CURRICULUM VITA

Michael S. Braasch

Education: B.S.E.E., 1988   Ohio University

                M.S.E.E., 1989   Ohio University
                                    Title of Thesis: <u>Current Developments In Signal
                                    Modeling Of The Precision Distance Measuring
                                    Equipment</u>.

                Ph.D. in E.E., 1992 Ohio University
                                    Title of Thesis: <u>On The Characterization Of
                                    Multipath Errors In Satellite-Based Precision
                                    Approach and Landing Systems</u>.

Professional Registration:

        Licensed Professional Engineer (P.E.) in the State of Ohio.

Employment:

        <u>Professor</u>, School of Electrical Engineering and Computer Science, Ohio
        University, Athens, Ohio, September 2003 to present. Appointed as the Neil D.
        and Bernice E. Thomas Professor of Engineering, September 2004.

        <u>Adjunct Professor</u>, Department of EECS, Embry-Riddle Aeronautical University,
        Daytona Beach, Florida, Fall 2020.

        <u>Visiting Erskine Fellow</u>, University of Canterbury, Christchurch, New Zealand,
        July – November 2017.

        <u>Director</u>, Avionics Engineering Center, School of Electrical Engineering and
        Computer Science, Ohio University, Athens, Ohio, October 2007 to May 2011.

        <u>Interim Director</u>, Avionics Engineering Center, School of Electrical Engineering
        and Computer Science, Ohio University, Athens, Ohio, January 2007 to
        September 2007.

        <u>Associate Professor</u>, School of Electrical Engineering and Computer Science,
        Ohio University, Athens, Ohio, September 1999 to August 2003.

        <u>Assistant Professor</u>, School of Electrical Engineering and Computer Science,
        Ohio University, Athens, Ohio, January 1994 to August 1999.

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Adjunct Assistant Professor, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, July 1993 to December 1993.

Visiting Scientist, Delft University of Technology, Delft, The Netherlands. December 1992 to May 1993.

Research Engineer, Avionics Engineering Center, Ohio University, Athens, Ohio. December 1989 to June 1993.

Graduate Fellow, Avionics Engineering Center, Ohio University, Athens, Ohio. June 1988 to November 1989.

Undergraduate Intern, Avionics Engineering Center, Ohio University, Athens, Ohio, September 1985 to June 1988.

Academic Specialization:

Antenna Theory
Communications and Digital Signal Processing
Electromagnetic Theory

Professional Specialization:

Electronic Navigation Receiver Design
Electronic Navigation System Engineering
Inertial Navigation Systems (INS)
Integrated Navigation Systems
Satellite-Based Navigation Systems with emphasis in GPS
Unmanned Aerial Vehicle (UAV) navigation and safety considerations

Honors:

First runner-up for Best Presentation at the 2nd International Meeting of the Satellite Division of the Institute of Navigation, September 1989.

1992 RTCA William E. Jackson Award (an international award given in recognition of an outstanding publication on aviation electronics).

1997 Ohio University EECS Outstanding Graduate Faculty Award.

1997-98 Ohio University EECS School Research Award.

1997-98 Ohio University Russ Engineering College Outstanding Research Paper Award.

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2009 Selected as Fellow of the U.S. Institute of Navigation

2016 Best-of-Session Paper at the Digital Avionics Systems Conference for "Flight-Test Evaluation of Small Form-Factor LiDAR and Radar Sensors for sUAS Detect-and-Avoid Applications," co-authored with M. Uijt de Haag and C. Bartone.

2019 – present: IEEE Aerospace and Electronic Systems Society Distinguished Lecturer

2023 Elevated to IEEE Fellow

Professional Memberships:

Member, Institute of Electrical and Electronics Engineers (Fellow)
Member, Institute of Navigation (Fellow)
Member, Tau Beta Pi

Research Grants and Contracts:

U.S. Department of Transportation (DOT) Volpe National Transportation Systems Center (VNTSC), "DME/P Signal Model Development and Integration with Refined Angle Signal Model," $81,000, 1990-92, Principal Investigator: R. Lilley (project was conducted entirely by M. Braasch).

U.S. DOT Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA), "Integrated Avionics Technology Development: Joint University Program in Air Transportation Research," $110,000, 1990-91, Principal Investigator: R. Lilley (grant was managed by M. Braasch).

U.S. DOT VNTSC, "Satellite-Based System Precision Approach Issues," $264,997, 1991-92, Principal Investigator: F. Van Graas (responsibility for this contract was shared with M. Braasch and T. Skidmore).

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program in Air Transportation Research," $75,320, 1991-92, Principal Investigator: R. Lilley (grant was managed by M. Braasch).

U.S. DOT FAA and NASA, "Joint University Program for Air Transportation Research," $75,989, 1993-94, Principal Investigator: R. Lilley (grant was managed by M. Braasch).

Boeing Commercial Airplane Company, "D/GPS Signal Model Enhancement and Validation," $48,682, 1994-1995, Principal Investigator: M. Braasch.

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Mayflower Communications/U.S. Air Force/Wright Lab, "Multipath Mitigation Investigations to Support Enhanced GPS," $35,000, 1995, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program in Air Transportation Research," $149,999, 1995-98, Principal Investigator: R. Lilley, co-PI: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 1995-1996, Principal Investigator: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $15,000, 1995, Principal Investigator: M. Braasch.

Boeing Commercial Airplane Company, "D/GPS Signal Model Enhancement and Validation in Support of GNSS Investigations," $99,945, 1996, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 1996-1997, Principal Investigator: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $80,000, 1996, Principal Investigator: M. Braasch.

Boeing Commercial Airplane Company, "D/GPS Signal Model Enhancement and Validation in Support of GNSS Investigations - Year Two," $171,493, 1997, Principal Investigator: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $80,000, 1997, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $135,000, 1997-1998, Principal Investigator: M. Braasch, Co-PI: J. Dill.

Megapulse, "Development and Testing of Antenna and Receiver Components Related to Navigation Using Loran-C and GPS," $49,000, 1997-1998, Principal Investigator: R. Lilley, co-PI: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $100,000, 1998-99, Principal Investigator: J. Rankin, co-PI: M. Braasch.

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Rockwell-Collins, "Multipath Mitigation Studies," $50,000, 1998, Principal Investigator: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $80,000, 1998, Principal Investigator: M. Braasch.

Boeing Commercial Airplane Group, "GPS Implementation Issues," $125,255, 1999, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 1998-1999, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Joint University Program for Air Transportation Research," $107,000, 1999-2000, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $80,000, 1999, Principal Investigator: M. Braasch.

Boeing Commercial Airplane Group, "GPS/INS Integration and VHF Data Broadcast Studies," $160,000, 2000, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 1999-2000, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $107,000, 2000-2001, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $40,000, 2000, Principal Investigator: M. Braasch.

SAIC, "AGNS Test Station Architecture Design," $60,000, 2000-2001, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 2001, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Joint University Program for Air Transportation Research," $126,666, 2001-2002, Principal Investigator: J. Rankin, co-PI: M. Braasch.

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Boeing Commercial Airplane Group, "GPS/INS Integration, VHF Data Broadcast and Air Traffic Management Studies," $160,000, 2001-2002, Principal Investigator: M. Braasch.

Honeywell, Inc., "Inertial Navigation - GPS/DGPS Studies," $40,000, 2001, Principal Investigator: M. Braasch, Principal Investigator: M. Braasch.

U.S. DOT FAA, "GPS Interference Mitigation via Exploitation of Software Radio Techniques," $198,670, 2001-2002, Principal Investigator: M. Braasch.

