



**MEMBERSHIPS IN PROFESSIONAL AND HONORARY SOCIETIES**

Fellow, Institute of Navigation (ION)

Fellow, The Royal Institute of Navigation (RIN)

Senior Member, Institute of Electrical and Electronics Engineers (IEEE)

**PROFESSIONAL SOCIETY AND MAJOR GOVERNMENTAL COMMITTEES, EDITORIAL BOARDS, AND CONFERENCES ORGANIZED/CHAIR****Outside Committees**

Land Representative, Institute of Navigation Governing Council, 2012–2014

**Conference Activities: Organizer**

Track chair, European Space Agency NAVITEC conference, April 2022

Lead organizer, Texas Wireless Summit, November 2016

Track chair, IEEE/Institute of Navigation PLANS conference, April 2016

Lead organizer, Texas Wireless Summit, October 2013

Track chair, Institute of Navigation GNSS+ conference, September 2013

Lead organizer, Civil GPS Security Meeting, September 2010

**Conference Activities: Session Chair**

Panel session chair, Brooklyn 6G Summit: The Metaverse, October 2022

Session chair, Institute of Navigation GNSS+ conference: Extended Reality and PNT, September 2022

Session chair, 6G@UT Forum, Extraterrestrial 6G, May 2022

Session chair, IEEE Wireless Communications and Networking Conference: Co-Design of Signals for Sensing and Communications, April 2022

Session chair, Munich Satellite Summit, Jamming and Spoofing in GNSS, March 2022

Session chair, Institute of Navigation GNSS+ conference: GNSS Authentication and Anti-Spoofing, September 2021

Session chair, Institute of Navigation GNSS+ conference: Novel Applications of GNSS in Smartphones, September 2020

Session chair, IEEE/ION PLANSx conference: Autonomous Vehicle Navigation in Challenging Environments, September 2020

Session chair, IEEE/ION PLANS conference: GNSS Resilience, May 2018

Session chair, Institute of Navigation GNSS conference: High Precision GNSS Positioning, September 2016

Session chair, Institute of Navigation GNSS conference: GNSS Vulnerabilities and Anti-Jamming, September 2015

Panel Session chair, Institute of Navigation GNSS conference: Privacy Issues, September 2015

Session chair, Institute of Navigation GNSS conference: GNSS Vulnerabilities 1: Interference, September 2014

Session chair, Institute of Navigation GNSS conference: GNSS Vulnerabilities 2: Spoofing and Authentication, September 2014

Panel Session chair, Institute of Navigation GNSS conference: GNSS Vulnerabilities and Threats, September 2014

Session chair, IEEE/ION PLANS conference: Interference and Robust Navigation, May 2014

Session chair, Institute of Navigation International Technical Meeting: Interference and Spectrum Management, January 2013

Session chair, Institute of Navigation GNSS conference: Spectrum Interference, September 2012

Session chair, IEEE/ION PLANS conference: Receiver and Antenna Technology Session, April 2012

Panel session chair, Institute of Navigation GNSS conference: GNSS Security, September 2011

Session chair, IEEE/ION PLANS conference: Algorithms and Processing, May 2010

### **Journal Activities**

Editor, IEEE Transactions on Wireless Communications, May 2014–January 2017

### **OTHER PROFESSIONAL HIGHLIGHTS**

#### **Congressional Testimony**

Invited witness, U.S. House Subcommittee on Homeland Security Oversight hearing on the threat of unmanned aerial systems, March 2015

Invited witness, U.S. House Judiciary Subcommittee on Crime, Terrorism, and Homeland Security field forum on privacy in an age of drones, October 2012

Invited witness, U.S. House Subcommittee on Homeland Security Oversight hearing on drone security, July 2012

#### **Invited Subject Matter Expert**

National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, June 2019

National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, June 2015

Department of Homeland Security risk assessment of critical infrastructure dependence on GPS, March-September, 2011

U.S. Patent and Trademark Office briefing on advances in GNSS technology, April 2011

National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, October 2010

#### **Current Review Activities**

IEEE Transactions on Aerospace and Electronic Systems

NAVIGATOR, the journal of the Institute of Navigation

IEEE Transactions on Wireless Communications

### **UNIVERSITY COMMITTEES/ADMINISTRATIVE ASSIGNMENTS**

#### **Administrative Assignments**

Director, Wireless Networking and Communications Group, 2021-present

Director, Radionavigation Laboratory, 2009-present

Director, UT SAVES, 2020-2021

Associate Director, UT SAVES, 2016-2020

Faculty advisor, UT student chapter of AIAA, 2010-2019

Faculty advisor, Sigma Gamma Tau Honor Society, 2016-2019

#### **Cockrell School of Engineering**

Cockrell School Honors Committee, 2011-2019

College of Engineering Faculty Committee

#### **Department Committees**

ECE Faculty Search Committee, 2021-2022

ASE Chair of Robotics Faculty Search Committee, 2019-2020

ASE Strategic Planning Committee, 2017-2019

ASE Department Faculty Committee, 2009-present  
 ASE Orbits Area Faculty Committee, 2009-present  
 ASE Controls, Autonomy, and Robotics Area Faculty Committee, 2014-present  
 ASE Graduate Studies Committee, 2009-present  
 ECE Graduate Studies Committee, 2012-present

