About the Editors

Scott Gleason received his B.S. in electrical and computer engineering from the State University of New York at Buffalo, an M.S. in engineering from Stanford University, and a Ph.D. from the University of Surrey. He has worked in the areas of GNSS, satellite design, and remote sensing for over 15 years, including at NASA's Goddard Space Flight Center and Stanford's GPS LAAS Laboratory. Over the past decade he has contributed to various GNSS related projects at several companies in the United Kingdom, including SSTL and EADS Astrium. He is currently working for QinetiQ Limited and part time at the National Oceanography Centre Southampton (UK).

Demoz Gebre-Egziabher is an associate professor of aerospace engineering and mechanics at the University of Minnesota, Twin Cities Campus. His research focuses on the design of algorithms and hardware for the navigation and guidance of aircraft, small satellites, and ground vehicles. He is the current secretary of the Satellite Division of the Institute of Navigation (ION) and an associate editor (navigation) for the *IEEE Transactions on Aerospace and Electronic Systems*. He received a B.S. in aerospace engineering from the University of Arizona, an M.S. in mechanical engineering from George Washington University, and a Ph.D. in aeronautics and astronautics from Stanford University.

About the Contributors

Pieter Abbeel received a B.S. and M.S. in electrical engineering from KU Leuven (Belgium) and received his Ph.D. in computer science from Stanford University in 2008. He joined the faculty at UC Berkeley in the Fall of 2008, with an appointment in the Department of Electrical Engineering and Computer Sciences. His research focuses on robotics, machine learning, and control.

Chi O. Ao received his bachelor's degree in physics from the University of California at Berkeley in 1993 and his Ph.D. in physics from the Massachusetts Institute of Technology in 2001. He has worked extensively on the electromagnetic scattering of geophysical random media in the past, and is a coauthor of the book *Scattering of Electromagnetic Waves: Numerical Simulations* (Wiley, 2001). He joined the tracking systems and applications section at the Jet Propulsion Laboratory in 2001 and has been working on various aspects of GPS radio occultation since. He has

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made significant contributions in evaluating and improving the quality of the atmospheric retrievals in the lower troposphere. His recent interests include the determination of planetary boundary layer heights from GPS radio occultation and other climate applications.

David M. Bevly is an associate professor in the Department of Mechanical Engineering at Auburn University. He directs the University's GPS and Vehicle Dynamics Laboratory (GAVLAB), which focuses on the control and navigation of vehicles using GPS in conjunction with other sensors, such as Inertial Navigation System (INS) sensors. The GAVLAB's research thrusts are focused towards vehicle dynamics and transportation systems, including heavy trucks, passenger cars, off-road vehicles, as well as autonomous and unmanned vehicles. Dr. Bevly received his B.S. from Texas A&M University in 1995, his M.S. from the Massachusetts Institute of Technology in 1997, and his Ph.D. from Stanford University in 2001, all in mechanical engineering.

Paul Blunt is a senior GPS/GNSS engineer at the GNSS group of Surrey Satellite Technology Limited. He received a master's degree in electrical engineering from the University of Liverpool in 2003 and earned his Ph.D. from the University of Surrey in 2007 for the study of advanced receiver architectures for modernized GPS and Galileo signals. Since then his work has focused on design of transmitter and receiver architectures for Galileo signals and multiantenna beamforming systems for GNSS interference mitigation. His research interests cover all aspects of GNSS receiver design including acquisition, tracking, multipath, and interference mitigation techniques.

Jacob Campbell is an electronics engineer at the Air Force Research Laboratory, Reference Systems Branch, at Wright Patterson AFB. Dr. Campbell received his B.S., M.S., and Ph.D. degrees in electrical engineering from Ohio University where he worked as a research associate for the Ohio University Avionics Engineering Center. While at Ohio University, he interned with Honeywell Labs in the Guidance, Navigation, and Control Center of Excellence, where he performed software GPS research. His research interests include image/shape-aided navigation systems, automated aerial refueling, and other navigation techniques enabling robust navigation in GPS degraded environments.

Richard Fuller, Ph.D., is currently a director of the Wireless Communications Alliance (WCA) and chairman of the Location-Based Services Special Interest Group (LBS SIG), a nonprofit organization dedicated "to promote collaboration, education and knowledge sharing within the Northern California LBS community." In addition to his work at the WCA he cofounded GeoTrax in 2002 and served multiple roles including project manager and technical lead. He has presented numerous speeches and papers and holds several patents in GPS and its applications. In April 2008 GeoTrax was acquired by 3SI Security Systems and Fuller was part of the transition team teaching the 3SI engineers about the Geotrax system. Fuller began his involvement with location-based technologies as chief system architect and programmer at Space Systems/Loral for the GPS Tensor, a position, time, and

attitude space receiver design. Prior to cofounding GeoTrax, Fuller help cofound Traxsis where he was vice president of engineering and responsible for directing their products related to the telecommunication and LBS area. Before Traxsis, Fuller worked as part of the Wide Area Differential GPS Laboratory at Stanford University, where he studied the use of geostationary satellites as an aircraft landing aid.

