F. Bérard, and J. R. Cooperstock. "Overcoming Limitations of the Trackpad for 3D Docking Operations." In: *Human Factors in Computing Systems (CHI), Extended Abstracts*. Paris, France: ACM, Apr. 2013. URL: http://dl.acm.org/authorize?N06273. Acceptance rate: 20%.

[CP18] **C. Côté**, **S. Arseneau**, and J. R. Cooperstock. "Telepresence with no Strings Attached: An Architecture for a Shared Reality Environment." In: *Second International Symposium on Mixed Reality (ISMR)*. Yokohama, Japan, Mar. 2001. URL: https://srl.mcgill.ca/publications/2001-ISMR.pdf.

[CP19] **S. Arseneau** and J. R. Cooperstock. "Automated Camera Tracking in a Real-World Environment." In: Montreal, QC, Canada, 2000.

[CP20] J. R. Cooperstock. "Rethinking the Remote Control." In: *HCI International, Conference on Human-Computer Interaction*. San Francisco, CA, USA, Aug. 1997, p. 116.

Book Chapters

[B1] **T. Kim**, **J. Blum**, **P. Alirezaee**, **A. Arnold**, **P. Fortin**, and J. R. Cooperstock. "Usability of Foot-Based Interaction Techniques for Mobile Solutions." In: *Mobile Solutions and Their Usefulness in Everyday Life*. Springer International Publishing AG, Jan. 2019, pp. 309–329. DOI: 10.1007/978-3-319-93491-4_16. URL: https://link.springer.com/chapter/10.1007/978-3-319-93491-4_16.

[B2] **M. Wozniewski**, Z. Settel, and J. R. Cooperstock. "Sonic Interaction via Spatial Arrangement in Mixed Reality Environments." In: *Sonic Interaction Design*. Ed. by K. Franinovic and S. Serafin. MIT Press, 2013, pp. 329–340. URL: http://xplorebcpaz.ieee.org/xpl/login.jsp?tp=&arnumber=6504636.

[B3] M. Marchal, **G. Cirio**, **Y. Visell**, F. Fontana, S. Serafin, J. R. Cooperstock, and A. Lécuyer. "Multimodal Rendering of Walking over Virtual Grounds." In: *Human Walking in Virtual Environments*. Ed. by Y. Visell, A. Lécuyer, F. Steinicke, and J. Campos. Springer Verlag, 2013, pp. 263–295. URL: http://www.springer.com/engineering/robotics/book/978-1-4419-8431-9.

[B4] **Y. Visell** and J. R. Cooperstock. "Interacting with augmented floor surfaces." In: *Human Walking in Virtual Environments*. Ed. by Y. Visell, A. Lécuyer, F. Steinicke, and J. Campos. Springer Verlag, 2013, pp. 377–399. URL: http://www.springer.com/engineering/robotics/book/978-1-4419-8431-9.

[B5] **Y. Visell**, **R. Rajalingham**, and J. R. Cooperstock. "A review of nonvisual signatures of human walking with applications to person tracking in augmented environments." In: *Walking with the senses: Perceptual techniques for walking in virtual environments*. Ed. by Y. Visell and F. Fontana. Logos Verlag, 2012, pp. 33–68.

[B6] **Y. Visell**, **S. Smith**, and J. R. Cooperstock. "Distributed human-computer interaction with augmented floor surface." In: *Walking with the senses: Perceptual techniques for walking in virtual environments*. Ed. by Y. Visell and F. Fontana. Logos Verlag, 2012, pp. 15–32.

[B7] J. R. Cooperstock. "Human-Computer Interaction." In: *Wiley Encyclopedia of Computer Science and Engineering*. Ed. by B. W. Wah. Vol. 3. Wiley-Interscience, Mar. 2009, pp. 1529–1542. DOI: 10.1002/9780470050118.ecse524. URL: http://onlinelibrary.wiley.com/doi/10.1002/9780470050118.ecse524/abstract.

[B8] **F. Aubé** and **R. Shield**. "Modeling the Effect of Leadership on Crowd Flow Dynamics." In: *Cellular Automata*. Ed. by P. Sloot, B. Chopard, and A. Hoekstra. Vol. 3305. Lecture Notes in Computer Science. originally presented in International Conference on Cellular Automata for Research and Industry. Amsterdam: Springer Berlin / Heidelberg, Oct. 2004, pp. 601–611. DOI: 10.1007/978-3-540-30479-1_62. URL: http://dx.doi.org/10.1007/978-3-540-30479-1_62.

Other Refereed Publications

[O1] **N. Hieda** and J. R. Cooperstock. *SharedFace2*. International Conference and Exhibition of Virtual Technologies and Uses: Laval Virtual ReVolution (refereed interactive demonstration). Laval, France, Apr. 2015.

[O2] **Y. Visell**, **G. Millet**, and J. R. Cooperstock. *Haptic Display via a Vibrating, Rigid Surface*. Demonstration in IEEE Haptics Symposium. Waltham, MA, USA, Mar. 2010.

[O3] **A. Law**, **J. Ip**, **B. Peck**, **Y. Visell**, P. Kry, and J. R. Cooperstock. *A Multimodal Floor for Virtual Environments*. Demonstration in SIGGRAPH Emerging Technologies. Aug. 2009.

[O4] **M. Wozniewski**, Z. Settel, and J. R. Cooperstock. *Ménagerie Imaginaire*. Artwork Performance in New Interfaces for Musical Expression (NIME). New York, NY, USA, June 2007.

Non-refereed Contributions

[N1] J. Cooperstock. "Situating UbiComp Education within or distinct from HCI?" In: *Ubiquitous Computing Education: Why, What, and How:* ed. by A. Girouard, A. L. Kun, A. Roudaut, and O. Shaer. Vol. 9. 6. Dagstuhl, Germany: Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, Mar. 2019. URL: http://drops.dagstuhl.de/opus/volltexte/2019/11460.

[N2] **E. Sheepy**, M. Orjuela-Laverde, and J. R. Cooperstock. "Encouraging active and collaborative learning in two engineering courses." In: *Supporting Active Learning and Technological Innovation in Studies of Education*. Montreal, Canada, June 2016.

[N3] J. R. Cooperstock and G. Lukács. *How to complain to airlines*. CBC Marketplace blog. Mar. 2014. URL: http://www.cbc.ca/marketplace/blog/plane-wrong-how-to-complain-to-airlines.

[N4] **F. Tordini** and J. R. Cooperstock. "Auditory salience modeling via streaming: A behavioural view." In: *Milestones in Music Cognition: BKN 25*. Montreal, Canada, July 2014.

[N5] J. R. Cooperstock. "Overcoming Complexity in the Teaching and Learning Environment." In: *Materials Science and Technology*. Ralph Lloyd Harris Memorial Symposium. Montreal, Oct. 2013.

[N6] J. R. Cooperstock. *From Rehearsal to Performance: Ensemble Learning in Open Orchestra and Distributed Rehearsal for World Opera*. Presentation in Music Anywhere, Anytime: International Symposium on Synchronous Distance Learning. Oct. 2011.

[N7] **Benovoy, M.**, J. Cooperstock, and M. Levine. *Real-Time Facial Recognition*. Phase II Project Report for Department of National Defence. 2010.

[N8] M. Levine, **Benovoy, M.**, and J. Cooperstock. *An Automatic Real-Time Facial Recognition System*. Phase I Project Report for Department of National Defence. 2009.

[N9] **N. Bouillot**, E. Cohen, J. R. Cooperstock, A. Floros, N. Fonseca, R. Foss, M. Goodman, J. Grant, K. Gross, S. Harris, B. Harshbarger, J. Heyraud, L. Jonsson, J. Narus, M. Page, T. Snook, A. Tanaka, J. Trieger, and U. Zanghieri. "AES White Paper AESTD1003V1: Best Practices in Network Audio." In: *Journal of the Audio Engineering Society* 57.9 (Sept. 2009), pp. 729–741. URL: http://www.aes.org/e-lib/browse.cfm?elib=14839.

[N10] V. N. Salimpoor, **M. Benovoy**, G. Longo, J. R. Cooperstock, and R. J. Zatorre. *Qualifying the Chills Response: Differences between Transient and Prolonged Chills in Response to Music*. Presentation in Auditory Perception, Cognition, and Action Meeting. Chicago, IL, USA, 2008.

[N11] J. Cooperstock. "Plus de largeur du bande, s'il vous plaît." In: *L'interdiscplinarité dans les sciences et technologies de la musique (invited)*. Montreal: Association francophone pour le savoir (ACFAS), May 2006.

[N12] J. Cooperstock. "Integrating Communication with Interaction: Computer Vision Challenges for Interactive and Intelligent Environments." In: *Workshop on Computer Vision for Interactive and Intelligent Environments (invited)*. Lexington, KY, USA, Nov. 2005. URL: http://srl.mcgill.ca/publications/2005-CV4IIE.pdf.

[N13] J. Cooperstock, J. Roston, and Woszczyk. "Broadband Networked Audio: Entering the Era of Multisensory Data Distribution." In: *18th International Congress on Acoustics (invited)*. Kyoto, Apr. 2004.

[N14] **Cayouette, F.**, **Sud, D.**, **Patel, K.**, **Sarikaya, D.**, and J. Cooperstock. "McGill Reddogs Final Report." In: *Robocup*. 2002.

[N15] J. Cooperstock. "Classroom of the Future: Enhancing Education through Augmented Reality." In: *HCI International, Conference on Human-Computer Interaction (invited)*. New Orleans, 2001.

[N16] **Sud, D.**, **Cayouette, F.**, **Gu, J.**, and J. Cooperstock. "McGill Reddogs Final Report." In: *Robocup*. 2001.

[N17] A. Saroyan, R. Harris, and J. R. Cooperstock. *Applying pedagogical principles to teaching and learning with technology*. Multi-cultural perspectives on the use of technology in education. Montreal, QC, Canada, 2000. URL: http://www.education.mcgill.ca/NAFTA.

Patents

[P1] **P. Fortin**, S. Kim, and J. R. Cooperstock. "Closed-loop XR Stimulus Presentation and Perception Feedback using Multi-Channel Physiological Signals." US12032740B2 (United States). July 2024.

[P2] **D. Marino**, **M. Henry**, **P. Fortin**, and J. R. Cooperstock. "System and method for displaying reaction animations." US application 18/463,799 (United States). 2023.

[P3] **H. Lee**, **C. Ducher**, **R. Wang**, **M. Henry**, and J. R. Cooperstock. "Voice Parameter Determination Method, System and Device." US application 18/310,213; Canada application 3,198,267 (United States). 2023.

[P4] **P. Fortin**, **J. Blum**, **Antoine Weill–Duflos**, and J. R. Cooperstock. "System and Method for Wearable Device Contact Force Estimation and Adjustment Feedback." application US 20230129166 A1 (United States). 2022.

[P5] J. R. Cooperstock, **A. Weill-Duflos**, **J. Regimbal**, **N. Radi**, **J. Blum**, **P. Alirezaee**, and **Y. Zhang**. "Methods and systems for controlling a haptic display." US 63/006,141, PCT/CA2021/050461, US 17/917,761 (United States). 2021.

[P6] J. R. Cooperstock and **J. Blum**. "Improving Haptic Feedback on Wearable Devices through Accelerometer Measurements." provisional application US 62/237,772; US 62/416,910 (United States). 2015.

[P7] J. R. Cooperstock, **Y. Visell**, **A. Law**, and K. Franinovic. "Floor-based Haptic Communication System." US 9,041,521 (United States). May 2015.

[P8] J. R. Cooperstock, **J. Blum**, **M. Bouchard**, **A. Olmos**, **S. Panëels**, and **D. El-Shimy**. "Spatialized audio augmented reality for blind users with a smartphone." provisional application US 61/727,828 (expired) (United States). 2012.

[P9] J. R. Cooperstock, **G. Millet**, and **M. Otis**. "Floor-Based Variable Friction Display." provisional application US 61/577,148 (expired) (United States). 2011.

[P10] J. R. Cooperstock, **L. To**, and R. Hess. "Binocular vision assessment and/or therapy." US 8,066,372 (United States). Nov. 2011.

[P11] **S. Spackman**, **S. Pelletier**, and J. R. Cooperstock. "High-resolution Video Synthesis." application 2,435,791 filed July 24, 2003 (expired) (Canada). 2003.

[P12] J. R. Cooperstock, **Y. Zhang**, and **S. Spackman**. "Adaptive Compression for the Storage, Transmission, and Arbitrary Quality Reconstruction of Spatial Data." US 60/339,816, provisional application filed Dec. 17, 2001 (expired) (United States). 2001.

[P13] J. R. Cooperstock and **S. Arseneau**. "A robust person tracking method and system." US 60/234,197 provisional application, filed Sept. 20, 2000 (expired) (United States). 2000.

[P14] J. R. Cooperstock. "Pixel Count-Sensitive PDA Tool Mechanism with Cut/Paste and/or Copy/Paste Function." P09-022797, filed in Japan by Sony Corp. (Japan). Feb. 1997.

Technology Transfer

License agreement signed in 2014 with amblyotech.com to commercialize amblyopia treatment (protected under US patent 8,066,372 "Binocular vision assessment and/or therapy"). The technology was subsequently acquired by Novartis in April 2020.

Research Demonstrations

[D1] 3D Printed Haptic Illusions and Demonstrations. IEEE World Haptics, Tokyo, Japan (conducted by Antoine Weill-Duflos and Pascal Fortin), July 2019.

[D2] Distributed Musical Practice and Performance, I Medici di McGill, Oscar Peterson Hall, Montreal, April 28, 2008.

[D3] Wide Screen Window on the World: Life Size HD Videoconferencing. Supercomputing 2005, Bandwidth Challenge, Seattle, November 16, 2005.