## HONORS AND AWARDS

Institute of Navigation Kepler Award, 2023  
 IEEE Walter Fried Best Paper Award, 2023 (with student Zach Clements)  
 Distinguished Alumnus of the Year, Utah State University ECE Department, 2022  
 Royal Institute of Navigation Fellow, 2021  
 IEEE Walter Fried Best Paper Award, 2020 (with student Lakshay Narula)  
 Institute of Navigation Fellow, 2020  
 PECASE: Presidential Early Career Award for Scientists and Engineers (via NSF), 2019  
 Qualcomm Innovation Fellowship, 2017 (with students Lakshay Narula and Matthew Murrian)  
 National Science Foundation CAREER Award, 2015  
 Outstanding Faculty Award, Dept. of Aerospace Engineering and Engineering Mechanics, 2015  
 Institute of Navigation Thurlow Award, 2014  
 GPS World Magazine Leadership Award, 2012  
 University of Texas System Regents' Outstanding Teaching Award, 2012  
 Cockrell School Dean's Award for Outstanding Teaching by an Assistant Professor, 2012  
 IEEE Walter Fried Best Paper Award, 2012 (with student Jahshan Bhatti)  
 Best Student Paper Award, IEEE/ION PLANS Conference, 2012 (with student Ken Pesyna)

## PUBLICATIONS

### Refereed Journal Publications

- J1 W. Qin, Z. M. Komodromos, A. M. Graff, and T. E. Humphreys, "Timing properties of the Starlink Ku-band downlink," *IEEE Transactions on Aerospace and Electronic Systems*, 2024. In preparation.
- J2 A. M. Graff and T. E. Humphreys, "Purposeful co-design of OFDM signals for ranging and communications," *EURASIP Journal on Advances in Signal Processing*, 2024 [pdf](#)
- J3 D. Akos, J. Arribas, M. Z. H. Bhuiyan, P. Closas, F. Doyis, I. Fernandez-Hernandez, S. Gunawardena, T. Humphreys, M. Nicola, T. Pany, M. Psiaki, A. Rügamer, J. A. L. Salcedo, C. Fernández-Prades, Y.-J. Song, and J.-H. Won, "GNSS software defined radio: History, current developments, and standardization efforts," *Navigation, Journal of the Institute of Navigation*, vol. 71, no. 1, 2024 [pdf](#)
- J4 T. E. Humphreys, P. A. Iannucci, Z. M. Komodromos, and A. M. Graff, "Signal structure of the Starlink Ku-band downlink," *IEEE Transactions on Aerospace and Electronic Systems*, pp. 1–16, 2023 [pdf](#)
- J5 J. E. Yoder and T. E. Humphreys, "Low-cost inertial aiding for deep-urban tightly-coupled multi-antenna precise GNSS," *Navigation, Journal of the Institute of Navigation*, vol. 70, no. 1, 2023 [pdf](#)
- J6 P. A. Iannucci and T. E. Humphreys, "Fused low-earth-orbit GNSS," *IEEE Transactions on Aerospace and Electronic Systems*, pp. 1–1, 2022 [pdf](#)
- J7 L. Narula, P. A. Iannucci, and T. E. Humphreys, "All-weather sub-50-cm radar-inertial positioning," *Field Robotics*, vol. 2, pp. 525–556, 2022 [pdf](#)
- J8 W. A. Lies, L. Narula, P. A. Iannucci, and T. E. Humphreys, "Long-range, low SWaP-C FMCW radar," *IEEE Journal of Selected Topics in Signal Processing*, pp. 1–1, 2021 [pdf](#)