Air Force Office of Scientific Research/Wright Lab, "L1-Band Receivers: Design, Simulation and Implementation," $50,000, 2002, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $133,666, 2002-2003, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Honeywell, "Inertial Navigation – GPS/DGPS Studies," $40,000, 2002-2003, Principal Investigator: M. Braasch.

Honeywell, "GPS Software Radio Support," $20,000, 2002-2003, Principal Investigator: M. Braasch.

Honeywell, "GPS Software Radio Support," $74,991, 2003-2004, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $133,666, 2003-2004, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Honeywell, "Inertial Navigation – GPS/DGPS Studies," $40,000, 2003-2004, Principal Investigator: M. Braasch.

Athena Technologies, Inc., "High Dynamic Flight Testing of Athena Technologies GPS/ADAHRS, $14,125, 2004, Principal Investigator: M. Braasch.

Honeywell, "Flight Testing of Honeywell (HI) Integrated F-15 GPS/INS Unit," $40,661, 2004, Principal Investigator: M. Uijt de Haag, Co-PI: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $133,666, 2004-2005, Principal Investigator: J. Rankin, co-PI: M. Braasch.

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Honeywell, "GPS Software Radio Support," $75,000, 2004-2005, Principal Investigator: M. Braasch.

Honeywell, "Inertial Navigation – GPS/DGPS Studies," $25,000, 2004-2005, Principal Investigator: M. Braasch.

Athena Technologies, Inc., "High Dynamic Flight Testing of Athena Technologies GPS/ADAHRS, $3,000, 2005, Principal Investigator: M. Braasch.

Honeywell, "The Basic Theory of Dithered versus Non-Dithered Gyros," $8,400, 2005-2006, Principal Investigator: M. Braasch.

Honeywell, "Inertial Navigation – GPS/DGPS Studies," $25,000, 2005-2006, Principal Investigator: M. Braasch.

U. S. Air Force Office of Scientific Research, "Unmanned Aerial Vehicle Swarming and Formation Flight Navigation via LiDAR/INS," $14,976, Principal Investigator: M. Braasch.

U.S. DOT FAA and NASA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $133,666, 2005-2006, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Northrop Grumman, "Precision AIME Program," $60,107, 2005-2006, Co-Principal Investigators: M. Braasch and F. van Graas.

Northrop Grumman, "Precision AIME Program," $162,842, 2006, Co-Principal Investigators: M. Braasch and F. van Graas.

Northrop Grumman, "Precision AIME Program," $95,866, 2006-2007, Co-Principal Investigators: M. Braasch and F. van Graas.

L-3 Communications/Interstate Electronics, "Development of an RF Simulation Capability," $77,000, 2006-2007, Principal Investigator: M. Braasch

U.S. DOT FAA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $60,000, 2006-2007, Principal Investigator: J. Rankin, co-PI: M. Braasch.

Rockwell Collins, "Multi-Sensor Integration for Autonomous Vehicle Relative Navigation," $80,000, 2007, Principal Investigators: M. Braasch and M. Uijt de Haag.

U.S. DOT FAA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $100,000, 2007-2008, Principal

Investigator: M. Braasch.

U.S. DOT FAA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $150,000, 2008-2009, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $129,000, 2009-2010, Principal Investigator: M. Braasch.

Northrop Grumman, "Engineering Support," $130,000, 2009-2010, Principal Investigator: M. Braasch

U.S. DOT FAA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $150,000, 2009-2010, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $231,000, 2010-2011, Principal Investigator: M. Braasch.

U.S. DOT FAA, "Integrated Avionics Technology Development: Joint University Program for Air Transportation Research," $150,000, 2010-2011, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $245,000, 2011-2012, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $357,000, 2012-2013, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $373,050, 2013-2014, Principal Investigator: M. Braasch.

Kearfott Corporation (Guidance & Navigation Division), "Sensor and System Trade Studies Support," $11,549, 2014.

Northrop Grumman, "Scholar-in-Residence Program," $323,879, 2015, Principal Investigator: M. Braasch.

Honeywell International, "Inertial Navigation GPS/DGPS Studies," $20,000, 2015, Principal Investigators: C. Bartone, M. Braasch, M. Uijt de Haag.

Kearfott Corporation (Guidance & Navigation Division), "Navigation Courses," $17,000, 2016, Principal Investigator: M. Braasch.

Northrop Grumman, "Scholar-in-Residence Program," $807,766, 2016-2020,

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Principal Investigator: M. Braasch.

Federal Aviation Administration, "Navigation Programs, RTCA Wide Area Augmentation System Support," $70,000, 2016-2018, Principal Investigator: M. Braasch

Federal Aviation Administration, "Navigation Programs, Antenna, Navigation, Radar and ILS, Concept Courses," $751,000, 2017-2018, Principal Investigator: M. DiBenedetto, Co-PIs: S. Odunaiya, M. Braasch (20% responsibility for Braasch)

Honeywell Inc., "Gravity Modeling in Support of RTCA SC-159 WG-2C," $40,000, 2020-2022, Principal Investigator: M. Braasch

Northrop Grumman, "Scholar-in-Residence Program," $702,093, 2021-2023, Principal Investigator: M. Braasch.

Supernal, "Supernal Flight Testing," $223,283, 2022-2023, Co-Principal Investigators: M. Braasch and S. Ugazio.

Publications:

Journal Articles

Braasch, M., "A Signal Model for GPS," Navigation: Journal of The Institute of Navigation, Vol. 37, No. 4, Winter 1990-91.

Van Graas, F. and M. Braasch, "GPS Interferometric Attitude and Heading Determination: Initial Flight Test Results," Navigation: Journal of The Institute of Navigation, Vol. 38, No. 4, Winter 1991-92.

Braasch, M., "Isolation of GPS Multipath and Receiver Tracking Errors," Navigation: Journal of the Institute of Navigation, Vol. 41, No. 4, Winter 1994-95.

Murphy, T., Snow, R. and M. Braasch, "GPS Multipath on Large Commercial Air Transport Airframes," NAVIGATION: Journal of the Institute of Navigation, Vol. 43, No. 4, Winter 1996-97.

Braasch, M., "Autocorrelation Sidelobe Considerations in the Characterization of Multipath Errors," IEEE Transactions on Aerospace and Electronic Systems, Vol. 33, No. 1, January 1997.

McGraw, G. and M. Braasch, "Modeling of Tracking Loop Noise and Dynamics for Efficient Simulation of Spread Spectrum Ranging Systems," IEEE Transactions on Aerospace and Electronic Systems, Vol. 34, No. 3, July 1998.

Braasch, M. and A. J. Van Dierendonck, "GPS Receiver Architectures and Measurements," Proceedings of the IEEE, Vol. 87, No. 1, January 1999.

Braasch, M. and M. DiBenedetto, "Spread-Spectrum Ranging Multipath Model Validation," IEEE Transactions on Aerospace and Electronic Systems, Vol., 37, No. 1, January 2001.

Kelly, J., Braasch, M. and M. DiBenedetto, "Characterization of the Effects of High Multipath Phase Rates in GPS," GPS Solutions, Vol. 7, No. 1, 2003, pp. 5 - 15.

Thornberg, D. B., Thornberg, D. S., DiBenedetto, M., Braasch, M., Van Graas, F. and C. Bartone, "The LAAS Integrated Multipath Limiting Antenna (IMLA)," NAVIGATION: Journal of the Institute of Navigation, Vol. 50, No. 2, Summer 2003.

Kalyanaraman, S., Braasch, M. and J. Kelly, "Code Tracking Architecture Influence on GPS Carrier Multipath," IEEE Transactions on Aerospace and Electronic Systems, Vol., 42, No. 2, April 2006, pp. 548 – 561.