[D4] Streaming DSD Audio comes to the AES. Audio Engineering Society 117th Convention, San Francisco, October 31, 2004.

[D5] Cross-continental low-latency ultra-videoconferencing. McGill-Stanford jazz jam, June 13, 2002.

[D6] Remote master's class using SDI video and multichannel audio. McGill-National Research Council session with Pinchas Zukerman, March 25, 2002.

[D7] SDI video and multichannel audio. CANARIE's 7th Advanced Networks Workshop, Toronto, November 28, 2001.

[D8] Low-latency distributed violin duet in full-frame video. RISQ 2001 Conference, Montreal, November 5, 2001.

The Globe and Mail noted that *"Cooperstock's demonstration was a watershed event for the elite club of the world's computer network engineers. No one had ever before been able to demonstrate that, under the right conditions, it is possible for natural, normal human interaction to occur over the Internet."*

[D9] The Recording Studio that Spans a Continent. Audio Engineering Society 109th Convention, Los Angeles, September 23, 2000.

The Audio Engineering Society noted that this *"Landmark demonstration shows cost effective and high performance transmission systems for high quality 24-bit, 96kHz uncompressed mulitchannel audio are on horizon"*

[D10] Dolby Digital 5.1 audio with MPEG-2 video around the world. Internet Global Summit INET 2000 Conference, Yokohama, July 20, 2000.

CBC Radio noted that *"McGill University in Montreal has made Internet history by setting up the first intercontinental netcast of a live concert in surround sound and full-screen video."*

[D11] Dolby Digital 5.1 audio with MPEG-2 video. CANARIE's 5th Advanced Networks Workshop, Toronto, November 29, 1999.

[D12] First real-time Multichannel Audio Internet demo. Audio Engineering Society 107th Convention, New York, September 26, 1999.

The Learning Technologies Networked noted that *"The performance marked the first real time multichannel audio Internet transmission, a feat made possible by software developed at McGill University by a team under the leadership of Professor Jeremy Cooperstock."*

Invited Talks

Invited Talks to Industry, Students, and the Public

[T1] "HCI Research in the Shared Reality Lab", Professor Speaker Series, Electrical, Computer & Software Engineering Students' Society of McGill University, Montreal, November 8, 2024.

[T2] "AI Digital Nurse Avatar", Place Kensington Retirement Home, Montreal, September 12, 2024.

[T3] "HCI Research in the Shared Reality Lab", Marianopolis Engineering Society, Marianopolis College, Montreal, November 21, 2023.

[T4] "HCI Research inthe Shared Reality Lab", Professor Speaker Series, Electrical, Computer & Software Engineering Students' Society of McGill University, Montreal, November 15, 2023.

[T5] "Engineering of Technologies to Improve the Lives of People Living with Vision Loss", Bioengineering and Biomedical Engineering, McGill University, September 15, 2023.

[T6] "Using smartphones to answer 'What's around me?', 'Am I crossing the street safely?' and 'Where's the entrance?"', Accessible Coding Demonstrations for Youth with Visual Impairment, Science Odyssey 2021, May 1, 2021.

[T7] "From flight simulators to the passenger experience: what can we learn from pilot-training tools to improve airline customer service", AIST–NRC Collaboration Meeting on Improving Client-Agent Interaction, January 17, 2020.

[T8] "I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery", Department of Information Engineering and Computer Science, University of Trento, July 4, 2019.

[T9] "I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery", Department of Industrial Engineering and Management, Ben Gurion University, March 11, 2019.

[T10] "I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery", Information Systems, University of Haifa, November 7, 2018.

[T11] "What's around me? Audio augmented reality for blind users with a smartphone, Pint of Science, Montreal, May 15, 2018.

[T12] Presenter at Canadian National Institute for the Blind's TechnoVision+ Conference, Montreal, May 5, 2017.

[T13] "Innovations for Gaming, AR, Simulation & Training", Innovations for gaming, augmented reality, simulation and training, and other applications, Centre d'entreprises et d'innovation de Montreal (CEIM), April 8, 2016.

[T14] "Enhanced Human: Wearable computing that transforms how we perceive and interact with our world", Department of Computer Science, Technion–Israel Institute of Technology, February 11, 2016.

[T15] "Is Humanity Smart Enough for AI?", McGill Science Outreach Program, Freaky Friday public outreach lecture, October 23, 2015.

[T16] "Delivering a Compelling User Experience in a Computer-Mediated Environment", HCIN 5300, Interactive Entertainment Technologies, Carleton University, March 7, 2014.

[T17] "Multimedia as a Building Block: How audio, video and haptics integrate in a Shared Reality", Multimedia Systems, GLIS 633, School of Information Studies, McGill University, February 13, 2014.

[T18] "Are we there yet? Cognitive Science Challenges in Telepresence and Virtual Reality", Student Association of Cognitive Science, Cognitive Science Research Day, McGill University, November 13, 2013.

[T19] "Telepresence doesn't quite cut it: Multimodal Challenges in Virtual and Shared Reality", Institute of Telecommunications and Multimedia Applications, Universidad Politècnica de València, July 10, 2013.

[T20] "Telepresence doesn't quite cut it: Multimodal Challenges in Virtual and Shared Reality", Dawson College, First Choice Science speakers series, April 17, 2013.

[T21] "Dangerous AI or dangerous us?", Academia Week Artificial Intelligence event, Science Undergraduate Society, McGill University, January 24, 2013.

[T22] "They don't use Skype on the Holodeck", Department of Computer Science, University of British Columbia, July 4, 2012.

[T23] "But can the Holodeck do a good Shiraz?", School of Computer Science and IT, Royal Melbourne Institute of Technology, February 17, 2012.

[T24] "But can the Holodeck do a good Shiraz?", School of Information Technologies, University of Sydney, February 15, 2012.

[T25] "Distributed Music Performance and Latency Issues", School of Drama, Fine Art and Music, University of Newcastle (Australia), February 13, 2012.

[T26] "But can the Holodeck do a good Pinot noir?", Department of Computer Science, University of Otago, January 23, 2012.

[T27] "Shared Reality: Toward perceptually convincing computer-mediated environments", Department of Computer Science, University of Auckland, August 25, 2011.

[T28] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Vanier College, Science Week Presentation, March 24, 2011.

[T29] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Simula Lab, Oslo, May 15, 2009.

[T30] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Ambient Intelligence Group, CITEC, Bielefeld University, May 6, 2009.

[T31] "Distributed and Multimodal Interaction in Virtual and Augmented Reality Environments", McGill University, School of Physical and Occupational Therapy, November 25, 2008.

[T32] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", University of Victoria, September 16, 2008.

[T33] "Bidirectional video communication for real-time applications", Institut für Telematik, University of Lübeck, Germany, May 15, 2008.

[T34] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", Aalborg University, Esbjerg, Denmark, May 14, 2008.

[T35] "Distributed Multimodal Interaction", Bang & Olufsen, Struer, Denmark, May 13, 2008.

[T36] "Distributed Musical Practice and Performance", Biology and Music Lecture, I Medici di McGill, April 28, 2008.

[T37] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", Arts, Media and Engineering, Arizona State University, February 29, 2008

[T38] "From Videoconferencing to Shared Reality" Department of Electrical and Computer Engineering, University of British Columbia, October 4, 2007.

[T39] "Engaging Technolog(ies) for Effective Interaction" Department of Computer Science, Hebrew University of Jerusalem, April 19, 2005.

[T40] "Engaging Technolog(ies) for Effective Interaction" Intelligence, Agents, Multimedia Group, University of Southampton, UK, March 7, 2005.

[T41] "From Videoconferencing to Shared Reality" l'Institut de Recherche et Coordination Acoustique/Musique (IRCAM), Paris, November 25, 2004.

[T42] "From Videoconferencing to Shared Reality" Taiyuan University, Taiyuan, China, April 18, 2004.

[T43] "From Videoconferencing to Shared Reality" Tsighua University, Beijing, China, April 14, 2004.

[T44] "From Videoconferencing to Shared Reality" Beijing University, Beijing, China, April 14, 2004.

[T45] "From Videoconferencing to Shared Reality" Beihan University, Beijing, China, April 12, 2004.

[T46] "From Videoconferencing to Shared Reality" Advanced Telecommunications Research (ATR), Nara, Japan, April 9, 2004.

[T47] "From Videoconferencing to Shared Reality" Dept. of Industrial Engineering, Musashi Institute of Technology, April 5, 2004.

[T48] "High-fidelity telepresence" Graphics and Geometric Computing Seminar Series, Technion – Israel Institute of Technology, January 1, 2003.

[T49] "The Virtual Studio" Royal Conservatory of Music, Toronto, February 25, 2002.

[T50] "Building a Shared Reality" Department of Computer Science, University of Toronto, February 25, 2002.

[T51] "Distributed Concerts and Shared Reality: Just how much streamed data and computation do we need to support effective interaction?" Department of Computer Science, Clarkson University, November 1, 2001.

[T52] "Robotics and Design" Round Table Panel, Centre Design UQAM, February 9, 2000.

[T53] "The Shared Reality Environment" Department of Electrical and Computer Engineering, Ecole Polytechnique, Montreal, May 28, 1999.

Invited Talks in Scholarly Conferences and Workshops

[T54] "Intelligent Systems to Enhance Human Experience", International Laboratory of Learning Systems–DATAIA Workshop, Paris, May 25, 2023.

[T55] Speaker in "Ethics Research I am Excited About", Laidley Centre for Business Ethics, Montreal, April 28, 2023.

[T56] Speaker in "Next Gen Health Powered By The Open Grid And Edge AI", IEEE Future Networks Forum, Montreal, October 14, 2022.

[T57] "Touch and feel when it isn't real: Integrating haptics into the XR experience", InterDigital Scientific Seminar series, December 4, 2020.

[T58] "Taking Haptics Out of the Lab and Into the Wild", Introduction to Haptics for Next Generation XR. International Conference on Intelligent Robots and Systems Tutorial Session, October 29, 2020.

[T59] "Assistive Technology Research in the Shared Reality Lab", Conférence scientifique du CRIR-Institut Nazareth et Louis-Braille, September 25, 2019.

[T60] "Learning from sparse feedback: Adapting an environmental awareness app to visually impaired user preferences", ACM-SIGCHI sponsored summer school on Intelligent User Interfaces in the Era of IoT and Smart Environments, Haifa, Israel, October 3, 2018.

[T61] Speaker in "AR/VR panel", IEEE Multimedia Signal Processing Workshop, Montreal, September 23, 2016.

[T62] "Immersive multimedia and mobile interaction: Applications to new media, gaming, medicine, and beyond" Keynote speaker, Entertainment Technology Summit, Concordia University, Montreal, September 17, 2016.

[T63] "Leveraging video in public safety scenarios", Ninth Canadian Public Safety Interoperability Workshop (CITIG 9), Toronto, December 1, 2015.

[T64] "Future Cities (2040) – Mind: Human and Machine", Institute for the Public Life of Arts and Ideas, Symposium on Future Cities, March 13, 2015.

[T65] "UltraVideo and the Quest for Minimal Latency", International Workshop on High Quality Dynamic cross-continental Networked Artistic interaction, World Opera Association, Struer, Denmark, August 29, 2013.

[T66] "Assisting the blind and treating amblyopia: Two more things you can do with your smartphone", 15e Symposium scientifique sur l'incapacité visuelle et la réadaptation (presented with J. Blum). University of Montreal, February 12, 2013.

[T67] "Revolutions in human-device interaction: How new paradigms impact user experience", International Conference on Consumer Electronics, Consumer Electronics Society, Las Vegas, January 12, 2013.

[T68] "Around the World in 80 ms." Panel presentation in Workshop of the Audio Engineering Society Convention, San Francisco, November 5, 2010.

[T69] "UltraVideo and Virtual Presence: A Video Perspective." Presentation on Teaching in Distributed Performance, Tromsø, Norway, October 15, 2010.

[T70] "Future Interfaces for Audio." Panel presentation in Workshop of the Audio Engineering Society Convention, New York, October 10, 2009.

[T71] "World Opera Technologies and Tests", Danish Sound Technology Network, Aalborg University, June 8, 2009.

[T72] "The Montreal World Opera Experiments". Presentation at the World Opera Symposium, Struer, Denmark, May 12, 2009.

[T73] "Audio-Visual-Haptic-Tactile: Putting them all together for an engaging immersive experience". Panel presentation in Workshop of the Audio Engineering Society Convention, Munich, Germany, May 10, 2009.

[T74] "New Technologies for Audio over IP". Panel presentation in Workshop of the Audio Engineering Society Convention, Munich, Germany, May 10, 2009.

[T75] "A Platform to Create and Support Ocean Science Virtual Organizations (Oceans 2.0)" and "HSVO Health Services Virtual Organization", RISQ 2008 Colloquium, Montreal, November 14, 2008.

[T76] "The Future of VC: Music Teaching and High Fidelity Video", Elevate 2008: Reaching New Heights in Educational Video-conferencing, Banff, August 27–28, 2008.

[T77] "Creating an immersive video space", International Symposium on The World Opera: When the Opera stage becomes worldwide, Tromsø, Norway, May 9, 2008.

[T78] "Multimodal Streaming and Distributed Audio Interaction", High Quality Audio over Networks (ANET II) Summit, Banff Centre, April 12, 2008.

[T79] "Music and Games: How Fun Applications Stimulate Core Technologies", Canadian University Software Engineering Conference, January 19, 2008.

[T80] "From Teleoperation to Teleimmersion: Design Challenges for Distributed Interaction", Canadian University Software Engineering Conference, January 19, 2007.

[T81] "CANARIE sur UCLP et ROADM, deux technologies qui changent le monde des télécoms", Round Table panel, RISQ Annual Conference, Quebec City, October 16, 2006.

[T82] "La recherche sur en ultra-videoconference", Panel on "Vitrine technopédagogique sur la vidéoconférence", RISQ Annual Conference, Quebec City, October 16, 2006.