- J9 M. J. Murrian, L. Narula, P. A. Iannucci, S. Budzien, B. W. O’Hanlon, S. P. Powell, and T. E. Humphreys, “First results from three years of GNSS interference monitoring from low Earth orbit,” *Navigation, Journal of the Institute of Navigation*, vol. 68, no. 4, pp. 673–685, 2021 [pdf](#)
- J10 T. E. Humphreys, M. J. Murrian, and L. Narula, “Deep-urban unaided precise global navigation satellite system vehicle positioning,” *IEEE Intelligent Transportation Systems Magazine*, vol. 12, no. 3, pp. 109–122, 2020 [pdf](#)
- J11 L. Narula, J. M. Wooten, M. J. Murrian, D. M. LaChapelle, and T. E. Humphreys, “Accurate collaborative globally-referenced digital mapping with standard GNSS,” *Sensors*, vol. 18, no. 8, 2018 [pdf](#)
- J12 J. N. Gross, C. Kilic, and T. E. Humphreys, “Maximum-likelihood power-distortion monitoring for GNSS-signal authentication,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 55, no. 1, pp. 469–475, 2018 [pdf](#)
- J13 G. N. Green and T. Humphreys, “Position-domain integrity analysis for generalized integer aperture bootstrapping,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 55, no. 2, pp. 734–746, 2018 [pdf](#)
- J14 G. N. Green and T. E. Humphreys, “Data-driven generalized integer aperture bootstrapping for high-integrity positioning,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 55, no. 2, pp. 757–768, 2018 [pdf](#)
- J15 L. Narula and T. E. Humphreys, “Requirements for secure clock synchronization,” *IEEE Journal of Selected Topics in Signal Processing*, vol. 12, pp. 749–762, Aug. 2018 [pdf](#)
- J16 K. D. Wesson, J. N. Gross, T. E. Humphreys, and B. L. Evans, “GNSS signal authentication via power and distortion monitoring,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 54, pp. 739–754, April 2018 [pdf](#)
- J17 K. M. Pesyna, Jr., T. Novlan, C. Zhang, R. W. Heath, Jr., and T. E. Humphreys, “Exploiting antenna motion for faster initialization of centimeter-accurate GNSS positioning with low-cost antennas,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 3, Aug. 2017 [pdf](#)
- J18 J. Bhatti and T. E. Humphreys, “Hostile control of ships via false GPS signals: Demonstration and detection,” *Navigation*, vol. 64, no. 1, pp. 51–66, 2017 [pdf](#)
- J19 M. L. Psiaki and T. E. Humphreys, “GNSS spoofing and detection,” *Proceedings of the IEEE*, vol. 104, no. 6, pp. 1258–1270, 2016 [pdf](#)
- J20 Z. M. Kassas and T. E. Humphreys, “Receding horizon trajectory optimization in opportunistic navigation environments,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 51, pp. 866–877, April 2015 [pdf](#)
- J21 Z. M. Kassas, A. Arapostathis, and T. E. Humphreys, “Greedy motion planning for simultaneous signal landscape mapping and receiver localization,” *IEEE Journal of Selected Topics in Signal Processing*, vol. 9, pp. 247 – 258, March 2015 [pdf](#)
- J22 C. R. Clauer, H. Kim, K. Deshpande, Z. Xu, D. Weimer, S. Musko, G. Crowley, C. Fish, R. Nealy, T. E. Humphreys, J. A. Bhatti, and A. J. Ridley, “Autonomous adaptive low-power instrument platform (AAL-PIP) for remote high latitude geospace data collection,” *Geoscientific Instrumentation, Methods and Data Systems*, vol. 3, pp. 211–227, 2014 [pdf](#)
- J23 A. J. Kerns, D. P. Shepard, J. A. Bhatti, and T. E. Humphreys, “Unmanned aircraft capture and control via GPS spoofing,” *Journal of Field Robotics*, vol. 31, no. 4, pp. 617–636, 2014 [pdf](#)
- J24 H. Kim, C. Clauer, K. Deshpande, M. Lessard, A. Weatherwax, G. S. Bust, G. Crowley, and T. E. Humphreys, “Ionospheric irregularities during a substorm event: Observations of ULF pulsations and GPS scintillations,” *Journal of Atmospheric and Solar-Terrestrial Physics*, vol. 114, pp. 1–8, 2014 [link](#)
- J25 K. M. Pesyna, Jr., Z. M. Kassas, R. W. Heath, Jr., and T. E. Humphreys, “A phase-reconstruction technique for low-power centimeter-accurate mobile positioning,” *IEEE Transactions on Signal Processing*, vol. 62, pp. 2595–2610, May 2014 [pdf](#)