Kalyanaraman, S. and M. Braasch, "GPS Adaptive Array Phase Compensation Using a Software Radio Architecture," NAVIGATION: Journal of the Institute of Navigation, Vol. 57, No. 1, Spring 2010.

Needham, T. and M. Braasch, "Gravity Modeling in GNSS-Aided Inertial Navigation System Safety Certification," NAVIGATION: Journal of the Institute of Navigation, Vol. 69, No. 2, June 2022.

Refereed Conference Papers

Braasch, M., "Performance Comparison of Multipath Mitigating Receiver Architectures," 2001 IEEE Aerospace Conference, Big Sky, MT, March 2001.

Kelly, J. and M. Braasch, "Validation of Theoretical GPS Multipath Bias Characteristics," 2001 IEEE Aerospace Conference, Big Sky, MT, March 2001.

Cutright, C. and M. Braasch, "GPS and INS Flight Test Instrumentation of a Fully Aerobatic Turbojet Aircraft," 2002 IEEE Aerospace Conference, Big Sky, MT, March 2002.

Burch, D. and M. Braasch, "Multi-View Head-Up Synthetic Vision Display System," 2003 IEEE Aerospace Conference, Big Sky, MT, March 2003.

Chakrabarty, J., Burch, D., Kalyanaraman, S. and M. Braasch, "Multi-View Synthetic Vision Display System for General Aviation," 2004 IEEE Aerospace Conference, Big Sky, MT, March 2004.

Kalyanaraman, S., Braasch, M., Kelly, J. and J. Kacirek, "Influence of GPS Code Tracking on Carrier-Phase Multipath Performance," 2004 IEEE Aerospace Conference, Big Sky, MT, March 2004.

Needham, T. and M. Braasch, "Impact of Gravity Modeling Error on Integrated GNSS/INS Coasting Performance," IEEE/AIAA Digital Avionics Systems Conference, St. Petersburg, FL, September 2017.

Book Chapters

Braasch, M., "Multipath Effects," Chapter 14 of Global Positioning System: Theory and Applications, Vol. 1, edited by B. Parkinson, J. Spilker, Jr., P. Axelrad and P. Enge, American Institute of Aeronautics and Astronautics, Washington, D.C., 1996.

Van Graas, F. and M. Braasch, "Selective Availability," Chapter 17 of Global Positioning System: Theory and Applications, Vol. 1, edited by B. Parkinson, J. Spilker, Jr., P. Axelrad and P. Enge, American Institute of Aeronautics and Astronautics, Washington, D.C., 1996.

Braasch, M., "Inertial Navigation Systems," Chapter 1 of Aerospace Navigation Systems, edited by A. Nebylov and J. Watson, Wiley, 2016.

Braasch, M., "Multipath," Chapter 15 of Springer Handbook of Global Navigation Satellite Systems, edited by P. Teunissen and O. Montenbruck, Springer International Publishing, Cham, Switzerland, 2017.

Conference Papers

Braasch, M., "A Signal Model For The Global Positioning System," ION GPS '89, Colorado Springs, Colorado, September 1989.

Van Graas, F. and M. Braasch, "GPS Interferometric Attitude and Heading Determination: Initial Flight Test Results," Proceedings of the 47th Annual Meeting of the Institute of Navigation, Williamsburg, VA, June 1991.

Braasch, M. and F. van Graas, "Guidance Accuracy Considerations for Realtime GPS Interferometry," ION GPS-91, Albuquerque, NM, September 1991.

Braasch, M. and F. van Graas, "Mitigation of Multipath in DGPS Ground Reference Stations," Proceedings of the Institute of Navigation National Technical Meeting, San Diego, CA, January 1992.

Braasch, M., "Characterization of GPS Multipath Errors in the Final Approach Environment," Proceedings of ION GPS-92, Albuquerque, NM, September 1992.

Braasch, M., Fink, A. and K. Duffus, "Improved Modeling of GPS Selective Availability," Proceedings of the ION National Technical Meeting, San Francisco, CA, January 20-22, 1993.

Braasch, M., "Isolation of GPS Multipath and Receiver Tracking Errors," Proceedings of the ION National Technical Meeting, San Diego, CA, January 24-26, 1994.

Braasch, M., "The All-Purpose D/GPS Signal Model," Proceedings of the ION National Technical Meeting, San Diego, CA, January 24-26, 1994.

Braasch, M., "Optimum Antenna Design for DGPS Ground Reference Stations," Proceedings of ION GPS-94, Salt Lake City, UT, September 1994.

McGraw, G. and M. Braasch, "GPS Receiver Tracking Loop Modeling to Support Autoland Simulations," Proceedings of the ION National Technical Meeting, Santa Monica, CA, January 22-24, 1996.

Braasch, M., "GPS Multipath Model Validation," Proceedings of the IEEE Position, Location and Navigation Symposium, PLANS >96, Atlanta, GA, April 22-25, 1996.

Akos, D. and M. Braasch, "A Software Radio Approach to Global Navigation Satellite System Receiver Design," Proceedings of the ION Annual Meeting, Cambridge, MA, June 19-21, 1996.

Braasch, M., and W. Huang, "GNSS and the L System: Truly Global Partners," Proceedings of the ION Annual Meeting, Cambridge, MA, June 19-21, 1996.

Akos, D. and M. Braasch, "Global Navigation Satellite System Software Radio Receiver Implementation," Proceedings of the ION GPS-96, Kansas City, MO, September 17-20, 1996.

Hill, S. and M. Braasch, "Achieving CAT IIIB Through UHF Augmentation," Proceedings of the ION GPS-96, Kansas City, MO, September 17-20, 1996.

Huang, W. and M. Braasch, "GNSS and the New Loran: Global Partners for the Next Century," Proceedings of the International Loran Association Technical Symposium, San Diego, CA, November 3-7, 1996.

Van Dierendonck, A. and M. Braasch, "Evaluation of GNSS Receiver Correlation Processing Techniques for Multipath and Noise Mitigation," Proceedings of the Institute of Navigation National Technical Meeting, Santa Monica, CA, January 14-16, 1997.

Braasch, M., Akos, D., Caschera, J., Stockmaster, M. and J. Tsui, "Test Results from a Direct L-Band Digitizing GPS/Glonass Receiver," Proceedings of the Institute of Navigation National Technical Meeting, Santa Monica, CA, January 14-16, 1997.

Braasch, M., Snyder, C. and R. Olin, "Ranging Accuracy Considerations in GPS Interference

Suppression," Proceedings of the Tenth International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GPS-97), Kansas City, MO, September 16-19, 1997.

Braasch, M., Snyder, C. and R. Olin, "GNSS Interference Suppression," Proceedings of the Ninth World Congress of the International Association of Institutes of Navigation, Amsterdam, The Netherlands, November 18-21, 1997.

Rosen, M. and M. Braasch, "Low-cost GPS Interference Mitigation Using Single Aperture Cancellation Techniques," Proceedings of the Institute of Navigation National Technical Meeting, Long Beach, CA, January 21-23, 1998.

Kanekal, S. and M. Braasch, "Multipath Mitigation with Gated Signal Technique," Proceedings of the ION Annual Meeting, Denver, CO, June, 1998.

Seitz, A. and M. Braasch, "High Fidelity GPS Receiver Simulation," Proceedings of the ION Annual Meeting, Denver, CO, June, 1998.

McGraw, G. and M. Braasch, "GNSS Multipath Mitigation Using Gated and High Resolution Correlator Concepts," Proceedings of the Institute of Navigation National Technical Meeting, San Diego, CA, January 25-27, 1999.

Kelly, J. and M. Braasch, "Mitigation of GPS Multipath via Exploitation of Signal Dynamics," Proceedings of the Institute of Navigation Annual Meeting, Cambridge, MA, June 28-30, 1999.