[T83] "Broadband transmission of multimodal content at the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT)", RISQ-CA*net4 Advanced Networking Day, Montreal, October 24, 2005.

[T84] "Low-Latency Ultra-Videoconferencing and Shared Reality" Interfaces Montreal, Rencontre du Génie numérique et des Affaires. Montreal, October 11, 2005.

[T85] "Shared Spaces" Asia-Pacific Advanced Networks (APAN) Conference, Taipei Aug. 22–27, 2005.

[T86] "Engaging Technolog(ies) for Effective Interaction" Keynote speaker, World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.

[T87] "Broadband Distance Education in 2007: Views from the Demand Side" Invited Panelist. World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.

[T88] "Ultra-Videoconferencing and Intelligent Classrooms" Keynote speaker, Canadian Higher Education and Information Technology Conference, Montreal, June 28, 2005.

[T89] "From Videoconferencing to Shared Reality" Bell University Laboratories' Annual Conference, Toronto, November 3, 2004.

[T90] "History of Internet Audio Experiments at McGill" High Quality Audio over Networks (ANET) Summit, Banff Centre, August 20–22, 2004.

[T91] "Advanced Video Applications: Developments in Extreme Video" Southeastern Universities Research Association Video Development Initiative (SURA/ViDe) 6th Annual Digital Video Workshop. Indianapolis, March 24, 2004.

[T92] "The Democratic Revolutions – Peer to Peer Meets Open Source: Design, Philosophy, Engineering" Intimate Technologies/Dangerous Zones. Banff New Media Institute, Banff Centre, April 27, 2002.

[T93] "The Development of Ultra VC Applications and Technology" Southeastern Universities Research Association Video Development Initative (SURA/ViDe) 4th Annual Digital Video Workshop. University of Alabama at Birmingham, April 25, 2002.

[T94] "High quality wide-screen SDI video and multichannel audio over CA*net3" CANARIE's 7th Advanced Networks Workshop, Toronto, November 28, 2001.

[T95] "Low-latency comes to videoconferencing: The Frères Jacques duet at a distance" RISQ 2001 Conference, Montreal, November 5, 2001.

[T96] Advanced Networking and the Arts: Innovations in Outreach, Collaboration, and Performance. Panel Discussion at Internet Global Summit INET 2001 Conference, Stockholm, June 6, 2001.

[T97] "The McGill–Calgary Advanced Learnware Network" CANARIE's 6th Advanced Networks Workshop, Montreal, November 29, 2000.

[T98] "Networks and Music Instruction" Panel Discussion with Pinchas Zukerman and Wieslaw Woszczyk, CANARIE's 6th Advanced Networks Workshop, Montreal, November 29, 2000.

[T99] "Tools for Distributed VR" Canadian Working Group on Virtualized Reality Systems, Montreal, November 28, 2000.

[T100] "Evolution of the Intelligent Classroom" Multicultural Perspectives on the use of Technology in Education. Montreal, October 2, 2000.

[T101] The Brave New World of Ubiquitous Bandwidth" Internet Global Summit INET 2000 Conference, Yokohama, July 20, 2000.

[T102] "Multichannel Audio over the Internet: The Next Phase" RISQ 2000 Conference, May 31, 2000.

[T103] "Multichannel Audio over the Internet" CANARIE's 5th Advanced Networks Workshop, Toronto, November 29, 1999.

[T104] "When Telemedicine feels like Regular Medicine" Communications and Information Technology Ontario (CITO) Healthcare for the Future: Telemedicine, February 18, 1999.

Media Exposure

[M1] Ami-Télé, Ça me regarde, February 8, 2018

[M2] Forbes, March 9, 2017

[M3] Discovery Channel, Daily Planet, Mar. 7, 2017

[M4] Télé-Québec, Electrons Libre, Jan. 17, 2017

[M5] ACB Radio, Mainstream, Nov. 18, 2016

[M6] CBC Radio, Tech Column, Aug. 8, 2016

[M7] CJAD Radio, Tech Talk, Aug. 6, 2016

[M8] Mobile Syrup, Aug. 4, 2016

[M9] CBC News, Aug. 4, 2016

[M10] Betakit, Aug. 3, 2016

[M11] Accessible Media Inc., Live from Studio 5, Aug. 2, 2016

[M12] La Presse, Jul. 31, 2016

[M13] CTV News, Jul. 29, 2016

[M14] Stevivor, Mar. 2015

[M15] Venture Beat, Mar. 3, 2015

[M16] Club Social (TV5), Feb. 4, 2011

[M17] Global TV (National), Jan. 29, 2009

[M18] Global TV (Montreal), Jan. 27, 2009

[M19] CBC Radio, As it Happens, Jan. 27, 2009

[M20] National Post, Jan. 27, 2009

[M21] Montreal Gazette, Jan. 27, 2009
[M22] Montreal Gazette, Feb. 20, 2009
[M23] Inside Higher Education, Sept. 3, 2008
[M24] CBC Radio (Daybreak), Sept. 3, 2008
[M25] CJAD radio, Sept. 2, 2008
[M26] Cabling Networing Systems, Jan. 2006
[M27] McGill Reporter, Nov. 24, 2005
[M28] CTV Quebec, Global News, Dec. 23, 2002
[M29] New York Times, Technology Section, Dec. 19, 2002
[M30] Discovery Channel, Daily Planet, Oct. 30, 2002
[M31] CFCF (CTV Quebec) Global News, June 19, 2002
[M32] National Post, June 15, 2002
[M33] CBC Television, The National, May 3, 2002
[M34] McGill Reporter, Learning the Strings, April 11, 2002
[M35] Ottawa Citizen, March 29, 2002
[M36] Montreal Gazette, March 27, 2002
[M37] Globe & Mail, Dec. 1, 2001
[M38] Canal Z, La Revanche des Nerdz, Nov. 13, 2001
[M39] Montreal Gazette, Nov. 10, 2001
[M40] CJAD Radio, The World Today, July 31, 2001
[M41] McGill Reporter, April 5, 2001
[M42] Globe & Mail Report on Business, Oct. 28, 2000
[M43] TQS Double Clic!, Oct. 7, 2000
[M44] McGill Reporter, Sept. 21, 2000
[M45] UPath.com, Vol 40, 2000
[M46] CBC (Montreal) Home Run, Aug. 22, 2000
[M47] Montreal Gazette, Aug. 22, 2000
[M48] CFCF (CTV Quebec) Pulse News, Aug. 21, 2000
[M49] CBC Radio The Arts Report, July 20, 2000
[M50] Elle Quebec, June 2000
[M51] Journal Le Monde des Affaires, May 2000
[M52] Canal Z, Technofolie, May 3, 2000
[M53] TQS Double Click, April 29, 2000
[M54] McGill Reporter, April 6, 2000

[M55] Briefing Digital, April 2000

[M56] Interface: La Revue de la Recherche, Vol. 21, No. 2, March-April 2000

[M57] American Society of Mechanical Engineers, Mechanical Advantage, Vol 9, No 3, March 2000

[M58] Canal Z, La Revanche des Nerdz, Feb. 2000

[M59] CFCF (CTV Quebec) Pulse News, Feb. 29, 2000

[M60] Canal Vox: CityMag, Jan. 15, 2000

[M61] Montreal Mirror, Jan. 6, 2000

[M62] Plan Mega: La revue du genie québecois, Ordre des ingenieurs du Québec. Vol 1, Jan. 2000

[M63] Radio Corporation of Singapore: Science and Technology Watch, Dec. 1999

[M64] Radio Canada (CBC French) Les Annees lumiere, Nov. 28, 1999

[M65] Financial Times Life/Technology, Nov. 25, 1999

[M66] CBC Radio: As it Happens, Nov. 22, 1999

[M67] Journal de Montreal, Nov. 19, 1999

[M68] Le Devoir, Nov. 18, 1999

[M69] TVA CyberClub, Nov. 13, 1999

[M70] La Presse, Sept. 26, 1999

[M71] CJAD Radio, April 11, 1999

[M72] Montreal Mirror, April 8, 1999

[M73] McGill Reporter, Jan. 14, 1999

[M74] High-Tech Shower International, Nov. 26, 1997

[M75] CBC Newsworld “Futureworld”, Oct. 5, 1996

[M76] Discovery Channel, Sept. 18, 1996

[M77] Toronto Star, Sept. 15, 1996

[M78] University of Toronto Varsity, Sept. 3, 1996

[M79] TV Ontario “Studio Two”, June 26, 1995

Research Supervision

Research Professionals

Name	Period	Project title	Present Position
Gvozdev, Mikhail	Feb 2025–	AI solutions architect, IMAGE project	
Yousef, Shahd	Sep 2024–	server-side developer, IMAGE project	
Singh, Jaydeep	Sep 2021–	web developer, IMAGE project	
Novack, Kaylee	Sep 2021–Apr 2022	medical doctor researcher on Avatar Therapy project	Medical Resident, Université de Montréal
Kuo, Cyan	Aug 2021 – Dec 2023	Usability Research Lead, IMAGE project	
Patil, Gandharv	Jun 2021 – Mar 2022	ML Research Lead, IMAGE project	PhD student, McGill
Grond, Florian	Apr 2021 – Mar 2023	Audio Research Lead, IMAGE project	Assistant Professor, Concordia University
Eichhorn, Alexander	Feb 2013 – Aug 2013	research associate under GRAND	CTO of Kidtsunami
Bouchard, Mathieu	Jan 2011 – Nov 2018	research assistant under MSG project	
Chen, Guangyi	Jan 2010 – Jul 2010	research associate under Canarie NEP	
Vincent, Coralie	Oct 2010 – Mar 2011	research assistant	Research Engineer, IRCAM, France
Dansereau, Don	Jun 2009 – Jan 2010	research associate under FRQNT grant	Senior Lecturer, University of Sydney

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Name	**Period**	**Project title**	**Present Position**
To, Long	Jan 2009 – Sep 2011	research associate under NSERC I2I	Software engineer, Abcam
Blum, Jeff	Oct 2008 – Aug 2013	research assistant under MSG project	
Olmos, Adriana	Sep 2008 – July 2012	user interface engineer under Canarie NEP	Interaction designer, Google/YouTube
Sun, Haijian	Sep 2008 – Oct 2010	computer engineer under Canarie NEP	ECM Consultant, JCDS Solutions Inc.
Soukhodolski, I.	Oct 2005 – Dec 2007	web services programmer under Canarie IIP	Owner, W4 Technology
Kiewe, Howard	Oct 2005 – Dec 2007	user interface developer under Canarie IIP	consultant
Spackman, S.	2000–2006	research associate on Canarie and VRQ projects	Google, Mountain View
Sarikaya, Deniz	2003–2004	research assistant on VRQ projects	deceased
Soucy, Gilbert	1999	research associate on CFI project	Imaging Specialist, 36pix Inc., Montreal

Post-doctoral Fellows

Name	Period	Project title	Present Position
Byeon, Yeong-Hyeon	Jan 2024 – Nov 2024	Bionic Ear Project	
Bouzekri, Élodie	Sep 2023 – Aug 2024	ADAIR Project	Assistant Professor, Université de Bretagne Occidentale
Fontana De Vargas, Mauricio	Jan 2023 – Nov 2023	Ai-Digital Nurse Avatar (ADiNA)	AI+VR Research Scientist, Meta, Toronto
Sullivan, John	Sep 2021 – Apr 2022	Multimodal Rendering for the IMAGE Project	post-doctoral fellow, Université Paris-Saclay
Jyoti, Vishav	Mar 2021 – Feb 2022	Mixed-Reality Platform for Simulation and Synthesis of Multi-Modal Hallucinations	Software Engineer, Youtube, India
Talhan, Aishwari	Jan 2021 – Dec 2022	Wearable Haptics	Research Scientist, SUNY Research Foundation, Albany, New York
Yoo, Yongjae	Mar 2020 – Jul 2022	Wearable Haptics and Haptics Lead, IMAGE project	Assistant Professor, Hanyang University ERICA, South Korea
Weill-Duflos, A.	Jan 2018 – Jan 2021	Wearable Haptics	Director of Research and Product Integration, Haply Robotics
Arnold, Andre	Oct 2017 – Dec 2017	Wearable Haptics	Product Manager – AI Nuvoola

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Name	Period	Project title	Present Position
Panëels, S.	Jan 2011 – Jan 2012	Natural Interactive Walking and In-Situ Audio Services	Researcher, Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
Pelletier, S.	Nov 2009 – Jun 2011	Real-time Image-based Rendering (Canarie NEP, 2009-2010)	
		Parallax Barrier Display rendering software optimization (NSERC ENGAGE, 2011	Game Programmer, Behaviour Interactive
Otis, Martin	Jan 2010 – Dec 2010	Natural Interactive Walking (FRQNT Scholarship)	Assoc. Professor, U. Québec à Chicoutimi
Millet, G.	Nov 2009 – Mar 2012	Natural Interactive Walking	Patent Examiner, EPO, The Hague
Bouillot, Nicolas	Sep 2007 – Dec 2011	Mobile Audio Interaction (NSERC New Media Initiative, 2007-2009)	
		Open Orchestra (Canarie NEP-2 Project)	Co-Founder - Lab148
Darolti, Cristina	Jan – Dec 2009	Real-time Image-based Rendering (Canarie NEP)	Patent Examiner, EPO, The Hague
Wang, Guangyu	Sep 2007 – Mar 2011	Neurosurgical Visualization and Virtual Presence (NSERC Strategic and NCE)	Facebook, Mountain View
Wang, Yan	2002–2003	Channel and spatial view allocation for videoconferencing (VRQ)	V.P. Marketing, AMH Canada