- J26 Z. M. Kassas and T. E. Humphreys, “Observability analysis of collaborative opportunistic navigation with pseudorange measurements,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 15, pp. 260–273, Feb. 2014 [pdf](#)
- J27 E. G. Lightsey, T. E. Humphreys, J. A. Bhatti, A. J. Joplin, B. W. O’Hanlon, and S. P. Powell, “Demonstration of a space capable miniature dual frequency GNSS receiver,” *Navigation*, vol. 61, pp. 53–64, Mar. 2014 [pdf](#)
- J28 T. E. Humphreys, “Detection strategy for cryptographic GNSS anti-spoofing,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 49, no. 2, pp. 1073–1090, 2013 [pdf](#)
- J29 B. W. O’Hanlon, M. L. Psiaki, T. E. Humphreys, J. A. Bhatti, and D. P. Shepard, “Real-time GPS spoofing detection via correlation of encrypted signals,” *Navigation, Journal of the Institute of Navigation*, vol. 60, no. 4, pp. 267–278, 2013 [pdf](#)
- J30 M. Psiaki, B. O’Hanlon, J. Bhatti, D. Shepard, and T. Humphreys, “GPS spoofing detection via dual-receiver correlation of military signals,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 49, no. 4, pp. 2250–2267, 2013 [pdf](#)
- J31 K. B. Deshpande, G. S. Bust, C. R. Clauer, H. Kim, J. E. Macon, T. E. Humphreys, J. A. Bhatti, S. B. Musko, G. Crowley, and A. T. Weatherwax, “Initial GPS scintillation results from CASES receiver at South Pole, Antarctica,” *Radio Science*, vol. 47, no. 5, 2012 [pdf](#)
- J32 D. P. Shepard, T. E. Humphreys, and A. A. Fansler, “Evaluation of the vulnerability of phasor measurement units to GPS spoofing attacks,” *International Journal of Critical Infrastructure Protection*, vol. 5, no. 3-4, pp. 146–153, 2012 [pdf](#)
- J33 K. D. Wesson, M. P. Rothlisberger, and T. E. Humphreys, “Practical cryptographic civil GPS signal authentication,” *Navigation, Journal of the Institute of Navigation*, vol. 59, no. 3, pp. 177–193, 2012 [pdf](#)
- J34 T. E. Humphreys, M. L. Psiaki, and P. M. Kintner, “Modeling the effects of ionospheric scintillation on GPS carrier phase tracking,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 46, pp. 1624–1637, Oct. 2010 [pdf](#)
- J35 T. E. Humphreys, M. L. Psiaki, B. M. Ledvina, A. P. Cerruti, and P. M. Kintner, Jr., “A data-driven testbed for evaluating GPS carrier tracking loops in ionospheric scintillation,” *IEEE Transactions on Aerospace and Electronic Systems*, vol. 46, pp. 1609–1623, Oct. 2010 [pdf](#)
- J36 T. E. Humphreys, M. L. Psiaki, J. C. Hinks, B. O’Hanlon, and P. M. Kintner, Jr., “Simulating ionosphere-induced scintillation for testing GPS receiver phase tracking loops,” *IEEE Journal of Selected Topics in Signal Processing*, vol. 3, pp. 707–715, Aug. 2009 [pdf](#)
- J37 T. E. Humphreys, M. C. Kelley, N. Huber, and P. M. Kintner, “The semidiurnal variation in GPS-derived zenith neutral delay,” *Geophysical Research Letters*, vol. 32, no. 24, 2005 [pdf](#)
- J38 T. E. Humphreys, M. Psiaki, E. Klatt, S. Powell, and P. M. Kintner, Jr., “Magnetometer-based attitude and rate estimation for a spacecraft with wire booms,” *Journal of Guidance, Control, and Dynamics*, vol. 28, pp. 584–593, July–Aug. 2005 [pdf](#)

### Refereed Conference Proceedings

- C1 Z. Clements, I. Goodridge, P. Ellis, M. J. Murrian, and T. E. Humphreys, “Demonstration of single-satellite GNSS spoofer geolocation,” in *Proceedings of the ION International Technical Meeting*, (Long Beach, CA), pp. 361–373, 2024 [pdf](#)
- C2 T. Haydon and T. E. Humphreys, “Trusted inertial terrain-aided navigation (TITAN),” in *Proceedings of the ION GNSS+ Meeting*, 2023 [pdf](#)
- C3 W. Qin, Z. M. Komodromos, and T. E. Humphreys, “An agile, portable antenna system for LEO megaconstellation-based PNT,” in *Proceedings of the ION GNSS+ Meeting*, 2023 [pdf](#)
- C4 Z. M. Komodromos, W. Qin, and T. E. Humphreys, “Signal simulator for Starlink Ku-Band downlink,” in *Proceedings of the ION GNSS+ Meeting*, 2023 [pdf](#)