Dorota A. Grejner-Brzezinska (Ph.D., 1995, The Ohio State University) is a professor in geodetic science, and leader of the Satellite Positioning and Inertial Navigation (SPIN) Laboratory at The Ohio State University. Her research interests cover GPS/GNSS algorithms, in particular, high precision positioning and navigation. She is vice president of the International Association of Geodesy (IAG) Commission 4, Positioning and Applications, and chair of the Sub-Commission 4.1, Multisensor Systems, and is an IAG fellow; she has been serving on the Institute of Navigation (ION) Council for the past 7 years. She published over 160 peer reviewed journal and proceedings papers, numerous technical reports, and five book chapters on GPS and navigation. She has led over 20 research projects sponsored by DOD, NASA, NGS, NGA, NSF, Federal DOT, and Ohio DOT, with a total budget of over eleven million USD. She is the recipient of the 2005 ION Thomas Thurlow Award, the 2005 United States Geospatial Information Foundation (USGIF) Academic Research Award, and the ESRI Award for Best Scientific Paper in Geographic Information Systems published in 2004. Her work on personal navigation, sponsored by NGA, and was featured as "NGA success story" at the NGA NURI Symposium in Washington DC, in September 2008.

Timo Jokitalo received his M.S. degree in 1994 at the Helsinki University of Technology, Department of Engineering Physics and Mathematics. From 1994 to 2002, he worked at Space Systems Finland Ltd. on various space related embedded and data processing software projects, as well as indoor pseudolite-based navigation. Since 2002 he has worked at Fastrax Ltd., Finland, where his activities have included mainly the research and development of navigation and signal processing algorithms for commercial hardware- and software-based GPS receivers.

Heidi Kuusniemi (born Sandström) received her M.S. degree in 2002 and doctor of technology degree in 2005 from the Department of Information Technology at Tampere University of Technology, Finland. Her doctoral studies on reliability and quality monitoring in personal satellite navigation were partly conducted at the Department of Geomatics Engineering at the University of Calgary, Canada. From 2005 to 2009 she worked in research and development at Fastrax Ltd., Finland, where her field of work included high sensitivity GPS receivers and various reliability enhancement and performance improvement techniques. Since May 2009, Dr. Kuusniemi has been working as a specialist research scientist in the Navigation and Positioning Department at the Finnish Geodetic Institute with research interests including personal positioning and sensor-aided GNSS.

E. Glenn Lightsey holds the W. R. Woolrich Professorship in Engineering in the Department of Aerospace Engineering and Engineering Mechanics at The University

of Texas at Austin. He received his Ph.D. from Stanford University in 1997. Prior to joining The University of Texas in 1999, Dr. Lightsey worked for 13 years as a guidance and control engineer at NASA's Goddard Space Flight Center. Dr. Lightsey specializes in the dynamics and control of spacecraft using avionics sensors such as the Global Positioning System (GPS).

Sherman C. Lo is currently a senior research engineer at the Stanford University Global Positioning System (GPS) Laboratory. He is the associate investigator for the Stanford University efforts on the Department of Transportation's technical evaluation of Loran. He received his Ph.D. in 2002 from Stanford University in developing additional redundancy for GPS in aviation. His current research areas include enhanced Loran, navigation security, and modernized GNSS. He is the recipient of the ION Early Achievement Award (2005) and the International Loran Association (ILA) Presidents Award (2003).

Stephen T. Lowe received B.S. degrees in both physics and mathematics from the Colorado School of Mines, and a Ph.D. in high energy particle physics from Stanford University. He has been employed at the Jet Propulsion Laboratory at the California Institute of Technology since 1987. His research interests include radio interferometry, optical interferometry, experimental tests of general relativity, spacecraft tracking/navigation, GNSS remote sensing, Neutrino astrophysics, Earth-based observations of the Huygens probe decent through Titan's atmosphere, pulsar astronomy, and radar imaging.

Ben Peterson founded Peterson Integrated Geopositioning in 2000. Prior to this he was a U.S. Coast Guard captain and head of the engineering department at the Coast Guard Academy. He is an Academy graduate and earned a Ph.D. in electrical engineering from Yale University. He is a former president of the U.S. Institute of Navigation and an institute fellow. He served as cochair of both the Loran Integrity Performance Panel (LORIPP) and the Loran Accuracy Performance Panel (LOR-IPP), which effectively defined enhanced or eLoran. He currently serves as chair of RTCM SC-127, eLoran Receiver Minimum Performance Standards.

Mark Petovello, Ph.D., is an assistant professor in the Position, Location, and Navigation (PLAN) group in the Department of Geomatics Engineering at the University of Calgary. Since 1998, he has been involved in various navigation research areas including software receiver development, satellite-based navigation, inertial navigation, reliability analysis, and dead-reckoning sensor integration.