Ph.D. Students

Name	Period	Thesis title	Present Position
Riazifar, Myles	Jan 2025–present	Advanced Airspace Usability	
Pinheiro de Oliveira, Henrique Jongh	Mar 2024–present	Orchestrating LLMs for blind and low-vision users, Cotutelle student with Universidade Federal do Rio Grande do Sul	
Kuo, Cyan	Jan 2024–present	Multimodal Perception in Sensory Substitution Frameworks	
Knappe, Sabrina*	Jan 2023–present	Advanced Airspace Usability	
Samuel, Segun*	Jan 2023–present	Spatial content representation strategies for blind and low-vision users	
Conan, Corentin*	Sep 2022–present	Advanced Airspace Usability	
Astles, Samantha*	Sep 2022–Jan 2024	Advanced Airspace Usability	
Shen, Lichao*	Oct 2021–Aug 2023	Social telepresence	
Regimbal, J.*§†C	Sep 2021–present	Audio-haptic authoring for information rich content delivery	
Fortin, P.*§	Sep 2016–Sep 2021	Methods and Interfaces for Closed-Loop Smartphone Communications	Asst. Professor, U. Québec à Chicoutimi
Blum, Jeff*†g	Sep 2013–present	Implicit Communication for Enriched Human Interaction	
Erfani-Joorabchi, M.*	Jan 2013–Jan 2015		iOS Software Engineer, Google

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Name	**Period**	**Thesis title**	**Present Position**
Anlauff, Jan*	Jan 2011–present	Sensor-Actor Wearables	
Tordini, F.	Jan 2011–Feb 2018	Auditory salience modeling for continuous processes sonification	Technology Transfer Manager, Innovation and Partnerships, McGill University
Ghourchian, N.*†	Jan 2010–Apr 2011	Affective Evaluation	transferred to another group
El-Shimy, D.†	Jan 2009–Nov 2014	Reactive Environment for Network Music Performance	Director of UX Research, WISE, London UK
Benovoy, M.†	Oct 2007–Aug 2010	Biosignals analysis	transferred to another group
Visell, Yon	Sep 2005–Mar 2011	Walking on virtual ground: physics, perception, and interface design	Assistant Professor (ECE), UC Santa Barbara
Qi, Zhi	Jan 2004–Dec 2008	Towards dynamic mosaic generation with robustness to parallax effects	Associate Professor (School of Electronic Science & Engineering), Southeast University, China
Pelletier, S.[p]	Jan 2003–Oct 2009	Acceleration methods for image super-resolution	Game Programmer, Behaviour Interactive
Yin, Jianfeng	Sep 2000–Aug 2008	Toward an Alternative Approach to Multi-Camera Scene Reconstruction	Software engineer, Geomagical Labs
Sun, Wei	2002–2006	Multi-camera Object Segmentation in Dynamically Textured Scenes Using Disparity Contours	Apple Inc., Cupertino

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Name	Period	Thesis title	Present Position
Cayouette, F.†	2003–2006	human tracking (withdrew from program)	Generalist Programmer, Reflector Entertainment
Arseneau, S.	2000–2006	Representing Junctions through Asymmetric Tensor Diffusion	Chief Technology Officer, MVP, Austin

* McGill Engineering Doctoral Award recipient
† NSERC PGS D Scholarship recipient
†C NSERC CGS D Scholarship recipient
§ FRQNT Scholarship recipient
g Graphics Animation and New Media (GRAND) Scholarship recipient
p Precarn Scholarship

Additional Ph.D. Supervisory Service

I co-supervised a portion of the thesis work of the following students:

- Kilic, Şeyma Nur (Jan 2025-), visiting student from Istanbul University-Cerrahpasa
- Du, Xiaoxi (Sep 2023-Aug 2024), visiting student from Southeast University, Nanjing, China
- Mousavi, Mastoureh (Sep 2023-), visiting student from Azad University, Tehran, Iran
- Liu, Xian (Nov 2013-Dec 2015), visiting student from University of Electronic Science and Technology, China
- Xie, Meng (Sep 2012-Mar 2014), visiting student from Beijing University of Aeronautics and Astronautics, China
- Grond, Florian. (Jul-Dec 2010), visiting student from Bielefeld University, Germany
- Zambon, S. (Jul-Oct 2010), visiting student from Verona University, Italy
- Cirio, Gabriel (Jun-Aug 2010), visiting student from INRIA-IRISA, France
- Rizutti, Costantino (Sep-Oct 2008), visiting student from Università della Calabria, Italy
- Bossi, Eugenia (Oct 2008), visiting student from Università della Calabria, Italy
- Pellerin, Romain. (Jun-Sep 2008), visiting student from Conservatoire Nationale des Arts et Métiers, France
- Cupellini, Enrico (Jul-Aug 2007), visiting student from Università della Calabria, Italy
- Usher, John (2003-2004), Ph.D. student, Faculty of Music, McGill University
- Mohammadi, M. (Feb-Aug 2004). visiting student from Sharif University, Iran

I served as external reviewer or examiner of the following theses:

- Mauricio Fontana de Vargas, School of Information Studies, McGill University (2022)
- Richard Olayniyan, Department of Computer Science, McGill University (2021)
- Xavier de Tingu, Université Rennes, France (2020)
- Damien Brun, Le Mans Université, France (2020)
- Cheryl Savery, Queen's University (2014)
- Alexandre Plouznikoff, École Polytechnique de Montréal (2009)
- Xiaoyong Sun, School of Information Technology and Engineering, University of Ottawa (2007)
- Nicolas Bouillot, Conservatoire Nationale des Arts et Métiers, France (2006)
- Harold Okai-Tettey, Computer Science, Rhodes University, South Africa (2006)

I served on the supervisory and/or examination committees of the following students:

- Department of Electrical and Computer Engineering: Edouard Antoniou, Oliver Astley, Carmen Au, Marc Boulé, Wei Chu, Olivier St-Martin Cormier, Vincent Levesque, Muhua Li, Rui Ma, Dante De Nigris Moreno, Jun Ouyang, Jerome Pasquero, Andrew Phan, Ala Qumsieh, Harkirat Sahambi, Wei Sun, Yick Kei Wong, Dingrong Yi, Olivier St-Martin Cormier, Karl Fayad, Shalaleh Rismani, Lixiao Zhu, Amir Abbas (2023), Haji Abolhassani (2024)
- Department of Mechanical Engineering: Zahir Albadawi, Omar Wyman, Ehsan Yousefi
- Department of Biological and Biomedical Engineering: Alireza Heidari
- School of Physical and Occupational Therapy: Jackie Girgis
- School of Information Studies: Xiaofeng (Allan) Yong
- Faculty of Music: Jason Corey, Cory McKay, Caroline Medeiros, Sean Olive, Dale Stammen, Vanessa Yarmechuk, Mark Zadel
- Grad. School of Library and Information Studies: Charles-Antoine Julien
- Department of Educational Psychology and Counselling: Adam Finkelstein
- School of Computer Science: Paul Haroun, Wisam Al Abed

Masters Students

Name	Period	Thesis title	Present Position
Wang, Melody	Jan 2025–	TBD	
Jabbari, Kasra	Jan 2025–	TBD	
Pan, Edina	Sep 2024–	TBD	
Li, Yuancao	Sep 2024–	TBD	
Dhanania, Mansi[◇]	Sep 2024–	TBD	
Buller, Abigail[◇◇†C]	Sep 2023–	Haptic displays for multi-patient vital sign monitoring	
Karve, Anay	Sep 2023–	ADvanced AIRspace Usability	
Naik, Khushi	Sep 2023–	Graphical displays for multi-patient vital sign monitoring	
Zou, Yichen	Sep 2023–	Bionic Ear	
Li, Heyang[§]	Jan 2023–	Emotion recognition and expression for ADiNA	
Fu, Jano	Jan 2023–	Dynamic multimodal chart representations for individuals who are blind	
Bazin, Romain	Sep 2022–Dec 2024	Leveraging Large Language Models for Automated Chart Summarization	
Quadros, Venissa Carol	Sep 2022–	Authoring of Audio-Tactile Content for Refreshable Tactile Displays	
Aubet, Antoine	Sep 2022–	Computationally efficient dynamic spatial audio rendering for distributed musical performance	
Liu, Yujing	Sep 2021–2024	Design and Implementation of Conversational Humanoid Avatars for Healthcare Applications	

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Name	Period	Thesis title	Present Position
Wilson, É.	Sep 2021–Sep 2024	Representations for the Blind of Depth Information in Photographs	Technical Product Coordinator, Haply Robotics
Duarte, Nathan◊◊	Sep 2021–Aug 2023	Deploying wearable sensors for pandemic mitigation	Senior Associate, Boston Consulting Group
Henry, Max	Sep 2021–	Spatial-aware audio rendering for immersive telepresence	
Lewis-Lane, Jonathan	Sep 2021–Aug 2023	Haptic Interfaces for Musical Notation and Expression	Haptics Engineer, Apple Computer
Akut, Rohan	Jan 2021–Jul 2023	Enriching AI-based Image Descriptions for People who are Vision-Impaired	Machine Learning Engineer, iCAD Dental
Gannavarapu, S.	Sep 2020–Dec 2023	Haptic Perception and Multimodal Maps for the Visually Impaired	
Isran, Rayan	Sep 2020–Aug 2023	Investigating Audio-Haptic Rendering Methods To Deliver Chart Information to Blind and Low-Vision Individuals	Mechatronics Software Engineer, Bombardier Recreational Products
Kirby, Linnea	Sep 2020–	The Implications of Technology-Augmented Circus in Training, Performance, and Interdisciplinary Research	
Knappe, Sabrina	Sep 2020 – Dec 2022-	Towards a User Interface for Audio-Haptic Exploration of Internet Graphics by People who are Blind and Partially Sighted	Ph.D. student (see above)
Regimbal, J.	Sep 2020 – Aug 2021	Haptic effects authoring in artistic and utilitarian contexts	(fast-tracked to Ph.D. program)

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Name	Period	Thesis title	Present Position
Ducher, Clara	Sep 2019 – Sep 2021	GAN-based interaction paradigms for photorealistic avatar creation (McGill nominee for Northeastern Association of Graduate Schools Distinguished Thesis Award)	Research Software Engineer, European Centre for Medium-Range Weather Forecasts
Marino, David	Sep 2019 – Nov 2021	Implicitly Conveying Emotion While Teleconferencing	R&D Scientist, Hitachi Energy, Montreal
Lee, Hyejin	Sep 2019 – Apr 2022	Generating Convincing Simulation of Internalized Voices for Human-avatar Interaction	Full-stack developer, Société Générale, Montreal
Li, Yaxuan	Sep 2019 – May 2022	Towards Context-aware Automatic Multimodal Haptic Effect Generation for Home Theatre Environments	Ph.D. student, U. Michigan
Bouanane, Y.	Jan 2019 – Dec 2020	EchoDepth: Using a depth camera and sonification for blind navigation	Entrepreneur, sktch.io
Demers, Marc	Sep 2018 – Mar 2021	A Data-Driven Strategy for Evaluating Tacton Perceptual Similarity	Data Scientist, Maxen Technologies
Vyas, Preeti	Sep 2017 – Apr 2020	Foot-based Haptic Interfaces for Numeric Information Delivery and Dance Learning	Ph.D. student, UBC
Sulmont, E.	Sep 2017 – Dec 2018	Improved Learning of Machine Learning by Non-Majors	Curriculum Manager, DataCamp
Patil, Gandharv	Jan 2017 – Dec 2019	Min-Max Inverse Reinforcement Learning for learning bi-modal dialogue policies	Ph.D. student, McGill
Girgis, Roger	Sep 2016 – Apr 2019	Assessing the Use of Deep Learning in Assisting Visually Impaired People with Outdoor Exploration	Ph.D. student, MILA

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Name	Period	Thesis title	Present Position
Kim, Taeyong	Sep 2016 – Aug 2019	Exploration of foot based interaction for menu control and virtual reality applications	HRI Researcher, Hyundai Robotics
Alirezaee, P.	Sep 2016 – Dec 2019	Multimodal approaches to improved hospital alarms	Product Designer, Unity Technologies
Diaz, Manfred	Sep 2016 – Aug 2017	Interactive and Uncertainty-Aware Imitation Learning	Ph.D. student, MILA
Ahmer, Z.	Jan 2016 – Jan 2019	Automated musical accompaniment to children's stories	
Yin, G.	Sep 2015 – Oct 2018-	Augmented Reality Tools for Workplace Safety	Software Engineer, Kooltra
Fortin, P.	Sep 2015 – Aug 2016	Physiological Perception of Tickling Sensation	(fast-tracked to Ph.D. program)
Horodniczy, D.†	Sep 2014 – Dec 2016	Characterization and Application of a Variable-Friction Foot Device	Software Developer, Philips Innovative Imaging Technologies
Vuibert, Vanessa	Sep 2013 – Aug 2015	Efficient and Accurate Performance with Unconstrained Mid-air Interaction	Software Developer, Guavus
Hieda, Naoto	Sep 2012 – Aug 2015	Digital Video Projection for Interactive Entertainment	PhD student, Tallinn University, Estonia
Viswanathan, R.	Jan 2010 – Dec 2012	Testing the Two-Stream Hypothesis in an Immersive Virtual Environment	Senior Software Developer, Faurecia Irystec Inc
Knight, Trevor	Jan 2010 – Sep 2011	Music Visualization for Open Orchestra (CIRMMT Student Award)	Software Developer, Noteloop Systems
Li, Weizhong	Sep 2008 – May 2009	(recommended alternative supervision)	