Kelly, J. and M. Braasch, "Validation of GPS Fading Multipath Effects through Modeling and Simulation," Proceedings of the Institute of Navigation National Technical Meeting, Anaheim, CA, January 26-28, 2000.

Braasch, M., DiBenedetto, M., Braasch, S. and R. Thomas, "LAAS Operations in Support of Airport Surface Movement, Guidance, Control, and Surveillance: Initial Test Results," Proceedings of the IEEE Position, Location and Navigation Symposium (PLANS 2000), San Diego, CA, March 2000.

Dubinsky, J., Braasch, M. and Uijt de Haag, M., "Advanced Flight Display for General Aviation Aircraft: A Cost-Effective Means to Enhance Safety," Proceedings of the Institute of Navigation Annual Meeting, Albuquerque, NM, June 2001.

Burns, C., Cutright, C. and M. Braasch, "Investigation of GPS Software Radio Performance in Combating Narrow Band Interference," Proceedings of the Institute of Navigation Annual Meeting, Albuquerque, NM, June 2002.

Thornberg, D. B., Thornberg, D. S., DiBenedetto, M., Braasch, M., Van Graas, F. and C. Bartone, "The LAAS Integrated Multipath Limiting Antenna (IMLA)," Proceedings of the Fifteenth International Meeting of the Satellite Division of the Institute of Navigation (ION GPS-2002), Portland, OR, September 2002.

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Burch, D. and M. Braasch, "Enhanced Head-Up Display for General Aviation Aircraft," Proceedings of the Digital Avionics System Conference, Irvine, CA, October 2002.

Cutright, C., Burns, J. and M. Braasch, "Characterization of Narrow-Band Interference Mitigation Performance Versus Quantization Error in Software Radios," Proceedings of the Institute of Navigation Annual Meeting, Albuquerque, NM, June 2003.

Kalyanaraman, S. and M. Braasch, "GPS Carrier-Phase Multipath Model Validation," Proceedings of the Institute of Navigation Annual Meeting, Albuquerque, NM, June 2003.

B. Schipper, M. Braasch, J. Campbell and S. Nair, "A testbed for frequency domain GPS acquisition and receiver simulation," 2004 IEEE Position, Location and Navigation Symposium (PLANS), Monterey, CA, April 2004.

Kalyanaraman, S. and M. Braasch, "Fading Multipath Reduction via FLL-aided Code Tracking in GPS," Proceedings of the Institute of Navigation Annual Meeting, Dayton, OH, June 2004.

Braasch, M. and F. van Graas, "Avionics Education and Research at Ohio University," Proceedings of the Institute of Navigation Annual Meeting, Dayton, OH, June 2004.

Kephart, J., Cutright, C. and M. Braasch, "Precise Positioning and Attitude Determination in High Dynamic Flight Testing," 2005 American Astronautical Society Guidance and Control Conference, Breckenridge, CO, February 2005.

Braasch, M. and M. Uijt de Haag, "GNSS for LEO, GEO, HEO and Beyond," 2006 American Astronautical Society Guidance and Control Conference, Breckenridge, CO, February 2006.

Kalyanaraman, S. and M. Braasch, "Phase Compensation in GPS Array Processing Using a Software Radio," ION/IEEE PLANS 2006, San Diego, CA, April 2006.

Poonawalla, B., Pandya, S., Kephart, J. and M. Braasch, "Flight Test Evaluation of Synthetic and Peripheral Vision Displays for General Aviation," 25th AIAA/IEEE Digital Avionics Systems Conference, Portland, OR, October 2006.

Kalyanaraman, S. and M. Braasch, "Tight Integration of a GPS Adaptive Array with a Software-Defined Receiver," Proceedings of the 2007 ION National Technical Meeting, San Diego, CA, January 2007.

Vydhyanathan, A., Braasch, M. and M. Uijt de Haag, "Multi-Sensor Integration for Autonomous Vehicle Relative Navigation," Proceedings of the Twentieth International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS-2007), Fort Worth, TX, September 25-28, 2007.

Poonawalla, B. and M. Braasch, "Human Factors Studies Evaluating Synthetic and Peripheral

Vision Displays in General Aviation," 26th AIAA/IEEE Digital Avionics Systems Conference, Dallas, TX, October 2007.

Kephart, R. and M. Braasch, "Comparison of See-and-Avoid Performance in Manned and Remotely Piloted Aircraft," 27th AIAA/IEEE Digital Avionics Systems Conference, St. Paul, MN, October 2008.

Simon, J. and M. Braasch, "Deriving Sensible Requirements for UAV Sense-and-Avoid Systems," 28th AIAA/IEEE Digital Avionics Systems Conference, Orlando, FL, October 2009.

Vydhyanathan, A., Luinge, H., Uijt de Haag, M., Braasch, M., "Integrating GPS/MEMS-based-IMU with single GPS baseline for improved heading performance," Proceedings of the 2012 IEEE Aerospace Conference, Big Sky, MT, March 2012.

Uijt de Haag, M., Bartone, C., Braasch, M., "Flight-Test Evaluation of Small Form-Factor LiDAR and Radar Sensors for sUAS Detect-and-Avoid Applications," IEEE/AIAA Digital Avionics Systems Conference, Sacramento, CA, September 2016.

Needham, T. and M. Braasch, "Gravity Model Error Considerations for High-Integrity GNSS-aided INS Operations," 2018 IEEE/ION Position, Location and Navigation Symposium (PLANS), Monterey, CA, April 2018.

Needham, T. and M. Braasch, "Stochastic Modeling of Gravity Compensation Error in GNSS-aided Inertial Navigation Systems," 2020 IEEE/ION Position, Location and Navigation Symposium (PLANS), Portland, Oregon, April 2020.

Datta, N., Braasch, M., Bruner, C. P., Esfandi, N., Moelich, M., Murphy, L. and G. T. Varty, "Closing the Loop on Model-Based Design: The Baro-Inertial Vertical Channel as a Case Study," ION Joint Navigation Conference, Covington, KY, August 2021.

Technical Memoranda

Braasch, M. and E. Mauer, "Preparations For MLS Azimuth Critical Areas Flight Evaluation Using The MLS Computer Model," Technical Memorandum OU/AEC 27-87TM86:1088.001/2-2, Avionics Engineering Center, Ohio University, November 1987.

Braasch, M., "Microwave Landing System (MLS) Flight Testing For The Purpose Of Validating The MLS Mathematical Model Establishing Azimuth Critical Area Criteria," Precis Number 81, Avionics Engineering Center, Ohio University, July 1988.

DiBenedetto, M. and M. Braasch, "MLS Azimuth and Elevation Volumes of Protection To Be Used In Conjunction With Operational And Obstacle Clearance Requirements In Refining MLS Critical Area Definitions," Technical Memorandum OU/AEC 65-88-TM-00006/9-3/ICAO, Avionics Engineering Center, Ohio University, August 1988.

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Braasch, M. and M. DiBenedetto, "Areas Of Protection Derived For An Offset Azimuth Antenna Which Supports A Computed Centerline Approach," Technical Memorandum OU/AEC 90-88TM-00006/9B-1/ICAO, Avionics Engineering Center, Ohio University, August 1988.

DiBenedetto, M. and M. Braasch, "Validation Results Obtained to Date on MLS Critical and Sensitive Areas," Technical Memorandum OU/AEC 91-88TM-00006/TTD-9B/ICAO, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, August 1988.

DiBenedetto, M. and M. Braasch, "Analysis Of Simulation Data And Flight Data Collected At Standiford Field, Louisville, Kentucky, To Investigate The Effects Of An Interfering Boeing B-747 On The MLS Azimuth and Elevation Signals," Technical Memorandum OU/AEC 97-88TM-00006/9C-1, Avionics Engineering Center, Ohio University, October 1988.