- C5 A. M. Graff and T. E. Humphreys, “Signal identification and entrainment for practical FMCW radar spoofing attacks,” in *Proceedings of the IEEE 97th Vehicular Technology Conference (VTC2023-Spring)*, (Florence, IT), 2023 [pdf](#)
- C6 R. M. Tenny, L. C. Sun, A. Duru, and T. E. Humphreys, “Robust absolute headset tracking for extended reality,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Monterey, CA), 2023 [pdf](#)
- C7 Z. Clements, P. Ellis, and T. E. Humphreys, “Dual-satellite geolocation of terrestrial GNSS jammers from low Earth orbit,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Monterey, CA), pp. 458–469, 2023 [pdf](#)  
**Walter Fried overall best paper award.**
- C8 R. Tenny and T. E. Humphreys, “Robust navigation for urban air mobility via tight coupling of GNSS with terrestrial radionavigation and inertial sensing,” in *Proceedings of the ION GNSS+ Meeting*, (Denver, CO), 2022 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C9 Z. Clements, P. Ellis, M. L. Psiaki, and T. E. Humphreys, “Geolocation of terrestrial GNSS spoofing signals from low Earth orbit,” in *Proceedings of the ION GNSS+ Meeting*, (Denver, CO), pp. 3418–3431, 2022 [pdf](#)
- C10 D. Akos, J. Arribas, M. Z. H. Bhuiyan, P. Closas, F. Dosis, I. Fernandez-Hernandez, S. Gunawardena, T. Humphreys, M. Nicola, T. Pany, M. Psiaki, A. Rügamer, J. A. L. Salcedo, C. Fernández-Prades, Y.-J. Song, and J.-H. Won, “GNSS software defined radio history, current developments, and standardization efforts,” in *Proceedings of the ION GNSS+ Meeting*, (Denver, CO), 2022 [pdf](#)
- C11 H. A. Nichols, M. J. Murrian, and T. E. Humphreys, “Software-defined GNSS is ready for launch,” in *Proceedings of the ION GNSS+ Meeting*, (Denver, CO), 2022 [pdf](#)
- C12 Z. Clements, J. E. Yoder, and T. E. Humphreys, “Carrier-phase and IMU based GNSS spoofing detection for ground vehicles,” in *Proceedings of the ION International Technical Meeting*, (Long Beach, CA), pp. 83–95, 2022 [pdf](#)
- C13 D. M. LaChapelle, L. Narula, and T. E. Humphreys, “Orbital war driving: Assessing transient GPS interference from LEO,” in *Proceedings of the ION GNSS+ Meeting*, (St. Louis, MO), 2021 [pdf](#)
- C14 Z. Clements, P. A. Iannucci, T. E. Humphreys, and T. Pany, “Optimized bit-packing for bit-wise software-defined GNSS radio,” in *Proceedings of the ION GNSS+ Meeting*, (St. Louis, MO), pp. 3749–3771, 2021 [pdf](#)
- C15 A. M. Graff, W. N. Blount, P. A. Iannucci, J. G. Andrews, and T. E. Humphreys, “Analysis of OFDM signals for ranging and communications,” in *Proceedings of the ION GNSS+ Meeting*, (St. Louis, MO), 2021 [pdf](#)
- C16 R. X. Kor, P. A. Iannucci, and T. E. Humphreys, “Autonomous signal-situational awareness in a terrestrial radionavigation system,” in *2021 International Conference on Intelligent Transportation Systems (ITSC)*, IEEE, 2021 [pdf](#)
- C17 T. E. Humphreys, R. X. T. Kor, and P. A. Iannucci, “Open-world virtual reality headset tracking,” in *Proceedings of the ION GNSS+ Meeting*, (Online), 2020 [pdf](#)
- C18 J. E. Yoder, P. A. Iannucci, L. Narula, and T. E. Humphreys, “Multi-antenna vision-and-inertial-aided CDGNSS for micro aerial vehicle pose estimation,” in *Proceedings of the ION GNSS+ Meeting*, (Online), pp. 2281–2298, 2020 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C19 R. X. Kor, P. A. Iannucci, L. Narula, and T. E. Humphreys, “A proposal for securing terrestrial radionavigation systems,” in *Proceedings of the ION GNSS+ Meeting*, (Online), 2020 [pdf](#)
- C20 L. Narula, P. A. Iannucci, and T. E. Humphreys, “Automotive-radar-based 50-cm urban positioning,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)  
**Walter Fried overall best paper award.**