Continued on next page

Name	Period	Thesis title	Present Position
Ip, Jessica	Sep 2008 – Mar 2011	Augmented Reality for Interactive Play in a Virtual and Physical Environment	iOS developer, Shopify, Toronto
Namit, Gaurav	May 2008 – Oct 2009	(withdrew in 2009 to pursue social entrepreneurship venture)	
El-Shimy, D.	Sep 2007 – Dec 2008	Gestural interaction for complex tasks	(fast-tracked to Ph.D. program)
Law, A.	Sep 2007 – Sep 2010	A Vibrotactile Floor for Enabling Interaction through Virtual Walking Spaces	Data Systems Engineer, AECOM, Vancouver
Benovoy, M.	Sep 2006 – Oct 2007	Biosignals analysis and its application in a performance setting	(fast-tracked to Ph.D. program)
Audet, Samuel†	2005-2007	Shadow Removal from Multi-Projector Displays via Three-Dimensional Modeling and Object Tracking	Deeplearning4j (Skymind), Tokyo, Japan
Wozniewski, M.	2003-2006	A framework for interactive three-dimensional sound and spatial audio processing in a virtual environment	research engineer, Societé des arts technologiques, Montreal
Rudzicz, Frank§	2004-2006	CLAVIUS: Understanding Language Understaing in Multimodal Interaction	Associate Professor, University of Toronto (status) and Dalhousie University
Rioux, Francois†	2003-2005	Software Framework for Parsing and Interpreting Gestures in a Multimodal Virtual Reality Context	Ph.D., Laval; Software Architect, Thales Canada
Chan, Siu-Chi	2002-2005	Hand and Fingertip Tracking for Gesture Recognition	Technical Staff, AMD Toronto
Hilario, Nadia§	2002-2005	Occlusion Detecion in Front Projection Environments	Software Developer, Spiria

Continued on next page

Name	Period	Thesis title	Present Position
Perez, Michael	2002-2005	Multimodal Human-Computer Interaction for a Public Kiosk System	User Interface Designer, Nuance
Sud, Daniel	2002-2005	Design of a Multi-Projector Display System	Senior Producer, Lucky Hammers
Boussemart, Y.	2002-2005	Design and Implementation of Framework for Immersive Environments in a Shared Context	Chief Technology Officer, Xerxes Global
Pelletier, S.	2001-2003	High-Resolution Video Synthesis from Mixed-Resolution Video Based on the Estimate-and-Correct Method	(see above)
Gu, Jinhua	2000-2002	A distributed software architecture for the Shared Reality Environment.	VP, Radian Asset Assurance Inc., NY
Yao, Jie	2000-2002	Human Arm Gesture Detection and Recognition in a Classroom Environment.	Ph.D. student, Concordia University
Zhang, Yuan	2000-2002	An efficient coding method for spatial data: the rotating, hierarchical, overlapping representation.	Ph.D. student, University of Delaware
Doutriaux, S.	1998-1999	(withdrew in 1999 to launch start-up company)	
Arseneau, S.	1998-2000	Robust Image Segmentation Towards an Action Recognition Algorithm.	(see above)
Xu, Aoxiang	1998-2000	A High-Performance Audiovisual Communication System.	QNX Software Systems, Ottawa

† NSERC PGS M Scholar recipient
†C NSERC CGS M Scholar recipient
§ FRQNT Graduate Scholarship recipient
⋄ McCall MacBain Scholar finalist
⋄⋄ McCall MacBain Scholarship recipient

Additional Masters Supervisory Service

I co-supervised a portion of the thesis work of the following students:

- Marcé, Clément (Jul-Aug 2024), visiting student from INSA (Toulouse)

- Albert, Nicolas (Jan-Jun 2024), visiting student from École Polytechnique Fédérale de Lausanne, Switzerland
- Peña Cortés, Dafne Vania (Nov 2023-present), School of Engineering and Sciences, Tecnológico de Monterrey, Mexico
- Dever, Ani (Sep 2017-Feb 2018), visiting student from Polytechnic University of Turin, Italy
- Gallo, Nicola (Sep 2015-Feb 2016), visiting student from Polytechnic University of Turin, Italy
- Roy, Louise (Jul-Dec 2015), visiting student from Ensimag, Grenoble, France
- Glesser, David (Feb-Jun 2012). visiting student from Ensimag, Grenoble, France
- Penin, O. (Jul-Aug 2011). visiting student from Paris-Sud 11, France
- Mabire, N. (Apr-Sep 2010). visiting student from Supélec, Metz, France
- Brulé, M. (Feb-Aug 2009). visiting student from Université de Louis Pasteur, Strasbourg, France
- Anlauff, J. (Dec 2008-Mar 2009). visiting student from Bielefeld University, Germany
- Delattre, G. (Apr-Aug 2007). visiting student from Université Paris VI, France

I served on the supervisory and/or examination committees of the following students:

- Zhonghao Zhao (M. Eng. project), Electrical and Computer Engineering, McGill University
- Anne-Marie Burns, Faculty of Music, McGill University
- Frank Riggi, Electrical and Computer Engineering, McGill University
- Eric Benzacar, Electrical and Computer Engineering, McGill University
- Oles Protsiym, Faculty of Music, McGill University

Funding

Individual Research Grants and Contracts

Date	Source	Amount	Title/Description
2024-2029	NSERC	$275,000	*Multimodal information communication to overcome environmental, sensory, and computer mediation limitations* Discovery grant
2024	HBHL/Human-Ware	$270,867	*Advancing IMAGE Support for the HumanWare/APH Monarch* Healthy Brains, Healthy Lives (CFREF) + McGill I+P with partner organization HumanWare
2024-2025	MEDTEQ/NSERC	$268,115	*Improving Intelligibility of Speech in Noisy Environments* MEDTEQ Partenar-IA and NSERC Alliance funding
2023	Humanware	$33,600	*Prototype experience for IMAGE content on the Monarch* Research contract
2023-2024	MEDTEQ/HBHL	$282,188	*Haptic devices for conveying non-textual visual information on the internet for individuals with vision loss.* MEDTEQ Partenar-IA (Ministère de l'Économie, de l'Innovation et de l'Énergie) and Healthy Brains, Healthy Lives (CFREF)
2022	HBHL	$50,000	*Extending Internet Multimodal Access to Graphical Exploration.* Healthy Brains, Healthy Lives (CFREF) Neuro Commercialization Ignite Grant
2022	Meta	$30,000	Unrestricted gift
2021	Mitacs	$13,333	*Analyse et recherche d'optimisation d'un processus d'adaptation de contenu issu de la numérisation 3D à un contenu photoréaliste et interactif.* Mitacs Accelerate – Intern: Chen, Hongjun
2021-2022	ISED	$608,594	*Enabling Access to Graphical Image Content Published via the Internet for People Who Are Blind, Deaf-Blind or Visually Impaired.* Innovation, Science and Economic Development Canada (ISED), Accessible Technology Program (Total project budget of $765,787)
2019-2021	NSERC/MEDTEQ	$374,366	*Mixed-Reality Platform for Simulation and Synthesis of Multi-Modal Hallucinations with Applications to Schizophrenia Treatment.* Collaborative Research and Development Grant with Industrial Partners, iMD Research and IA Précision Santé Mentale
2019	NSERC	$25,000	*360 degree imaging for navigation assistance for the visually impaired.* Engage Grants Program with Industrial Partner, ImmerVision.

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Date	Source	Amount	Title/Description
2019	Mitacs	$15,000	*Advanced sensor control implementations for energy optimization in commercial buildings using machine learning and data visualisation applied to building automation systems.* Mitacs Accelerate – Intern: Demers, Marc
2019	Mitacs	$6,000	*Facilitating Human Interaction with a Robotic Exercise Coach using Smart Objects.* Mitacs Globalink – Intern: Vyas, Preeti
2018	Mitacs	$6,000	*Mobile Remote Implicit Communication.* Mitacs Globalink: Intern: Blum, Jeff
2018	NSERC	$25,000	*Educational wine recommendations from initially sparse data.* Engage Grants Program with Industrial Partner, Wineout Inc.
2017-2018	McGill	$7500	*Physiological confirmation of stimulus reception.* Faculty of Engineering TechAccelR Grant
2017-2020	NSERC	$631,650	*Wearable Haptics.* Collaborative Research and Development Grant with InterDigital Corporation
2017-2018	CIRA	$44,500	*Intelligent Agent for the Visually Impaired: Vision-based scene description and contextual awareness for Autour.* Canadian Internet Registry Authority .CA Community Investment Program
2017-2022	NSERC	$ 222,000	*Multimodal Influences on Perception and Action in Computer-Mediated Environments.* Discovery grant.
2017-2018	MSP	$177,673	*Social Media Monitoring Architecture.* Research Contract with Ministère de la Sécurité publique
2015	CIRA	$53,878	*What's Around Me? Conveying Environmental Awareness to the Visually Impaired Community.* Canadian Internet Registry Authority .CA Community Investment Program
2014-2015	Mitacs	$15,000	*Effect of Mobile Technologies in Emergency Response.* Mitacs Accelerate – Intern: Erfani-Joorabchi, Minoo
2014	NSERC	$25,000	*Haptic user experience delivered through the shoes.* Engage Grants Program with Industrial Partner, InterDigital Canada
2013-2014	NSERC	$137,474	*3D immersive projection infrastructure with full-body motion capture and analysis.* Research Tools and Instruments Grants
2012-2013	Mozilla	$50,000	*Real-Time Emergency Response.* Mozilla Ignite Development Challenge (in partnership with the National Science Foundation)
2012-2017	NSERC	$210,000	*Improved Shared Reality for Multi-Party, Multimodal Simulation and Interaction.* Discovery grant.

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Date	Source	Amount	Title/Description
2012	Toyota	$30,000	*Haptic interaction with an augmented steering wheel.* Toyota Infotechnology Centre
2011	HP	$60,950	*Capturing attention via spatialized audio cues.* HP Labs Innovation Research Program (IRP)
2011	NSERC	$25,000	*Improved Parallax Barrier Autostereoscopic Display Software.* Engage Grants Program with Industrial Partner, Holoptick Technologies Inc.
2010-2011	Google	$50,000	*A Spatialized Audio Map System for Mobile Blind Users.* Google Faculty Research Awards.
2010-2011	Honda	$30,000	*Facial Expression Recognition for Machines.* Honda Research Institute.
2010	UVic	$8,000	*NEPTUNE Pleora streamer.* University of Victoria software license
2008-2012	MDEIE	$367,195	*Natural Interactive Walking.* Support for International Research and Innovation Initiatives, Ministère du Développement économique, de l'Innovation et de l'Exportation; for Canadian participation in EU FP-7 program with partners in France, Italy, and Denmark.
2007-2010	MDEIE	$15,000	*Un environment virtual pour la création de musique et de son à partir de systèmes chaotiques.* Support for International Research and Innovation Initiatives, Ministère du Développement économique, de l'Innovation et de l'Exportation.
2006-2009	NSERC	$317,785	*A pervasive multi-user augmented space for mobile immersive interaction with sound and music.* (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initative STPGP 337999-06.
2006-2011	NSERC	$100,000	*Enhanced video for shared reality environments.* Discovery grant.
2004-2006	NSERC	$136,600	*Soundscape performance works via interactive environment for immersive audiovisual scene generation.* (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initative NMIPJ 307934-04.
2002-2006	NSERC	$100,000	*Shared Reality Interaction over High Bandwidth Connectivity.* Discovery grant.
2000	LUB	$100,000	*Distributed Visualization Environment.* Laboratoire universitaire Bell Equipment Grant.

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Date	**Source**	**Amount**	**Title/Description**
1999-2000	Petro-Canada	$20,500	*Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.* Young Innovator Award.
1999-2002	FCAR	$45,000	*Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.* New Researchers Award.
1999	FCAR	$15,700	*Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.* Equipment Grant.
1999	AES	$25,000	*Multichannel audio over Internet.* Audio Engineering Society.
1999	OSC	$15,000	*Timespace Exhibit.* Ontario Science Center contract.
1999	MFM	$10,000	*Intelligent Classroom tools.* McGill Faculty of Management.
1998-2002	NSERC	$76,000	*Reactive Hospital Environment.* Discovery research grant.
1998	FGSR	$20,000	McGill Graduate Studies and Research Development Fund

Team Research Grants and Contracts

(Percentages refer to my portion.)