Tony Pratt has over 40 year of experience with signal processing and GPS. He graduated with a B.S. and Ph.D. in electrical engineering from Birmingham University, U.K. in 1967. He has held teaching positions at Loughborough University, U.K.; Yale University; IIT, New Delhi; and University of Copenhagen; and holds a full special professorship at the University of Nottingham. His teaching is primarily in signal processing, electronics, probability theory, and satellite navigation system design. He has worked for or consulted Navstar Ltd., Peek, Parthus, QinetiQ Ltd. (U.K.), Cambridge Positioning Systems (now part of the CSR plc group), and

the European Space Agency. Dr. Pratt is a consultant to the U.K. government in the development of the Galileo Satellite System and has played key roles in the signal design and international negotiations. He runs two companies, OrbStar Consultants and OrbStar Ltd., providing various services to the GNSS sector. Dr. Pratt has published numerous papers on signal processing, sonar, and satellite navigation. He published more than 50 papers and holds over 40 patents.

Sam Pullen is a senior research engineer at Stanford University, where he is the director of the Local Area Augmentation System (LAAS) research effort. He has supported the FAA in developing LAAS and WAAS system concepts, requirements, integrity algorithms, and performance models since receiving a Ph.D. degree in aeronautics and astronautics from Stanford in 1996. His current work includes the design of system architectures and algorithms for the next phases of LAAS. He also participates in the development of the next generation of GPS, and his research extends to the broader problem of optimal system design and safety assurance under uncertainty. Dr. Pullen was awarded the Institute of Navigation Early Achievement Award in 1999.

Jason Rife received his B.S. degree in mechanical and aerospace engineering from Cornell University, Ithaca, New York, in 1996, and his M.S. and Ph.D. degrees in mechanical engineering from Stanford University, Stanford, CA, in 1999 and 2004. He is currently an assistant professor of mechanical engineering at Tufts University in Medford, Massachusetts. He directs the Automation Safety and Robotics Laboratory, which applies theory and experiment to characterize the integrity of autonomous vehicle systems. Before joining the faculty at Tufts University, he worked as a research engineer with the Stanford University GPS Laboratory where he specialized in error bounding and fault monitoring. While with the Stanford GPS Lab he directed the Joint Precision Approach and Landing System (JPALS) group, served as a member of the Local Area Augmentation System (LAAS) Integrity Panel, and codesigned the architecture of the Local Airport Monitor (LAM) alternative to LAAS.

Morgan Quigley is a Ph.D. candidate in the Stanford University Computer Science Department. His research endeavors have included software GPS for small aerobatic UAVs, distributed software systems for robotics, and the design and control of low-cost robotic manipulators.

Chris Rizos is currently the head of the School of Surveying & Spatial Information Systems at the University of New South Wales (UNSW). Chris has been researching the technology and applications of GPS since 1985, and established over a decade ago the Satellite Navigation and Positioning group at UNSW, today the largest and best known academic GPS and wireless location technology R&D laboratory in Australia. Chris is the vice president of the International Association of Geodesy (IAG), a member of the Governing Board of the International GNSS Service (IGS), and a member of the IAG's Global Geodetic Observing System Steering Committee. Chris is a fellow of the IAG and a fellow of the Australian Institute of Navigation.

Maarten Uijt de Haag is an associate professor of electrical engineering and computer science and a principal investigator (PI) with the Avionics Engineering Center at Ohio University since 1999. He obtained his M.S. electrical engineering degree from Delft University in The Netherlands in 1994 and his Ph.D. in electrical engineering from Ohio University in Athens, Ohio in 1999. He has authored or coauthored over 80 navigation-related publications, including three book chapters. He is a senior member of the IEEE and AIAA, and a member of the SPIE and ION. Within the latter organization, Dr. Uijt de Haag has served as the air representative on the council and is currently an associate editor for *NAVIGATION*: *The Journal of the Institute of Navigation.* Furthermore, Dr. Uijt de Haag currently serves on the AIAA Digital Avionics Technical Committee. Dr. Uijt de Haag was awarded the 2008 Institute of Navigation Thomas L. Thurlow Award for his contributions to laser-based navigation and integrity monitors for synthetic vision systems.

Valery U. Zavorotny received his M.S. in radio physics from Gorky State University, Gorky, Russia, in 1971, and his Ph.D. in physics and mathematics from the Institute of Atmospheric Physics of the USSR Academy of Sciences, Moscow, in 1979. He is currently a physicist with the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA), Boulder, CO. From 1971 to 1990 he was a research scientist with the Institute of Atmospheric Physics of the USSR Academy of Sciences, Moscow. In 1990 he joined Lebedev Physical Institute, Moscow, Russia. In 1991–2000, he was a CIRES research associate in the Environmental Technology Laboratory of NOAA, Boulder, CO, and became a NOAA/ETL physicist in 2000. His research interests include theory of wave propagation through random media, wave scattering from rough surfaces, and GPS ocean and land remote sensing applications. Dr. Zavorotny is a senior member of the Institute of Electrical and Electronics Engineers, a member of URSI (Commission F), and a member of the American Geophysical Union.