- C21 L. Narula, D. M. LaChapelle, M. J. Murrian, J. M. Wooten, T. E. Humphreys, J.-B. Lacambre, E. de Toldi, and G. Morvant, “TEX-CUP: The University of Texas Challenge for Urban Positioning,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)
- C22 P. A. Iannucci and T. E. Humphreys, “Economical fused LEO GNSS,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)
- C23 P. A. Iannucci, L. Narula, and T. E. Humphreys, “Cross-modal localization: Using automotive radar for absolute geolocation within a map produced with visible-light imagery,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)
- C24 W. A. Lies, L. Narula, P. A. Iannucci, and T. E. Humphreys, “Low SWaP-C radar for urban air mobility,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)
- C25 N. Montalbano and T. Humphreys, “Intercepting unmanned aerial vehicle swarms with neural-network-aided game-theoretic target assignment,” in *Proceedings of the IEEE/ION PLANS Meeting*, 2020 [pdf](#)
- C26 D. LaChapelle, T. E. Humphreys, L. Narula, P. A. Iannucci, and E. Moradi-Pari, “Automotive collision risk estimation under cooperative sensing,” in *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing*, (Barcelona, Spain), 2020 [pdf](#)
- C27 M. J. Murrian, L. Narula, and T. E. Humphreys, “Characterizing terrestrial GNSS interference from low earth orbit,” in *Proceedings of the ION GNSS+ Meeting*, Institute of Navigation, Oct. 2019 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C28 L. Narula, M. J. Murrian, and T. E. Humphreys, “Accuracy limits for globally-referenced digital mapping using standard GNSS,” in *2018 21st International Conference on Intelligent Transportation Systems (ITSC)*, pp. 3075–3082, IEEE, 2018 [pdf](#)
- C29 N. Montalbano and T. E. Humphreys, “A comparison of methods for online lever arm estimation in GPS/INS integration,” in *2018 IEEE/ION Position, Location and Navigation Symposium (PLANS)*, pp. 680–687, April 2018 [pdf](#)
- C30 T. E. Humphreys, M. Murrian, and L. Narula, “Low-cost precise vehicular positioning in urban environments,” in *2018 IEEE/ION Position, Location and Navigation Symposium (PLANS)*, pp. 456–471, April 2018 [pdf](#)
- C31 J. Gross and T. E. Humphreys, “GNSS spoofing, jamming, and multipath interference classification using a maximum-likelihood multi-tap multipath estimator,” *Proceedings of the ION International Technical Meeting*, Jan. 2017 [pdf](#)
- C32 L. Narula and T. E. Humphreys, “Requirements for secure wireless time transfer,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Savannah, GA), 2016 [pdf](#)
- C33 G. N. Green, M. King, and T. E. Humphreys, “Data-driven generalized integer aperture bootstrapping for real-time high integrity applications,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Savannah, GA), 2016 [pdf](#)
- C34 M. Murrian, C. Gonzalez, T. E. Humphreys, and T. D. Novlan, “A dense reference network for mass-market centimeter-accurate positioning,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Savannah, GA), 2016 [pdf](#)
- C35 T. E. Humphreys, M. Murrian, K. M. Pesyna, Jr., F. van Diggelen, and S. Podshivalov, “On the feasibility of centimeter-accurate positioning via a smartphone’s antenna and GNSS chip,” in *Proceedings of the IEEE/ION PLANS Meeting*, (Savannah, GA), 2016 [pdf](#)
- C36 G. N. Green, M. King, and T. E. Humphreys, “Fault free integrity of mid-level voting for triplex differential GPS solutions,” in *Proceedings of the ION GNSS+ Meeting*, (Tampa, FL), 2015 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C37 M. L. Psiaki, B. W. O’Hanlon, S. P. Powell, J. A. Bhatti, K. D. Wesson, T. E. Humphreys, and A. Schofield, “GNSS spoofing detection using two-antenna differential carrier phase,” in *Proceedings of the ION GNSS+ Meeting*, (Tampa, FL), Institute of Navigation, 2014 [pdf](#)
- C38 Z. M. Kassas, V. Ghadiok, and T. E. Humphreys, “Adaptive estimation of signals of opportunity,” in *Proceedings of the ION GNSS+ Meeting*, 2014 [pdf](#)