Date	Source	Amount	Title/Description
2024	Societé inclusive	$35,000 (?%)	*Perceptions des utilisateurs ayant une déficience visuelle concernant l'utilisation des électroménagers et la nécessité d'améliorer la connaissance ou l'expérience utilisateur pour des innovations futures* Societé inclusive, Programme de recherche participative intersectorielle (with F. Poncet)
2023	Mitacs	$150,000 (70%)	**Avatar Care Provider for Seniors Residences* Mitacs Accelerate (with K. Moffatt)
2022-2025	CRIAQ	$1,318,171 (35%)	†NSERC Alliance with Consortium for Aerospace Research and Innovation of Québec (CRIAQ) *ADvanced Airspace Usability (ADAIR)* (with P. Doyon-Poulin (Poltechnique), Joon Chung (Ryerson), and 6 aerospace industrial partners)
2020-2021	CIRMMT	$1,500	*Agile Seed Funding for *Conveying paralinguistic cues and context while teleconferencing* (with students David Marino, Max Henry and Pascal Fortin)
2017-2018	SSHRC	$199,680 (10%)	†*Real time impact signalling and collective goods* Partnership Development Grant (with R. Janda and 6 co-investigators)
2016-2017	NAKFI	$100,000 (20%)	*Empathy Mirror* National Academies Keck *Futures Initiative* Art and Science, Engineering and Medicine Grant (with B. Korgel and 3 co-applicants)
2015-2018	FRQNT	$182,880 (25%)	†*Étude des modèles d'interactivité humain-robot en réalité mixte afin de réduire l'apparition des troubles musculo-squelettiques en utilisant une cellule de travail hybride* Recherche en équipes (with M. Otis and 6 co-applicants)
2014	Mozilla	$20,000 (90%)	**Augmented Reality Tools for Improved Training of First Responders* Mozilla Gigabit Community Fund (with R. Dearden)
2011	CIRMMT	$10,000 (90%)	**Acoustic Sculptures* CIRMMT Strategic Innovation Fund Award (with A. Olmos and 3 others)
2010-2011	NSERC	$49,815 (90%)	**Novel Portable Treatment Device for Lazy Eye* Idea to Innovation (I2I) Booster (Phase Ib) (with R. Hess)

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Date	Source	Amount	Title/Description
2009-2011	MSG	$200,000 (80%)	**Location-Based Spatialized Audio Interaction for the Blind and Visually Impaired* Programme Appui au passage à la société de l'information (Support for the transition to an information society program), Ministère des Services gouvernementaux (MSG) (with M. Wozniewski and Z. Settel)
2010-2014	CHRP	$327,000 (?%)	*Computational and statistical tools for image guided neurosurgery of brain tumors* NSERC Collaborative Health Research Projects (with L. Collins and 7 others)
2009-2010	CCSIP	$48,000 (4%)	**Digitally Merged Environments* California-Canada Strategic Initiatives Program (with S. Brown, UCSD and 20 co-applicants)
2009-2011	Canarie	$927,648 (40%)	†*Open Orchestra* Network-Enabled Platforms 2 (with J. Roston and W. Woszczyk)
2010-2014	NCE	$23,000,000 (2%)	†*GRAND: Graphics, Animation and New Media* Networks of Centres of Excellence (With K. Booth and 49 others)
2009	DND	$47,500	†*Video-Based Facial Recognition–Algorithm and Demonstration* Department of National Defence Contract (with M. Levine)
2008-2009	NSERC	$120,250 (90%)	**Novel Portable Treatment Device for Lazy Eye* Idea to Innovation (I2I) (with R. Hess)
2008-2010	Canarie	$1,397,758 (7%)	*NEPTUNE: A Platform to Create and Support Ocean Science Virtual Organizations* Network-Enabled Platforms (with B. Pirenne and J. Roston)
2008-2010	Canarie	$2,000,000 (18%)	*Health Services Virtual Organization* Network-Enabled Platforms (with R. Ellaway and 8 others)
2008-2010	NSERC	$196,000 (50%)	**3-D Visualization and gestural interaction with multimodal neurological data* Strategic Projects (with 5 others)
2006-2009	FRQNT	$146,550 (50%)	**Unités agenceables: Reseau d'Environnements Immersifs pour Collaboration à Distance* Recherche en équipes (with X.-W. Sha)
2005-2006	Canarie	$825,000 (50%)	*Undersea Window–High Definition Video Online* Intelligent Infrastructure Program. (with J. Roston)
2005-2006	SAT	$1,276,000 (1%)	*TOT2: Nouveau Territoires de la Création-Diffusion en Réseau* Heritage Canada New Media Research. (M. Savoie, PI)
2004-2006	Canarie	$568,971 (33%)	*Shared Spaces – High Definition Ultra-Videoconferencing* Advanced Applications Program. (with J. Roston)
2003-2004	SAT	$792,082 (1%)	*TOT1: Nouveau Territoires de la Création-Diffusion en Réseau* Heritage Canada New Media Research. (M. Savoie, PI)

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Date	Source	Amount	Title/Description
2002-2005	IRIS	$573,000 (25%)	**Parallel Distributed Camera Arrays for Intelligent Environments* (with J. Clark, S. Fels, R. Vertegaal)
2002-2005	VRQ	$2,180,000 (20%)	*Real-time Communication Of High-res. Multi-sensory Content via Broadband Networks.* Valorisation-Recherche Quebec (with W. Woszczyk and others)
2001-2002	Canarie	$391,000 (30%)	*Remote Video Sign-Language Interpreting.* Advanced Networking Apps. Services & Technologies. (with J. Roston and others)
2000-2002	Canarie	$808,000 (35%)	*McGill Advanced Learnware Project.* Advanced Networking Applications Services and Technologies. (with B. Pennycook)
2000-2003	LUB	$150,000 (50%)	**Distributed Shared Visualization Environment.* Laboratoire universitaire Bell. (with B. Ozell)
2000-2001	Royal Bank	$2,000 (80%)	**Improving Teaching through an Interactive Critiquing System.* Teaching Improvement Fund Award. (with R. Harris and J. Blatter)
1999-2002	CFI	$400,000 (50%)	†*The Shared Reality Environment.* New Opportunities Award. (with J. Clark)
1999-2000	Royal Bank	$10,000 (80%)	**Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.* TIF (with R. Harris)

*Indicates grants on which I am project leader. †Grant on which I am co-investigator.

Centre Research Grants

Date	Source	Amount	Title/Description
2022-2026	ILLS	$400,000	FRQNT International Laboratory on Learning Systems, funded jointly by CNRS (France) and FRQNT (Quebec), Pablo Piantanida, PI, $100,000 per annum
2021-2028	FRQSC/ FRQNT	$2,712,295	Regroupement Stratégique: *Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie.* (with I. Cossette and 52 others) $276,000 per annum for 2 years and $432,059 per annum for the remainder
2019-2025	FRQNT	$2,160,000	Regroupement Stratégique pour *Systémes cyberphysiques et intelligence machine matérialisée (REPARTI).* (with C. Gosselin and 49 others) $480,000 per annum.
2015	CFI	$4,366,723	Innovation Fund: *Live Expression "in situ": Musical and Audiovisual Performance and Reception* (with M. Wanderley and 9 others)
2014-2021	FRQSC/ FRQNT	$1,800,000	Regroupement Stratégique: *Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie.* (with M. Wanderley and 23 others)
2013-2019	FRQNT	$2,160,000	Regroupement Stratégique pour *l'Étude des Environnements PARTagés Intelligents répartis (REPARTI).* (with D. Laurendeau and 34 others) $359,943 per annum.
2008-2014	FRQSC/ FRQNT	$1,800,000	Regroupement Stratégique: *Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie.* (with S. McAdams and 23 others)
2007-2009	NSERC	$57,630	Major Resources Support: *Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT).* (with S. McAdams and 8 others)
2006-2013	FRQNT	$1,530,000	Regroupement Stratégique pour *l'Étude des Environnements PARTagés Intelligents répartis (REPARTI).* (with D. Laurendeau and 23 others) $100,000 per annum allocated to CIM.
2002-2005	FCAR	$720,000	Regroupement Stratégique: *Réseau Québecois de Recherche en Réalité Artificiellle Distribuée (QUERRAnet).* (with F. Ferrie, R. Bergevin, P. Cohen, and others)
2001	CFI	$6,500,000	Major Facilities Award: *Centre for Integrated Research in Music Media and Technology.* (with W. Woszczyk and 11 others)
2000-2002	FCAR	$113,500	Centre de Recherches. (with F. Ferrie and 17 others)

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Date	Source	Amount	Title/Description
2000	NSERC	$275,000	*Information Systems in Support of Intelligent Machine Research.* (with F. Ferrie and 17 others)

Teaching

Courses Taught

Course title and number	Description	Semester
ECSE-618 *Haptics*	Graduate course on haptic information design, co-taught with other instructors across Canada, under the informal designation of HAPTICS 501	Winter 2021–present
ECSE-421 *Embedded Systems*	Undergraduate course dealing with both the theory and practice of design for embedded systems	2018–present
ECSE-526 *Artificial Intelligence*	Graduate level course in artificial intelligence with emphasis on machine learning and autonomous agents	1998–present
*ECSE-683 *Topics in Vision and Robotics*	Graduate level laboratory course for RoboCup projects	Fall 2000 Fall 2002
*ECSE-424/542 *Human-Computer Interaction*†	Undergraduate (424) and graduate (542) course in human-computer interaction with emphasis on new interface paradigms	2000–present
ECSE-487 *Computer Architecture Laboratory*	Undergraduate laboratory course	1999–2018
ECSE-427 *Operating Systems*	Undergraduate course (core for Computer Engineering students)	1998
CSC-270 *Introduction to Modelling and Optimization*	Computer Science undergraduate course, University of Toronto	1993–1994
CEE 1714Y *Digital Systems and Computers*	Continuing Engineering Education course for the Association of Professional Engineers of Ontario	1993–1994
CSC-228 *File Structures and Data Management*	Computer Science undergraduate course, University of Toronto	1992–1995

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Course title and number	Description	Semester
COSC-3411 *File Structures and Data Management*	Computer Science undergraduate course, York University	1992

*Indicates new course that I created.
†In 2011, a project from this class placed third in the Usability Professionals Association International Student Design Competition. Note that graduate students have also enrolled in this course under the designation of ECSE-681, *Colloquium in Electrical Engineering* or ECSE-689, *Recent Advances in Electrical Engineering*.

Undergraduate Supervision

ECE Honors Undergraduate Projects (2 semesters)

Name	Year	Research topic
Bu, Bruce	2020	360^o Imaging for Navigation Assistance for the Visually Impaired
Akgul, Ahmet	2017-2018	Haptic Wearables
Bashar, Sharhad	2016-2017	Image-based environment description
Wu, Pei Yuan (Richard)	2016	Mixed-Reality Human-Machine Interaction
Gordon, Adam	2011-12	Virtual Presence
Warraich, Shahjahan	2010-11	Natural Interactive Walking
Lin, Nan	2008	Location sensing for mobile apps
Wang, Letao	2007	Interactive Agent
Charlebois, Pierre-Olivier	2004–2005	Sound Objects in a Soundscape
Myer, Sam	2003	Automated Music Transcription
El-Refaei, Sameh	1998–1999	Shared Reality simulator

ECE Undergraduate Design Projects (2 semesters)

Name	Year	Research topic
Archambault, Roxanne	2024-2025	Holoportation: CSA VR Astronaut Training
Dejanov, Aleksej	2024-2025	Holoportation: CSA VR Astronaut Training
Nguyen, Anh Tu	2024-2025	Holoportation: CSA VR Astronaut Training
Turianskyj, Alex	2024-2025	Holoportation: CSA VR Astronaut Training
Lu, Yu-An	2024-2025	AI Digital Nurse Avatar (ADiNA)
Chowdhury, Nazia	2024-2025	AI Digital Nurse Avatar (ADiNA)
Hall, Allison	2024-2025	AI Digital Nurse Avatar (ADiNA)
Gouchee, Annie	2024-2025	AI Digital Nurse Avatar (ADiNA)
Ajji, Maya	2024	AI Digital Nurse Avatar (ADiNA)
Rahman, Nafis	2024	AI Digital Nurse Avatar (ADiNA)
Wang, Jingyi	2024	AI Digital Nurse Avatar (ADiNA)
Zhang, Rong Wei	2024	AI Digital Nurse Avatar (ADiNA)
Srivastava, Atreyi	2024	AI Digital Nurse Avatar (ADiNA)
Ktaily, Nour	2024	AI Digital Nurse Avatar (ADiNA)
Bansal, Pratham	2024	AI Digital Nurse Avatar (ADiNA)
Cattani, Alex	2024	AI Digital Nurse Avatar (ADiNA)
Wang, Bohan	2024	Cybersight
Feng, Shuzhao	2024	Cybersight
Tian, Steven	2024	Cybersight
Wang, Yiqiao	2024	Cybersight
Bebee, Lukas	2023-2024	Force-feedback experiences for IMAGE

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Name	**Year**	**Research topic**
Alexander Tsahageas	2023-2024	Force-feedback experiences for IMAGE
Emma Kawczynski	2023-2024	Force-feedback experiences for IMAGE
Massimo Rosati	2023-2024	Force-feedback experiences for IMAGE
Gurhan, Eren	2023-2024	Vision-guided Navigation Assistance
Yan, Ke	2023-2024	Vision-guided Navigation Assistance
Calitoiu, Mihail	2023-2024	Vision-guided Navigation Assistance
Park, John	2023-2024	Vision-guided Navigation Assistance
Hu, David	2023	Vision-guided Navigation Assistance
Gasmi Ilyes	2023	Vision-guided Navigation Assistance
Habelrih Edward	2023	Vision-guided Navigation Assistance
Arabian Ari	2023	Vision-guided Navigation Assistance
Fathi, Saab	2023	Avatar therapy for psychosis
Ham, Sia	2023	Avatar therapy for psychosis
Choi, Myunghoon	2023	Avatar therapy for psychosis
Kruchinski Almeida, Martin	2023	Avatar therapy for psychosis
Kabir, Anika	2023	Chatting with historical figures
Huynh, Vy-Kha	2023	Chatting with historical figures
Solaberrieta, Emilia	2023	Chatting with historical figures
Cui, Bowen	2022-2023	Immersive multimodal CAVE experience
El Haddad, Georges	2022-2023	Immersive multimodal CAVE experience
Fazal, Gohar Saqib	2022-2023	Immersive multimodal CAVE experience
Mahajan, Madhav	2022-2023	Immersive multimodal CAVE experience
Pan, Edwin	2022-2023	Touching faces in VR
Gosman, Mircea	2022-2023	Touching faces in VR
Justin, Legrand	2022	Vision-guided Navigation Assistance
Sen, Wang	2022	Vision-guided Navigation Assistance
Chamberland, Noah	2022	Vision-guided Navigation Assistance
Natchev Keanu	2022	Novel digital representation of sign language
Arabian Matthias	2022	Novel digital representation of sign language
Destiné, Maxens	2022	Novel digital representation of sign language
Jarvis, Thomas	2022	Natural Dialog Generation for Mental Health
Kong, Norman	2022	Natural Dialog Generation for Mental Health
MacNaughton, Ben	2021-2022	plots data parsing for IMAGE project
Williams, Aidan	2021-2022	plots data parsing for IMAGE project
Nunez, Matteo	2021-2022	Foot-fluid interaction simulation in mobile VR
Comeau, Francis	2021-2022	Foot-fluid interaction simulation in mobile VR
Gure, Kaan	2021-2022	Foot-fluid interaction simulation in mobile VR
Calin, Haluk	2021-2022	ML-based Navigation Assistance
Cano, Victor	2021-2022	ML-based Navigation Assistance
Das Sharma, Kaustav	2021-2022	ML-based Navigation Assistance
Dufault, Louca	2021-2022	ML-based Navigation Assistance
Simard, Felix	2021	detecting benevolent sexism in text
Watson, Tyler	2021	detecting benevolent sexism in text