Braasch, M., "Independent Confirmation Of DME/P Signal Modeling Techniques," Technical Memorandum OU/AEC 19-89TM-00006/TTD-25/ICAO, Avionics Engineering Center, Ohio University, May 1989.

Braasch, M., "A DME/P Signal Model Concept," International Civil Aviation Organization, All Weather Operations Panel Working Group A, Working Paper 202, Amsterdam, The Netherlands, November 1989.

Braasch, M., "Current Developments in Signal Modeling of the Precision Distance Measuring Equipment," Technical Memorandum OU/AEC 3-90TM00006/25-FR, Masters Thesis, Avionics Engineering Center, Ohio University, Athens, Ohio, December 1989.

Braasch, M., "MLS Signal Model Refinements," Technical Memorandum OU/AEC 36-90TM00006/39-3/ICAO, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, March 1990.

Braasch, M., "Considerations for Collision Risk Modeling to Support MLS Advanced Procedures," Technical Memorandum OU/AEC 34-90TM00006/39-1/ICAO, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, July 1990.

Braasch, M., "MLS Signal Model Documentation," Technical Memorandum OU/AEC 91-6TM00006/39-4/ICAO, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, February 1991.

Braasch, M. and C. Flynn III, "Light-Lane Structures and MLS Siting Criteria," Technical Memorandum OU/AEC 91-35TM-00006/37-1/ICAO, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, May 1991.

Braasch, M., "DME/P Signal Model Development and Integration with the MLS Signal Model,"

Technical Memorandum OU/AEC 92-60TM00006/39-FR, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, October 1992.

Van Graas, F., Braasch, M. and T. Skidmore, "Satellite-Based System Precision Approaches," OU/AEC EER 92-4, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, October 1992.

Braasch, M., "Manual on the Use of the MLS Signal Model," Technical Memorandum OU/AEC 92-70TM3400/CTA-4, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, November 1992.

Flynn III, C., Braasch, M. and M. DiBenedetto, "DME/P Model: Final Report on IF-filter Development, Implementation, Testing and Documentation," Technical Memorandum OU/AEC 92-83TM3400/CTA-6, Avionics Engineering Center, Department of Electrical and Computer Engineering, Ohio University, Athens, Ohio, January 1993.

Braasch, M. and M. DiBenedetto, "Multipath Mitigation Investigations to Support Enhanced GPS for Combat Systems," OU/AEC EER 96-03, Avionics Engineering Center, School of Electrical Engineering and Computer Science, Ohio University, Athens, Ohio, September 1996.

Kalyanaraman, S. and M. Braasch, "GPS Multipath Mitigation Studies," Technical Memorandum OU/AEC 98-18TM-Rockwell-Collins, Avionics Engineering Center, School of Electrical Engineering and Computer Science, Ohio University, Athens, Ohio, August 1998.

Braasch, M., "Characteristics and Benefits of the GPS Software Radio," Technical Memorandum OU/AEC 03-06TM-B09380044, Avionics Engineering Center, School of Electrical Engineering and Computer Science, Ohio University, Athens, Ohio, July 2003.

Invited Presentations:

"Aircraft Navigation Using GPS and LORAN-C," Tri-State Helicopter Seminar, sponsored by the Federal Aviation Administration, Cincinnati Flight Standards District Office, April 1992.

"Characterization of GPS Multipath Errors in the Final Approach Environment," FALLCON '92 (IEEE Cedar Rapids, Iowa section conference), November 1992.

"GPS Operations," Ohio Avionics Seminar, sponsored by the Federal Aviation Administration, Cincinnati and Columbus Flight Standards District Offices, March 1996.

Two lectures: "Requirements on GNSS for Civil Navigation," and "Signals Integrity," NATO-sponsored lecture series, Moscow State Aviation Institute, Moscow, RUSSIA, March 1997.

Two lectures: "Requirements on GNSS for Civil Navigation," and "Signals Integrity," NATO-

sponsored lecture series, Kiev International University of Civil Aviation, Kiev, UKRAINE, March 1997.

Two lectures: "Requirements on GNSS for Civil Navigation," and "Signals Integrity," NATO-sponsored lecture series, Istanbul, TURKEY, March 1998.

"GPS Multipath," Department of Geomatics Engineering, University of Calgary (Alberta), CANADA, July 1998.

Four lectures: "Requirements on GNSS for Civil Navigation," "Signals Integrity," "GNSS Augmentation for High Precision Navigation Services," and "Attitude Determination," NATO-sponsored lecture series, Samara State Aerospace University, Samara, RUSSIA, December 1998.

"Airborne Multipath," presented in the Aircraft Applications session of the International Workshop on Aerospace Applications of the Global Positioning System, sponsored by IFAC, ESA, OU, ION and AAS, Breckenridge, CO, Jan. 31 - Feb. 2, 2000.

"GPS Multipath," GPS Hot Topics Workshop, Institute of Mathematics and Its Applications, Minneapolis, MN, August 2000.

"Enhanced Flight Test Capability," Institute of Navigation, Dayton Section Luncheon, Dayton, OH, September 2000.

"Flight Test Instrumentation Package for the L-29 Delfin Turbojet," Institute of Navigation, Dayton Section Luncheon, Dayton, OH, May 2002.

"Fundamentals of the Global Positioning System (GPS)," Environmental Modeling and Simulation conference, organized by the International Association of Science and Technology for Development (IASTED), St. Thomas, U.S.V.I., November 2004.

"UAV Swarming and Formation Flight Navigation via LiDAR/INS," with Mikel Miller, WPAFB, presented at the 2006 Joint Navigation Conference, Las Vegas, NV, May 2006.

"Navigation: A Look at the Past, Discussion of the Present & Glimpse at the Future," presented at the Naval Research Laboratory, Washington, DC, September 2007.

"Iron Stomachs and White Knuckles: Navigation Flight Testing at the Ohio University Avionics Engineering Center," presented to the Alberta Section of the Institute of Navigation, held at the University of Calgary, Calgary, CANADA, February 6, 2009.

"Iron Stomachs and White Knuckles: Navigation Flight Testing at the Ohio University Avionics Engineering Center," presented to the Southern California Section of the Institute of Navigation, held at Navcom, Torrance, CA, August 30, 2011.

"GPS Multipath and Inertial Sensor Considerations for Targeting in the Dismounted Soldier

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Environment," presented to the Joint Precision Targeting Working Group, U.S. Army Night Vision and Electronic Sensors Directorate, Ft. Belvoir, VA, November 5, 2015.

"GNSS Multipath: Effects on Tracking and Mitigation Techniques," "GNSS Receiver Processing," and "Evolutions of GPS," International GNSS Seminar 2016 on BeiDou/GNSS Technologies and Applications, Beijing, CHINA, May 2016.

"Introduction to Kalman Filtering" and "Inertial Navigation," International Seminars on Positioning and Navigation, Toulouse, FRANCE, May 2017.

"Fundamentals of Inertial Navigation Systems," All Ohio Engineering Conference, Ohio Society of Professional Engineers, Columbus, OH, June 17, 2017.

"Global Positioning System," All Ohio Engineering Conference, Ohio Society of Professional Engineers, Columbus, OH, June 17, 2017.

"System-Level Considerations in Inertial Sensor Performance," IEEE Inertial Sensors & Systems Symposium, Lake Como, ITALY, March 2018.

"Fundamentals of Inertial Navigation Systems and Aiding," IEEE/ION Position, Location and Navigation Symposium (PLANS), Monterey, CA, April 2018.