- C39 K. M. Pesyna, Jr., R. W. Heath, Jr., and T. E. Humphreys, “Centimeter positioning with a smartphone-quality GNSS antenna,” in *Proceedings of the ION GNSS+ Meeting*, 2014 [pdf](#)
- C40 T. E. Humphreys, D. P. Shepard, J. A. Bhatti, and K. D. Wesson, “A testbed for developing and evaluating GNSS signal authentication techniques,” in *Proceedings of the International Symposium on Certification of GNSS Systems and Services (CERGAL)*, (Dresden, Germany), July 2014 [pdf](#)
- C41 D. P. Shepard and T. E. Humphreys, “High-precision globally-referenced position and attitude via a fusion of visual SLAM, carrier-phase-based GPS, and inertial measurements,” in *Proceedings of the IEEE/ION PLANS Meeting*, May 2014 [pdf](#)
- C42 A. J. Kerns, K. D. Wesson, and T. E. Humphreys, “A blueprint for civil GPS navigation message authentication,” in *Proceedings of the IEEE/ION PLANS Meeting*, May 2014 [pdf](#)
- C43 K. D. Wesson, B. L. Evans, and T. E. Humphreys, “A probabilistic framework for Global Navigation Satellite System signal timing assurance,” in *Proceedings of Asilomar Conference on Signals, Systems, and Computers*, (Pacific Grove, CA), 2013 [pdf](#)
- C44 K. D. Wesson, B. L. Evans, and T. E. Humphreys, “A combined symmetric difference and power monitoring GNSS anti-spoofing technique,” in *IEEE Global Conference on Signal and Information Processing*, 2013 [pdf](#)
- C45 Z. M. Kassas, J. A. Bhatti, and T. E. Humphreys, “A graphical approach to GPS software-defined receiver implementation,” in *Proceedings of IEEE Global Conference on Signal and Information Processing*, December 2013 [pdf](#)
- C46 Z. Kassas and T. E. Humphreys, “The price of anarchy in active signal landscape map building,” in *Proceedings of IEEE Global Conference on Signal and Information Processing*, December 2013 [pdf](#)
- C47 Z. Kassas, J. A. Bhatti, and T. E. Humphreys, “Receding horizon trajectory optimization for simultaneous signal landscape mapping and receiver localization,” in *Proceedings of the ION GNSS+ Meeting*, September 2013 [pdf](#)
- C48 K. M. Pesyna, Jr., R. W. Heath, Jr., and T. E. Humphreys, “Precision limits of low-energy GNSS receivers,” in *Proceedings of the ION GNSS+ Meeting*, (Nashville, Tennessee), Institute of Navigation, 2013 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C49 Z. M. Kassas and T. E. Humphreys, “Motion planning for optimal information gathering in opportunistic navigation systems,” in *AIAA Guidance, Navigation, and Control Conference (GNC’13)*, (Boston, MA), pp. 4551–4565, Aug. 2013 [pdf](#)
- C50 K. D. Wesson, T. E. Humphreys, and B. L. Evans, “Position paper: Secure time transfer for CPS,” in *NSF/NSA National Workshop on The New Clockwork for Time-Critical Systems*, 2012 [pdf](#)
- C51 D. P. Shepard, K. M. Pesyna, Jr., and T. E. Humphreys, “Precise augmented reality enabled by carrier-phase differential GPS,” in *Proceedings of the ION GNSS Meeting*, (Nashville, Tennessee), Institute of Navigation, 2012 [pdf](#)
- C52 D. P. Shepard, J. A. Bhatti, T. E. Humphreys, and A. A. Fansler, “Evaluation of smart grid and civilian UAV vulnerability to GPS spoofing attacks,” in *Proceedings of the ION GNSS Meeting*, 2012 [pdf](#)
- C53 Z. M. Kassas and T. E. Humphreys, “Observability and estimability of collaborative opportunistic navigation with pseudorange measurements,” in *Proceedings of the ION GNSS Meeting*, (Nashville, Tennessee), Institute of Navigation, 2012 [pdf](#)
- C54 T. E. Humphreys, J. A. Bhatti, D. P. Shepard, and K. D. Wesson, “The Texas Spoofing Test Battery: Toward a standard for evaluating GNSS signal authentication techniques,” in *Proceedings of the ION GNSS Meeting*, 2012 [pdf](#)
- C55 Z. M. Kassas and T. E. Humphreys, “Observability analysis of opportunistic navigation with pseudorange measurements,” in *Proceedings of AIAA Guidance, Navigation, and Control Conference*, Aug. 2012 [pdf](#)