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Name	**Year**	**Research topic**
Porporino, Anthony	2021	detecting benevolent sexism in tex
Bourbeau, Charles	2021	detecting benevolent sexism in text
Ko, Neroli	2020-2021	haptic dance shoes
Zwack, Noah	2020-2021	haptic dance shoes
Zhang, Weijing	2020-2021	haptic dance shoes
Szwimer, Benjamin	2020-2021	visually impaired access to web graphics
Zoltak, Matthew	2020-2021	visually impaired access to web graphics
Itovitch, Ethan	2020-2021	visually impaired access to web graphics
Weiss, Ben	2020-2021	mixed-reality for schizophrenia treatment
Bieber, Nicolas	2020-2021	mixed-reality for schizophrenia treatment
Khan, Marwan	2020-2021	360^o imaging for navigation assistance
Johansen, Anthony	2020-2021	360^o imaging for navigation assistance
Gurkan, Mert	2020-2021	360^o imaging for navigation assistance
Warsi, Osman	2020-2021	360^o imaging for navigation assistance
Lague, Ethan	2019-2020	AR firefighter situational awareness tools
Masciotra, Alex	2019-2020	AR firefighter situational awareness tools
Philippon, Thomas	2019-2020	AR firefighter situational awareness tools
Bouchard, Tristan	2019-2020	AR firefighter situational awareness tools
Smith, Babette	2019-2020	AR and 360: camera-mediated future
Smith, Lilith	2019-2020	AR and 360: camera-mediated future
Chen, Jennie	2019-2020	Foot-fluid interaction simulation in mobile VR
Servera, Ryan	2019-2020	Foot-fluid interaction simulation in mobile VR
Wong, Tyrone	2019-2020	Foot-fluid interaction simulation in mobile VR
Bluethner, Lucas	2019-2020	Foot-fluid interaction simulation in mobile VR
Volodina, Yuliya	2019	360^o camera scene understanding
Ritch, David	2019	360^o camera scene understanding
Lam, Guillaume	2019	360^o camera scene understanding
Nasseem, Veronica	2019	360^o camera scene understanding
Amjad, Adeeb Ibne	2019	360^o camera supported intersection-crossing
Amarouche, Hakim	2019	360^o camera supported intersection-crossing
Tang, James	2019	360^o camera supported intersection-crossing
Commodari, Stefano	2019	360^o camera supported intersection-crossing
Regimbal, Juliette	2019	Haptic Wearables
Radi, Nusaiba	2019	Haptic Wearables
Berman, Isaac	2018	Vision-based crossing assistance
Mashaal, Stuart	2018	Vision-based crossing assistance
Liu, Shi Yu	2018	Vision-based crossing assistance
Legrand, Augustin	2018	Force Feedback for VR and AR
Fournier, Clément	2018	Force Feedback for VR and AR
Nith, Romain	2018	Force Feedback for VR and AR
Malik, Numan	2017-2018	Variable-Friction Surface Mechanism
Eshaq, Yousef	2017-2018	Variable-Friction Surface Mechanism
Alalawi, Beshr	2017-2018	Variable-Friction Surface Mechanism

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Name	**Year**	**Research topic**
Ahmed, Ridwan	2017-2018	Variable-Friction Surface Mechanism
Nichyporuk, Brennan	2017-2018	AI/vision-based Q&A Dialogue
Benseler, Nick	2017-2018	AI/vision-based Q&A Dialogue
Karatzas, Thomas	2017-2018	Wine recommendation engine
Zhilin, Oleg	2017-2018	Wine recommendation engine
Simard-Morissette, Olivier	2017-2018	Wine recommendation engine
Mirfallah Liarestani, N.	2017	Autour
Kim, Yong Beom	2017	Autour
Gibeault-Girard, Gabriel	2017	AR firefighter display
Velastegui, Nicolas	2017	AR firefighter display
V Cama, Carmen Aimee	2017	AR firefighter display
Dermont, Daniel	2016-2017	Haptic shoes
Makriogiorgos, A.	2016-2017	Haptic shoes
Rohlicek, Greg	2015-2016	Mobile telepresence
Carter, Stephen	2015-2016	Mobile telepresence
Zhang, Zhaowei	2015-2016	Haptic shoes
Huynh, Alex	2015-2016	Haptic shoes
Guzman, Juan	2015-2016	Video analytics
Ali, Hassan	2015-2016	Video analytics
Macario, Daniel	2015-2016	Automated event detection
Arané, Yarden	2015-2016	Automated event detection
Leighton, Brett	2015-2016	Automated event detection
Aird, Nicholas	2015-2016	AR firefighter display
Chen, Yuechuan	2015-2016	AR firefighter display
Lei, Simon	2015-2016	AR firefighter display
Mendonca, Justin	2015-2016	Firefighter IPS
Asfour, Justin	2015-2016	Firefighter IPS
Ward, Thomas	2015-2016	Firefighter IPS
Laramée, Alexandre	2015-2016	Firefighter IPS
Sahib, Shivan	2015-2016	Biosignal wearables
Nath, Saptaparna	2015-2016	Biosignal wearables
Bramson, Shawn	2013–2014	Mobile Telepresence
Larose, Andrew	2013–2014	Mobile Telepresence
Dirik, Alize	2013–2014	Mobile Telepresence
Mansour, Rita	2013–2014	Walking Straight
Elkerdi, Ghalia	2013–2014	Walking Straight
Redel, Josh	2012	Augmented Meeting Collaboration
Savchenko, Eugene	2010	3D interaction

ECE Undergraduate Design Projects (1 semester)

Name	Year
Himmelman, Tristan	2009
Ephraim, Theo	2009
Peck, Benjamin†	2008
Mankarios, Daniel	2007
Konstantinidis, Alex	2007
Pufahl, David	2005
Zhu, Ming-Zhang	2005
Chan, Keng Chi	2005
Phan, Andrew	2004
Saifee, Ali-Akber	2004
Shield, Robert	2004
Aubé, Francois	2004
Rudzicz, Frank	2003
Sarikaya, Deniz	2002
Vallianatos, K.	2002
Hassaine, Sofiane	2002
Wyse, Marisa	2001
Bancroft, David	2001

Name	Year
Glass, Emily	2001
Asselin, Ramy	2001
Sud, Daniel	2001
Gapakov, Timofei	2001
Rosenblatt, Avi	2001
Pekofsky, Gregory	2001
Kitisa, Anousack	2000
Vial, Thibaut	2000
Bernier, Martin	2000
Agha, Khurram Z.	2000
Bhattacharya S.	2000
Lavery, William	2000
Yeung, Jason	2000
Liao, Yuan Mei	1999
Yee, Amy	1999
Pereira, David	1999
Ciambella, Gary	1999
Kassouf, Nadim	1999
Lee, Garvin	1999

Name	Year
Li, (Shao-Gi) Chris	1999
El-Sharif, Osama	1999
Nasereddin, Hazem	1999
Virdi, Gurpratap	1999
Shah, Ali	1999
Djihanian, Sylvie	1999
Moussaoui, Khaled	1999
Dib Youssef	1999
Tam, H.	1999
Gagnon, Gabriel	1999
Tjhin, P.	1999
Luong, Mai	1999
Lau, Sau	1999
Tsai, Wanti	1999
Lerner, Sorin*	1999
Hochstein, Lorin*	1999
Pollack, Jonathan	1998
Nguyen, Bau	1998

*Co-supervised with James Clark
†Co-supervised with Paul Kry

Computer Science Undergraduate Projects (1 semesters)

Lakhwani, Sanjeev	Sep–Dec 2024	Musical Telepresence
Kandlikar-Bloch, Mira	Jun–Aug 2024	AI Digital Nurse Avatar
Gostovic, Lilith	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Newman, James	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Song, Juyeon Olivia	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Chowdhury, Shadman	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Liang, Tina	Jan– Apr 2024	Integrating Attention Detection with Human-Avatar Interaction
Nejad, Namdar	2022	Improving Accessible Representations of Web Graphics
Li, Dailun	2022	Training and Testing an Open-Source French TTS Model

Bioengineering Undergraduate Research Projects (1 semesters)

Wang, Angela	Sep–Dec 2024	Characterizing comfort of wearable band tightness

Mechanical Engineering Undergraduate Design Projects (2 semesters)

Sadaqa, Abdel-Rahman	2020-2021	Haptic illusions
Waite, Emilie	2020-2021	Haptic illusions
Shi, Rock	2020-2021	Haptic illusions
Fitz-Gerald, Thomas	2020-2021	Haptic illusions
Pollet, Nathan	2020-2021	Multimodal haptic armrest
Uzan, Emanuel	2020-2021	Multimodal haptic armrest
Ruivo Patricia	2020-2021	Multimodal haptic armrest
Abravanel Tal	2020-2021	Multimodal haptic armrest
Fowo, Clovis	2017-2018	Haptic interface for the feet
Robert, Gabrielle	2015-2016	Variable friction shoe
King, Michael	2013-2014	Variable Friction Foot-Ground Contact

Undergraduate Internships

Name	Year	Research project
Raza, Abbas	2024	(NYU Abu Dhabi research grant intern) Comparing speech and text interactions with automation in the cockpit
Castrillon Acosta, Isabel	2024	(Mitacs Globalink) Transforming speech into vibrations
Adnaan, Mohammad	2024	(Mitacs Globalink) Autonomous Navigation Assistance for the Visually Impaired
Mandampully, Samyuktha	2024	(Mitacs Globalink) Internet Multimodal Access to Graphical Exploration (IMAGE)
Lu, Calla	Jan–Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Sarellano, Andrés	Sep– Dec 2023	(Tec de Monterrey Undergraduate Research Trainee) Social Telepresence
Moreno Piedra, Balthazar	Sep– Dec 2023	(Tec de Monterrey Undergraduate Research Trainee) Social Telepresence
Tomiuk, Emma	2023	(ARIA Intern) Musical Telepresence
Gunatilaka, Movinya	2023	(Mitacs Globalink) Musical Telepresence
Lavoie, Gabrille	2023	(research trainee) Internet Multimodal Access to Graphical Exploration (IMAGE)
Bessonov, Vladimir	2023	(research trainee)
Phan Antoine	2023	(SURE student) Internet Multimodal Access to Graphical Exploration (IMAGE)
MacInnes, Gabrielle	2023	(SURE student) Internet Multimodal Access to Graphical Exploration (IMAGE)
Abderrahim, Ons	2023	(Mitacs Globalink) Autour
Glavas, Theodore	2023	(NSERC USRA) ChatGPT-based health assistants
Li, Hanzi	2022	(CS Intern) Internet Multimodal Access to Graphical Exploration (IMAGE)
Gutiérrez, Diego Macias	2023	(Mitacs Globalink) Haptic dance shoes
Cortes, Dafne Peña	2023	(Tec de Monterrey Undergraduate Research Trainee) Internet Multimodal Access to Graphical Exploration (IMAGE)
Shen, Xing	2022	(ECE Intern) Vision-Guided Navigation Assistance
Dutta, Riana	2022	(NSERC USRA) Internet Multimodal Access to Graphical Exploration (IMAGE)
Pan, Edwin	2022	(SURE Student) Touching Face in VR
Chen, Hongye	2022	(ECE Intern) Internet Multimodal Access to Graphical Exploration (IMAGE)

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Name	Year	Research project
Behal, Rahul	2021-2022	ML-based Navigation Assistance for the Visually Impaired
Rao Appala, Siddharth	2021	(Mitacs Globalink) Making internet graphics accessible through rich audio and touch
Contreras, Luis F. H.	2021	(Mitacs Globalink) Haptic device for sensory re-education application
Bhayana, Rachit	2021	(NSERC USRA) Conveying Paralinguistic and Non-Verbal Cues in Teleconferencing
Reszetnik, Grace	2021	(NSERC USRA) Avatar therapy for psychosis
Jiang, Cecilia	2021	(NSERC USRA) Avatar therapy for psychosis
Radi, Rakshitha	2021	(ECE Intern) Assistive Technology Project
Marshall, Kenji	2020-21	(ECE Intern) Avatar therapy for psychosis
Pollet, Nathan	2020	(SURE Student) 360^o camera imaging
Bu, Bruce	2019	(SURE Student) Haptic Wearables
Chen, Jennie	2019	(SURE Student) Haptic Wearables
Zhang, Yukai	2019	(SURE Student) Haptic Wearables
Ratnakirti, Navneet	2019	(SURE Student) Sweatsponse
Al Taha, Feras	2018-2019	(NSERC USRA) Haptic Wearables
Nunez, Matteo	2018	(SURE Student) Haptic Wearables
Huang, Yixiang	2018	(SURE Student) Non-Intrusive Mobile Experience Sampling
Li, Zihang	2018	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Kaoubi, Hadir	2018	(Mitacs Globalink) Autour: "What's around me?"
Ma, Jiantong	2018	Haptic Zoom
Tran, Jessica	2017	Social Media Monitoring
Xing, Emily	2017	Attention Switching Protocols in Family Conversations
Hao, Ju	2017	(Mitacs Globalink research intern) Haptic shoes
Lisus, Daniil	2017	(NSERC USRA) Natural Interactive Walking
Tran, Andrew	2016-2017	Multimodal CAVE integration
Sun, Nan Jin (Kelly)	2016-2017	Multimodal CAVE integration
Liu, Yufei (Kevin)	2016	Flexible graphical display of foot-ground interactions
Kashyap, Sumeha	2016	(Summer Intern from Indian Institute of Technology Guwahati) Walking Straight Project