"Inertial Navigation: Free and Aided," IEEE Inertial Sensors & Systems Symposium, Naples, FL, April 2019.

"Iron Stomachs and White Knuckles: Navigation Flight Testing at the Ohio University Avionics Engineering Center," presented to the Aviation Museum of Kentucky, Lexington, KY, May 11, 2019.

"Inertial Sensor Technology for Autonomous Navigation," webinar hosted by Inside GNSS, November 20, 2019.

"Inertial Navigation Systems and Aiding," MAE Seminar / IEEE AESS Distinguished Lecture, Department of Mechanical and Aerospace Engineering, University of California – Irvine, January 31, 2020.

"Inertial+, the Once and Future Navigation System," Smead Aerospace Engineering Sciences Researchpalooza / IEEE AESS Distinguished Lecture, University of Colorado – Boulder, February 7, 2020.

"Fundamentals of Inertial Navigation," Virtual Distinguished Lecture, Baltimore IEEE AESS Chapter, June 3, 2020.

"Inertial+, the Once and Future Navigation System," IEEE AESS Virtual Distinguished Lecture, December 10, 2020.

"Inertial+, the Once and Future Navigation System," U.K. Institution of Mechanical Engineers Virtual Lecture, March 23, 2021.

"Characterization and Mitigation of Multipath in GNSS," IEEE AESS Virtual Distinguished Lecture, October 26, 2021.

"Inertial+, the Once and Future Navigation System," IEEE AESS Distinguished Lecture, IEEE Buenaventura Section / AESS Chapter, Westlake Village, CA, August 18, 2022.

"Gravity-Modeling Considerations in High-Integrity Inertial Systems," IEEE AESS Virtual Distinguished Lecture, November 30, 2022.

Academic Service:

M.S. Advisees

AnnMarie Fink, Thesis: "Investigation of the Selective Availability in the NAVSTAR Global Positioning System," November 1994.

Lap Ho, Thesis: "High Precision Short-Baseline Pointing System Using GPS Interferometry," March 1995.

Chi-Li Soong, Thesis: "Fast Time Domain-Based GPS Acquisition," March 1996.

Steven Hill, Thesis: "DGPS/ILS Integration for an Automatic Landing System Using Kalman Filtering," June 1996.

J. Jeffrey Haubeil, Thesis: "Operational Viability of a Directive Distance Measuring Equipment (DME) Antenna in a National Airspace System (NAS) Approach and Landing Environment," August 1996.

Wen-Jye Huang, Thesis: "Investigation of the Benefits of Multi-Chain Loran-C and Hybrid GPS/Loran-C Positioning," March 1997.

Sunil Bhanot, Thesis: "Implementation and Optimization of a GNSS Receiver," August 1998.

Sunil Kanekal, Thesis: "Spread Spectrum Multipath Mitigation Studies," defended: August 1998.

Chin-Yuan Cheng, "Numerical Electromagnetic Modeling of a Small Aperture Helical-Fed Reflector Antenna," M.S.E.E., 1998

Hao Ding, "Facility Separation Criteria Development and Enhancement for Directive Distance

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Measuring Equipment in the National Airspace System," M.S.E.E., November 1998.

Mahesh Surathu, "Investigating Global Positioning System Helibowl Antenna Performance Sensitivity with Variation in Design Parameters," M.S.E.E., June 1999.

Sai Kalyanaraman, "A Comparative Study of Advanced Multipath Mitigating Global Positioning System Receiver Architectures," M.S.E.E., August 1999.

Andrew C. Seitz, "A High Fidelity Global Positioning System Receiver Simulation," M.S.E.E., March 2000.

Sridhar Ramaswamy, "An Investigation of Integrated Global Positioning System and Inertial Navigation System Fault Detection," M.S.E.E., June 2000.

Azhar H. R. Osmanbhoy, "High Dynamic Simulations for Global Positioning System Receivers," M.S.E.E., August 2000.

Joseph Kelly, "Investigation of GPS Fading Multipath Bias Characteristics," M.S.E.E., June 2001.

Joseph Dubinsky, "Advanced Flight Display for General Aviation Aircraft," M.S.E.E., August 2002.

Jason Burns, "Effects of Quantization Error on the Global Positioning System Software Receiver Interference Mitigation," M.S.E.E., November 2002.

Douglas Burch, "Implementation and Evaluation of a General Aviation Synthetic Vision Display System," M.S.E.E., March 2004.

Jahnavi Chakrabarty, "Development, Implementation and Flight Testing of Peripheral Vision Displays for General Aviation," M.S.E.E., March 2005.

Behlul Poonawalla, "Applications to Synthetic and Peripheral Vision Display Systems for Manned and Unmanned Air Vehicles," M.S.E.E., November 2007.

Ryan Kephart, "Comparison of See-and-Avoid Performance in Manned and Remotely Piloted Aircraft," M.S.E.E., November 2008.

Jerry Simon, "A Systems Approach to the Formation of Unmanned Air Vehicle Detect, Sense and Avoid Performance Requirements," M.S.E.E., November 2009.

Nikhil Gandhi, "ADS-B Enabled, Wake Vortex Mitigation Using Cockpit Display," M.S.E.E., December 2012.

Mark Phillips, "Antenna Baseline Measurement System (ABMS) – Realizing a Real-Time

Kinematic GPS Algorithm in the Physical World," M.S.E.E., April 2015.

Yuanyan Chen, "Autonomous Unmanned Ground Vehicle (UGV) Follower Design," M.S.E.E., August 2016 (co-advised with J. Zhu).

Ph.D. Advisees

Dennis M. Akos, "A Software Radio Approach to Global Navigation Satellite System Receiver Design," Ph.D., August 1997.

Fan Liu, "Analysis of Integrity Monitoring for Local Area Augmentation Systems Using the Global Navigation Satellite System," Ph.D., August 1998.

Sai Kalyanaraman: "High Accuracy Phase Tracking Using Software Adaptive Arrays," Ph.D., August 2009.

Timothy Needham: "Gravity Modeling in High-Integrity GNSS-Aided Inertial Navigation Systems," Ph.D., August 2022. [Co-Advisor with C. Bartone]

Courses Taught (note: 3-digit courses were taught under quarters; 4-digit courses were taught under semesters)

EE 101 (Introduction to Electrical Engineering): Fall 1999, Fall 2000, Fall 2001

EE 232 (Advanced Engineering Mathematics): Fall 1995

EE 310 (Linear Systems, Part 1 of 2): Winter 1994, Winter 1995

EE 312 (Linear Systems, Part 2 of 2): Winter 1996, Winter 1997, Spring 1998, Spring 1999

EE 3223 (Electromagnetics, Part 2 of 2): Spring 2016

EE 395C (Comm and Emag Lecture/Lab Course): Co-taught with Chris Bartone: Spring 2005, Fall 2006

EE 478 (Digital Signal Processing): Fall 2003

EE 490 (Advanced Linear Systems and Introduction to Digital Signal Processing): Winter 2002

EE 495 (Senior Capstone Design): Served as a senior project supervisor during 2000-2001, 2001-2002, 2002-2003, 2003-2004, 2004-2005 and 2006-2007

EE 495A, B, C (Senior Capstone Design): Co-taught with Angie Bukley: 2004-2005, 2006-2007

EE 495C: Spring 2004

EE 4953/4963 (Senior Capstone Design): Served as a project supervisor 2018-2019

EE 5003 (Computational Tools for Engineers): Fall 2013, Spring 2014, Fall 2014, Fall 2015

EE 5853 (Electronic Navigation Systems): Fall 2016, Fall 2018 - 2022 (also during Fall 2020 this course was taught online at Embry-Riddle Aeronautical University as EE 525)

EE 603 (Inertial Navigation Systems I): Winter 1998, Winter 2000, Winter 2002, Winter 2004, Fall 2005, Summer 2007, Winter 2011, Fall 2011

EE 604 (Inertial Navigation Systems II): Spring 2000, Spring 2002, Spring 2004, Winter 2006, Fall 2007

EE 6033 (Inertial Navigation Systems): Fall 2012, Fall 2013, Spring 2015, Spring 2017, Summer 2018, Fall 2018, Spring 2019, Fall 2019- 2022

EE 605 (Satellite-Based Navigation Systems): Spring 1994, Fall 1995, Fall 1996, Fall 1998, Fall 2002, Winter 2012

EE 6053 (Satellite-Based Navigation Systems): Spring 2013, Spring 2014

EE 606 (Integrated Navigation Systems): Fall 1994, Spring 1996, Winter 1999, Summer 2000; Winter 2008

EE 6063 (Integrated Navigation Systems): Summers 2013-2022

EE 607 (Navigation Receiver Design): Spring 1995, Spring 1997, Winter 2001, Summer 2002, Spring 2005

EE 612 (GPS Multipath): Spring 2001

EE 690 (Propagation Anomalies in Spread-Spectrum Ranging): Fall 1997

EE 690 (GPS/INS Integration): Fall 2000, Fall 2004

EE 690 (GPS Receiver Design II): Spring 2003

EE 690 (GPS Receiver Signal Processing): Summer 2004

EE 6900 (Attitude and Heading Reference Systems): Spring 2019

EE 790 (GPS Software Receivers): Fall 2003

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ENEL 320 (Signals and Communications): Semester II (2017), University of Canterbury

University Committees

Twice elected to the Faculty Senate (serving June 2000 through June 2005); member of the Professional Relations committee (2000 – 2003); member of the Promotion & Tenure committee (2003 – 2005)

Member of the University Council for Research, Scholarship and Creative Activity (Fall 2000 – Spring 2003; Fall 2012 – Spring 2018)

College Committees

Member of the Cooperative Education Committee (Fall 1994 – Spring 1998)

Member of the Robe Leadership Institute Advisory Board (1998 – 2005)

Member of the P&T Committee (2006 – 2015; 2021 - present); Chair: 2008 - 2015

School Committees

Ad Hoc 395A,B,C implementation committee: 2001-2002

Annual Review and Raise Allocation Advisory committee: 2003-2005

Assessment committee: 1997 – 2003

Board of Visitors Implementation committee: 2000-2001

EE Design courses committee (chair): 2003-2005

EE Senior Focus Ad Hoc committee (chair): 2003-2004

Foundations course committee (chair): Fall 2000 – Fall 2004

Graduate committee: 1999 – 2002: 2018 - present

Introductory course committee (interim chair): Jan. 2002 – Dec. 2002

Library committee: 1998 – 2002

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P&T committee (elected): Fall 2000 – Spring 2005; Fall 2020 – Spring 2021

P&T committee Chair: Fall 2006 – 2015; 2021 - present

Research committee (chair): 2001 – 2003

Professional Service:

WGA Symposium, October 1993, Session Chairman, "Loran-C and GNSS Interoperability."

Institute of Navigation National Technical Meeting, January 1994, Session Chairman, "Precision Aircraft Positioning and Landing Applications."

Position Location and Navigation Symposium, PLANS '94, April 1994, Session co-chairman, "GPS and Ground-Based Navaids."

Referee for NAVIGATION: Journal of the Institute of Navigation: 1994-present.

Judge for student session paper competition: Institute of Navigation ION GPS-95.

Referee for IEEE Transactions on Aerospace and Electronic Systems: 1995-2005.

Session Chairman: Institute of Navigation ION GPS-96.

Session Chairman: International Loran Association Technical Symposium, November 1996.

Elected 1997-98 Central Region Member-at-Large for the Institute of Navigation.

Session Chairman: Institute of Navigation ION GPS-97.

Technical Program Co-Chair: 54th Annual Meeting of the Institute of Navigation, June 1998.

Elected 1998-99 Central Region Vice President for the Institute of Navigation.

RTCA Special Committee 159 (GPS Standards): 1994-2001, 2015-present.

General Chair: 55th Annual Meeting of the Institute of Navigation, June 1999.

Appointed Finance Chair of the Institute of Navigation, 1999-2004.

Referee for the AIAA Journal of Guidance, Control and Dynamics, 2000.

Referee for GPS Solutions, 1999-present.

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Session Chairman: Institute of Navigation ION GPS-2001, ION GPS-2002, ION GNSS-2004, ION GNSS-2011, ION GNSS-2012, ION GNSS-2021

Associate Editor (Navigation) for the IEEE Transactions on Aerospace and Electronic Systems: 2006 – 2009.

Technical Editor (Navigation) for the IEEE Transactions on Aerospace and Electronic Systems: 2010 – 2011.

IEEE Aerospace and Electronic Systems Society liaison to the Position, Location and Navigation Symposium (PLANS) organizing committee: 2014 – present.

Associate Editor (Navigation) for the IEEE Aerospace and Electronic Systems Magazine: 2015 – 2019.

Elected to the IEEE Aerospace and Electronic Systems Society (AESS) Board of Governors, 2017-2022. Elected Vice President – Conferences, 2019-2021. Elected Vice President – Technical Operations, 2022-2023.

Founding Chair of the IEEE AESS Navigation Systems Panel, 2017 – present.

Associate Editor, NAVIGATION: Journal of the Institute of Navigation: 2020-present.

Consulting:

GE/Harris Railway Electronics: 1995.

GPSoft LLC, 1996-present.
        This work has involved software development and short-course teaching. The software developed consists of the GPSoft SatNav Toolbox, INS Toolbox and Navigation System Integration and Kalman Filtering Toolbox for MATLAB. Separately, on-site short-courses in GPS, INS and navigation system integration have been taught at companies such as ITT and Honeywell.

Honeywell: 1995-96.

ITT Industries, Advanced Engineering Services division: 2000.

LinCom: 1996.

Nanyang Enc, 2005 – 2016.
        Short courses provided in Singapore on a variety of topics including GPS, INS, integration and unmanned aerial vehicle technology.

NavtechGPS Seminars: 1994-2003; 2010-2016.

Tracking and Imaging Systems, Inc., 2005-2006.

Mining support equipment manufacturer (name withheld by request): 2013-2014 (the consultation involves improving the accuracy of GPS receivers used to survey the location of boreholes).

United Launch Alliance, 2018 – 2020.

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Expert Witness Service:

       Type of Matter: U.S. ITC, Investigation Number 337-TA-596
       Client: Broadcom
       Law Firm: WilmerHale
       Case Name: In the Matter of Certain GPS Chips, Associated Software and Systems,
             and Products Containing Same
       Services provided: Expert witness. Expert reports, deposition, testimony at the
hearing
       Date: 2007 – 2008 (initial determination in favor of Broadcom)

       Type of Matter: U.S. ITC, Investigation Number 337-TA-602
       Client: Broadcom
       Law Firm: WilmerHale
       Case Name: In the Matter of Certain GPS Devices and Products Containing Same
       Services provided: Expert witness. Expert reports, deposition, testimony at the
hearing
       Date: 2007 – 2011 (initial determination in favor of Broadcom)

       Type of Matter: U.S. ITC, Investigation Number 337-TA-657
       Client: Honeywell
       Law Firm: Robins, Kaplan, Miller & Ciresi
       Case Name: In the Matter of Certain Automotive Multimedia Display and Navigation
              Systems, Components Thereof, and Products Containing Same
       Services provided: Expert witness. Expert reports, deposition, testimony at the hearing
       Date: 2009 (initial determination against Honeywell)