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Name	Year	Research project
Hamed-Baghi, Bobak	2016	(SURE Student) Game Interaction for Haptic Shoes
Dubé, Felix	2016	(SURE Student) Haptic Shoes
Yang, Yanzhe	2015	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Morency-Trudel, Juan	2015	(NSERC USRA) Spatialized audio for environmental awareness for the visually impaired
Liu, Bei Chen	2015	(SURE Student) Haptic in-sole design and implementation
Liu, Shuxuan (Dennis)	2015	Multimodal CAVE integration
Chaudhary, Yetesh	2014	Communication in Emergency and Crisis Response
Pavlasek, Jana	2014	(NSERC USRA) Natural Interactive Walking
Jiang, Mike	2014	(IAESTE student trainee) Graphics Rendering for Multimodal CAVE
Yin, Guofan	2014	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Murgai, Prateek	2014	Acoustic Signal Processing
Sharma, Alok	2013-14	(BITS India Student) rt Emergency Response
Gupta, Sakshi	2013	(SURE Student from Indian Institute of Information Technology, Jabalpur) In-Situ Audio Services
Brais, Robert	2013	(NSERC USRA) Natural Interactive Walking
Gourdy, Oriane	2013	(Grenoble INP Student) 3DUI Interaction
Jain, Nehil	2011-12	(BITS India Student) In-Situ Audio Services
Sutcliffe, Andrew	2011	Haptically Augmented Steering Wheel
Greencorn, Dan	2011	Food Analysis Simulation
Redel, Josh	2011	Open Orchestra
Varenne, Dylan	2011	(Polytech Nice-Sophia), In-Situ Audio Services
Tomiyoshi, Marcio	2011	(ELAP Scholarship Student) Open Orchestra
Beniak, Stephane	2010	(NSERC USRA) Natural Interactive Walking
Salenikovich, Stepan	2010	Natural Interactive Walking
Chaw, Gary	2010	Natural Interactive Walking
Redel, Josh	2010	Health Services Virtual Organization
Smith, Severin	2009-11	Natural Interactive Walking

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Name	Year	Research project
Rajalingham, Rishi	2009	(NSERC USRA) Natural Interactive Walking
Rener, Farid	2009	(SURE Student) Natural Interactive Walking
Bae, Sung	2009	Optical Tracking for Audio Graffiti
Jathal, Kunal	2007	Haptic and auditory perception in human walking
Lin, Nan*	2006	(NSERC USRA) Interactive navigational control of robotic wheelchair
Reiter, Philippe	2005	(VP USRA Student) Distributed Video Rendering
Ariane Chan-You	2003	Region-of-Interest Control in Videoconferencing
Ariane Chan-You	2002	Videoconferencing Data Reduction
Gupta, Greeshma	2000	(NSERC Student) Automated slide converter
Cote, Christian	2000	(NSERC Student) Video transformations
Ayatizadeh, Negah	2000	Network communication daemons
Swartz, Tanya	2000	Speech-based TV-tuner interface
Cohen, Ouri	2000	Classroom 2000 access control
Yeong, Jason Aw	1999	(Work Study) Previously Asked Questions system
Agha, Khurram Zubair	1999	(Work Study) URL access tracking
Lim, Weoi Peng	1999	(Work Study) Graffiti board
Agha, Haroon Ali	1999	(Work Study) Classroom 2000 minipres. system
Klinger, Zamir	2000	(NSERC Student) Automated Door Attendant
Hooshangi, Sara	2000	(NSERC Student) Intelligent Classroom
Liao, Yuan Mei	1999	Electronic Classroom control interfaces
Luo, Jiexin	1999	PowerPoint C2000 interface and image libraries
Zhao, Changpeng	1998-99	Seamless PowerPoint upload for Classroom 2000
Lakdawalla, Azeem	1998-99	Real-time conjugate-gradient based head-tracking

*Co-supervised with Joelle Pineau

Service

University Service

Department Committees

2024-2025	Department Search Committee
2024-2025	Professional Advancement and Recognitions Committee
2020-2022	ECE Unit Lab Access Committee
2017-2018	Undergraduate Recruitment Committee, Chair
2017-2020	Search Committee (Software Engineering, Artificial Intelligence)
2017-2018	Tenure Committee
2015-2025	Safety Committee (Chair in 2015-2017)
2014-2016	Grant Application Support Committee
2012-2024	Graduate Committee
2008-2012	Undergraduate Recruitment Committee
2005-2011	Scholarships/Graduate Student Financing Committee
2002	Ad hoc Committee on Computing Infrastructure for ECE/SOCS
2000-2008	College Liaison Comittee
2001-2004	Information Technologies & Undergraduate Lab
2000-2002	Curriculum Committee
2000	Software Engineering subcommittee
2000-2007	Undergraduate Student Advisor

Other University Service

2024	Chair's representative, Biomedical Engineering PhD Committee meeting
2024	Faculty Mentor, McGill Biomechanics Club
2022-2024	Research Axis Co-lead and Member of CIRMMT Executive Committee
2014-2016	Elected Member of Council, McGill Association of University Teachers
2009-2013	Research Axis Co-lead and Member of CIRMMT Executive Committee
2007-2013	Co-chair, Multimodal Immersive Systems research axis, CIRMMT
2006-2008	Member, CIRMMT Board of Directors
2006	Advisory Committee for Dean of Music
2004	Tomlinson University Science Teaching Project adjudication
2003-2004	Royal Bank Teaching and Learning Innovation Fund adjudication
2003	Groupe de travail sur les normes et standards de la formation en ligne. Conférence des recteurs et des principaux des universités du Québec (CREPUQ), McGill University Representative
2002-2003	SC-IST Workgroup on Research Computing
2000-2003	SC-IST Workgroup on Classroom Design
1999-2004	Engineering Committee on Teaching and Learning
1999	SC-IST McGill Machine Project
1998	Workgroup on Educational Technology

Fundraising Activities

2002	RoboCup demonstration at McCord museum for Dean's Circle
2002	Corporate fundraising for McGill RoboCup team
2001-2002	Intelligent Classroom promotion with the Engineering Class of '50; helped raise $274,000
2001	Trottier Building research promotion

Other Activities

2007-2010	Promotion of Academic Integrity
2001-2002	Design of new Intelligent Classroom systems for ENGMC 304
1999-2002	Maintenance of the Intelligent Classrooms, training other faculty in use of the technology
1999	Curriculum development of three new courses in software engineering

Professional Activities

Service to the Community

2023-2024	Local Events Organizer, 2024 IEEE Cognitive and Computational Aspects of Situation Management (CogSIMA)
2023	Sponsorship and Exhibits Co-Chair, 2024 IEEE Haptics Symposium
2019	Government of Canada, Network of Canadian Experts on Virtual Reality
2018	Consulted by Ordre des ingénieurs du Québec regarding the OIQ's position on AI
2018	Invited Member, Fonds de recherche, Chantier sur l'intersectorialité et la créativité
2018	Co-chair, ACM SIGCHI Demonstrations
2017	External member of academic selection committee, École de technologie supérieure
2016	Organizing Committee, IEEE International Workshop on Multimedia Signal Processing, Special Session on Multimodal Interaction with Digital Information in Smart Cities
2016,2019	Selection Committee, Bill Buxton HCI Thesis Award
2016	Digital Media Program Review, York University
2016	Critique of TCPS CORE Tutorial on Research Ethics (Secretariat agreed to remove problematic question associated with the Zimbardo study)
2010-2015	Theme Leader, Enabling Technologies, Graphics Animation and New Media (GRAND) Networks of Centres of Excellence
2010-ongoing	Voting Member, IEEE Communication Society Multimedia Communications Technical Committee (IEEE MMTC)
2009	Organizer and Chair, AES Workshop on Network Technologies for Audio over IP
2008	Tenure Portfolio evaluation, York University
2005-2006	Organizer, AES Tutorial and Workshop on Human Factors in Audio
2004	Founder, AES Technical Committee for Human Factors in Audio Systems
2003	Organizer, Workshop on LAN Delivery of Audio for AES
2002-2003	Comité Scientifique de Robofolies, Centre Science de Montreal
2001	Local Events Organizer, Autonomous Agents Conference, Montreal
2001-2009	Chair, AES Technical Committee for Network Audio Systems
2000-2004	Scientific Organizer, RoboCup Junior, Montreal
2000-2001	Organizing Committee, Robofesta International Robot Games Festival, Japan
1999-2000	Member and Webmaster, Canadian Virtualized Reality Working Group
1998	Co-organizer, AAAI Symposium on Intelligent Environments

Editorial Service

2025-ongoing	Associate Editor-in-Chief, IEEE Transactions on Haptics
2021-2024	Associate Editor, IEEE Transactions on Haptics
2021	Senior Program Committee, International Conference on Multimodal Interaction
2021	Guest Editor, IEEE Transactions on Haptics (WHC track)
2020-ongoing	Associate Editor, Frontiers in Virtual Reality
2019, 2025	Associate Editor, World Haptics Conference
2019	Guest Editor, Multimodal Technologies and Interaction, Special Issue on Multimodal Medical Alarms
2018-2022	Associate Editor, Program Committee member, Haptics Symposium
2013	Guest Editor, Journal of the Audio Engineering Society, Special Issue on Audio Networking
2008-2022	Associate Editor, Journal of the Audio Engineering Society

Journal Referee

2025	Springer Nature Discover Computing
2022	IEEE Multimedia
2021	ACM Transactions on Human-Computer Interaction
2020-21	ACM Transactions on Applied Perception
2020	ACM Interactive, Mobile, Wearable and Ubiquitous Technologies
2019	Frontiers in Neurobotics
2018	Peer J–Journal of Life & Environmental Sciences
2017	Sensor Review
2015	Ambient Intelligence and Smart Environments
2010-20	IEEE Transactions on Haptics
2012	International Journal on Acoustics
2011	BMC Medical Informatics and Decision Making
2011	IEEE Software
2010	IEEE Transactions on Affective Computing
2010	IEEE Transactions on Robotics
2010	IEEE Signal Processing Magazine
2009	IEEE Transactions on Robotics
2008	EURASIP Advances in Signal Processing
2008	EURASIP Image and Video Processing
2008-ongoing	Audio Engineering Society
2007	IEEE Transactions on Systems, Man, and Cybernetics
2006	International Journal of Human-Computer Interaction
2006	Springer Virtual Reality
2005	Elsevier: Computers and Education
2005	Elsevier: Image and Vision Computing
2004, 2019	IEEE Pervasive Computing
2000, 2003	Wiley Journal of Robotic Systems
1999	ACM Transactions on Computer-Human Interaction
1999	IEEE Transactions on Robotics and Automation
1998	IEEE Personal Communications

Conference Review

2024	IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA)
2023	ACM/IEEE Human-Robot Interaction
2020	IEEE Virtual Reality
2018, 2020, 2024	ACM SIGCHI User Interface Systems and Techniques
2018	Workshop on Assistive Computer Vision and Robotics
2018	Eurohaptics
2017	International Conference on Auditory Display
2017	Mobile HCI
2017-19	IEEE World Haptics
2016	IEEE International Workshop on Multimedia Signal Processing
2015	ACM Multimedia
2015	INTERACT
2014	ACM SIGGRAPH
2012, 2013	Workshop on Context Based Affect Recognition
2012, 2013	International Society for Presence Research
2012	IEEE Canadian Conference on Electrical and Computer Engineering
2011	AES Conference on Audio Networking
2011	Intelligent Robots and Systems
2011	VRIC Wkshop on Haptics for Telepresence, Teleoperation & Collab. Environments
2009	IEEE Haptics Symposium
2009	International Computer Music Conference
2009	Stereoscopic Displays and Applications
2008-19	ACM SIGCHI Human Factors in Computing
2008	Immersive Medical Telepresence
2006	International Conference on Digital Audio Effects
2006, 2007	IEEE Workshop on Projector-Camera Systems (part of CVPR)
2005-2009	Canadian Conference on Computer and Robot Vision
2004, 2009-14, 2016	Graphics Interface
2003, 2006	Audio Engineering Society
2003	New Interfaces for Musical Expression
2002	RoboCup International Symposium
2002, 2015	IEEE International Conference on Robotics and Automation
2001	ACM UbiComp
2001	IEEE International Conference on Computer Vision

Grant Review

2017	NSERC Strategic Project Grants
2017	Member of Expert Committee, CFI Innovation Fund
2016	L'Agence Nationale de la Recherche (France)
2011	NSERC Collaborative Research and Training Experience Program (CREATE)
2009, 2011	Mathematics of Information Technology and Complex Systems (MITACS)
2009	NSERC Strategic Networks (Site Visit Chair)
2008, 2015, 2017	Peer review, NSERC Collaborative Research and Development Grants
2007-2008	NSERC Industrial Research Chair (Site Visit)
2007-2020	Research Grants Council, Hong Kong
2005	NSERC Steacie Memorial Fellowship
2002, 2005-2008	Panel member, NSERC/Canada Council, New Media Initiative
2001-2017	Peer review, NSERC Discovery Grants
2001, 2008	Peer review, CFI (Canada Foundation for Innovation)

Participation in Academic Fora

2019	San Diego Opera – Opera Hack, July 27-28
2019	Dagstuhl Seminar on Ubiquitous Computing Education, June 2-7
2010	Participant, NSF/CCC Workshop on Ultra-Large Scale Interaction

Service to Society

Organizations for People with Disabilities

2024	foster parent for Mira Foundation service dog in training

Consumer Rights' Advocacy

2013	brought successful appeal (2013 QCCA 1670) before Quebec Court of Appeal regarding anti-SLAPP legislation
2013	initiated petition to improve rights of Canadian airline passengers
2010	advocating for reliable public transportation in Montreal
1997-2019	created and maintained passenger rights website