       Type of Matter: California Central District Court, Intellectual Property - Patent
       Client: Broadcom
       Law Firm: McAndrews, Held & Malloy; Keker & Van Nest; WilmerHale;
       Case Name: Broadcom Corporation v. SiRF Technology, Inc.
       Services provided: Expert witness. Expert reports, deposition.
       Date: 2008 – 2011 (matter settled)

       Type of Matter: Patent Re-examinations
       Client: Broadcom
       Law Firm: Sterne, Kessler, Goldstein & Fox
       Case Name: N/A
       Services provided: Expert declarations.
       Date: 2010

       Type of Matter: U.S. ITC, Investigation Number 337-TA-783
       Client: Honeywell
       Law Firm: Robins, Kaplan, Miller & Ciresi
       Case Name: In the Matter of Certain Navigation Products, Components Thereof, And

Related Software
Services provided: Consulting expert. Expert report.
Date: 2011 – 2012 (matter settled)

Type of Matter: Delaware District Court, Intellectual Property – Patent - Civil Action No. 10-258-SLR
Client: Apple, Inc.
Law Firm: O'Melveny & Myers
Case Name: MobileMedia Ideas LLC v. Apple, Inc.
Services provided: Expert witness. Expert report, deposition.
Date: 2011 – 2012; 2015 - 2018

Type of Matter: District Court, Intellectual Property – Misappropriation of Trade Secrets
Client: Name withheld by request
Industry: GPS chip manufacturing
General Technology involved: Assisted GPS
Services provided: Expert consulting.
Date: 2010 - 2012

Type of Matter: Eastern District of Michigan, Intellectual Property - Patent
Client: Garmin International, Inc.
Industry: Aviation electronics
General Technology involved: Aviation navigation systems
Services provided: Expert consulting. Expert report, deposition.
Date: 2011 - 2014

Type of Matter: District Court, Intellectual Property - Patent
Client: Name withheld by request
Industry: Automotive electronics
General Technology involved: Original equipment manufacturing of automotive navigation systems
Services provided: Expert consulting.
Date: 2011 – 2012 (matter settled)

Type of Matter: Re-examination of U.S. Pat. No. 7,149,625
Client: TeleNav, Inc.
Industry: Navigation systems
General Technology involved: Navigation using distributed networked architecture
Services provided: Expert declarations.
Date: 2010 - 2012

Type of Matter: District Court (E.D. Texas), Intellectual Property - Patent
Client: Name withheld by request
Industry: Navigation systems
General Technology involved: Automotive navigation systems

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Services provided: Expert consulting. Expert report.
Date: 2011 – 2012 (matter settled)

Type of Matter: District Court (E.D. Texas), Intellectual Property – Patent - Case No. 6:11-cv-00096-LED
Client: AT&T, Cellco, MetroPCS
Industry: Navigation systems
General Technology involved: Wireless location determination techniques
Services provided: Expert consulting. Expert reports, deposition.
Date: 2011 – 2013 (matter settled)

Type of Matter: Re-examination of U.S. Patent No. RE41,983
Client: Google
Industry: Geographic positioning systems
General Technology involved: Organizing and compressing spatial data
Services provided: Expert declarations.
Date: 2012

Type of Matter: USPTO – Inter Partes Review – Case IPR2013-00191
Client: Google Inc. and Apple Inc.
General Technology involved: graphical displays
Services provided: Expert declaration, depositions
Date: March 2013 – January 2014

Type of Matter: District Court (C.D. California), Intellectual Property – Patent – Case No. 11-CV-05210-DDP
Client: AT&T Mobility
General Technology involved: Location reporting systems.
Services provided: Expert consulting, expert report, deposition.
Date: 2012 - 2015

Type of Matter: USPTO – Inter Partes Review – Case IPR2015-00224
Client: Factual, Inc.
General Technology involved: graphical displays
Services provided: Expert declaration, deposition
Date: October 2014 – July 2015

Type of Matter: USPTO – Inter Partes Review – Case IPR2015-00849 and Case IPR2015-00851
Client: Apple Inc., Google Inc. and the Samsung entities
General Technology involved: handheld GPS mapping devices
Services provided: Expert declarations, deposition
Date: February 2015 – May 2016

Type of Matter: USPTO – Inter Partes Review – Case IPR2016-01535, IPR2016-01536

and IPR2016-01537
    Client: Google Inc.
    General Technology involved: Vehicle route guidance systems
    Services provided: Expert declarations and depositions.
    Date: June 2016 – March 2018

    Type of Matter: USPTO – Inter Partes Review – Case IPR2017-00946 and IPR2017-02051
    Client: Flir Systems Inc., Flir Maritime US, Inc., Navico, Inc.
    General Technology involved: Marine navigation systems
    Services provided: Expert declarations and depositions.
    Date: December 2016 – March 2018

    Type of Matter: USPTO – Inter Partes Review – Case IPR2017-00815, IPR2017-00816, IPR2017-00817 and IPR2017-00818
    Client: Google Inc.
    General Technology involved: Vehicle route guidance systems
    Services provided: Expert declarations and depositions.
    Date: 2016 – 2018

    Type of Matter: District Court (E.D. Texas), Case No. 5:16-cv-00178-RWS and Case No. 5:16-cv-00179-RWS
    Client: Maxell, Ltd.
    General Technology involved: Mobile device location determination techniques
    Services provided: Expert declarations, reports, depositions, testimony at trial.
    Date: 2017 - 2019

    Type of Matter: District Court (Delaware), C.A. No. 16-706-LPS-CJB
    Client: SZ DJI TECHNOLOGY CO., LTD. and DJI EUROPE B.V.
    General Technology involved: Drone design
    Services provided: Expert declaration, reports, deposition.
    Date: April 2017 – August 2021

    Type of Matter: USPTO – Inter Partes Review – Case IPR2018-01024
    Client: Unified Patents, Inc.
    General Technology involved: Vehicle navigation displays
    Services provided: Expert declaration.
    Date: 2018

    Type of Matter: USPTO – Inter Partes Review – Case IPR2018-01490
    Client: Flir Systems Inc., Flir Maritime US, Inc.
    General Technology involved: Technology for backtracking a route
    Services provided: Expert declaration.
    Date: 2018

Type of Matter: USPTO – Inter Partes Review – Case IPR2018-00210
Client: Maxell, Ltd.
General Technology involved: Mobile communication devices with navigation functions
Services provided: Expert declaration and deposition.
Date: 2018

Type of Matter: USPTO – Inter Partes Review – Case IPR2021-00502, IPR2021-00503 and IPR2021-00504
Client: Google, Inc.
General Technology involved: Vehicle route guidance systems
Services provided: Expert declarations.
Date: 2020 – 2021

Type of Matter: USPTO – Inter Partes Review – Case IPR2021-01552, IPR2021-01553 and IPR2022-00073
Client: Apple, Inc.
General Technology involved: Navigation functionality in terrestrial communication networks
Services provided: Expert declarations.
Date: 2021 – 2022

Type of Matter: District Court (E.D. Texas), Case No. 2:21-cv-00315-JRG-RSP
Client: Cellco Partnership dba Verizon Wireless
General Technology involved: Mobile device location determination techniques
Services provided: Expert consulting.
Date: 2021 - 2022

Type of Matter: USPTO – Inter Partes Review
Client: Unified Patents, LLC
General Technology involved: Wireless communication system for locating wireless devices
Services provided: Expert declaration.
Date: 2022

Type of Matter: District Court (W.D. Texas), Case No. 21-cv-1312-ADA
Client: Google, Inc.
General Technology involved: Mobile device navigation
Services provided: Expert declaration.
Date: 2022 - present