- C56 J. A. Bhatti, T. E. Humphreys, and B. M. Ledvina, “Development and demonstration of a TDOA-based GNSS interference signal localization system,” in *Proceedings of the IEEE/ION PLANS Meeting*, pp. 1209–1220, April 2012 [pdf](#)  
**Walter Fried overall best paper award.**
- C57 K. M. Pesyna, Jr., Z. M. Kassas, and T. E. Humphreys, “Constructing a continuous phase time history from TDMA signals for opportunistic navigation,” in *Proceedings of the IEEE/ION PLANS Meeting*, pp. 1209–1220, April 2012 [pdf](#)  
**Conference best student paper award.**
- C58 D. Shepard, T. E. Humphreys, and A. Fansler, “Evaluation of the vulnerability of Phasor Measurement Units to GPS spoofing,” in *Sixth Annual IFIP WG 11.10 International Conference on Critical Infrastructure Protection*, (Washington, DC), Mar. 2012 [pdf](#)
- C59 A. J. Joplin, E. G. Lightsey, and T. E. Humphreys, “Development and testing of a miniaturized, dual-frequency GPS receiver for space applications,” in *Proceedings of the ION International Technical Meeting*, (Long Beach, CA), Jan. 2012 [pdf](#)
- C60 K. D. Wesson, M. P. Rothlisberger, and T. E. Humphreys, “A proposed navigation message authentication implementation for civil GPS anti-spoofing,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2011 [pdf](#)
- C61 D. Shepard and T. E. Humphreys, “Characterization of receiver response to a spoofing attack,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2011 [pdf](#)
- C62 R. Mitch, R. Dougherty, M. Psiaki, S. Powell, B. O’Hanlon, J. Bhatti, and T. Humphreys, “Signal characteristics of civil GPS jammers,” in *Proceedings of the ION GNSS Meeting*, 2011 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C63 M. L. Psiaki, B. W. O’Hanlon, J. A. Bhatti, and T. E. Humphreys, “Civilian GPS spoofing detection based on dual-receiver correlation of military signals,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2011 [pdf](#)
- C64 G. Crowley, G. S. Bust, A. Reynolds, I. Azeem, R. Wilder, B. W. O’Hanlon, M. L. Psiaki, S. Powell, T. E. Humphreys, and J. A. Bhatti, “CASES: A novel low-cost ground-based dual-frequency GPS software receiver and space weather monitor,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2011 [pdf](#)
- C65 B. O’Hanlon, M. Psiaki, S. Powell, J. Bhatti, T. E. Humphreys, G. Crowley, and G. Bust, “CASES: A smart, compact GPS software receiver for space weather monitoring,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), pp. 2745–2753, Institute of Navigation, 2011 [pdf](#)
- C66 K. D. Wesson, D. P. Shepard, J. A. Bhatti, and T. E. Humphreys, “An evaluation of the vestigial signal defense for civil GPS anti-spoofing,” in *Proceedings of the ION GNSS Meeting*, (Portland, OR), 2011 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C67 K. M. Pesyna Jr., Z. M. Kassas, J. A. Bhatti, and T. E. Humphreys, “Tightly-coupled opportunistic navigation for deep urban and indoor positioning,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2011 [pdf](#)
- C68 K. M. Pesyna, Jr., K. D. Wesson, R. W. Heath, Jr., and T. E. Humphreys, “Extending the reach of GPS-assisted femtocell synchronization and localization through tightly-coupled opportunistic navigation,” in *IEEE GLOBECOM Workshop*, 2011 [pdf](#)
- C69 B. O’Hanlon, J. Bhatti, T. E. Humphreys, and M. Psiaki, “Real-time spoofing detection in a narrow-band civil GPS receiver,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2010 [pdf](#)
- C70 T. E. Humphreys, J. Bhatti, and B. Ledvina, “The GPS Assimilator: a method for upgrading existing GPS user equipment to improve accuracy, robustness, and resistance to spoofing,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2010 [pdf](#)

- C71 K. D. Wesson, K. M. Pesyna, Jr., J. A. Bhatti, and T. E. Humphreys, “Opportunistic frequency stability transfer for extending the coherence time of GNSS receiver clocks,” in *Proceedings of the ION GNSS Meeting*, (Portland, Oregon), Institute of Navigation, 2010 [pdf](#)
- C72 T. E. Humphreys, J. Bhatti, T. Pany, B. Ledvina, and B. O’Hanlon, “Exploiting multicore technology in software-defined GNSS receivers,” in *Proceedings of the ION GNSS Meeting*, (Savannah, GA), pp. 326–338, Institute of Navigation, 2009 [pdf](#)
- C73 B. W. O’Hanlon, M. L. Psiaki, P. M. Kintner, Jr., and T. E. Humphreys, “Development and field testing of a DSP-based dual-frequency software GPS receiver,” in *Proceedings of the ION GNSS Meeting*, (Savannah, GA), Institute of Navigation, 2009 [pdf](#)
- C74 T. E. Humphreys, B. M. Ledvina, M. L. Psiaki, B. W. O’Hanlon, and P. M. Kintner, Jr., “Assessing the spoofing threat: Development of a portable GPS civilian spoofer,” in *Proceedings of the ION GNSS Meeting*, (Savannah, GA), Institute of Navigation, 2008 [pdf](#)
- C75 J. C. Hinks, T. E. Humphreys, B. O’Hanlon, M. L. Psiaki, and P. M. Kintner, Jr., “Evaluating GPS receiver robustness to ionospheric scintillation,” in *Proceedings of the ION GNSS Meeting*, (Savannah, GA), Institute of Navigation, 2008 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C76 S. Mohiuddin, T. E. Humphreys, and M. L. Psiaki, “A technique for determining the carrier phase differences between independent GPS receivers during scintillation,” *Proceedings of the ION GNSS Meeting*, 2007 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C77 M. L. Psiaki, T. E. Humphreys, S. Mohiuddin, S. P. Powell, A. P. Cerruti, and P. M. Kintner, Jr., “Searching for Galileo,” in *Proceedings of the ION GNSS Meeting*, (Fort Worth, TX), Institute of Navigation, 2006 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C78 T. E. Humphreys, B. M. Ledvina, M. L. Psiaki, and P. M. Kintner, Jr., “GNSS receiver implementation on a DSP: Status, challenges, and prospects,” in *Proceedings of the ION GNSS Meeting*, (Fort Worth, TX), pp. 2370–2382, Institute of Navigation, 2006 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C79 T. E. Humphreys, M. L. Psiaki, B. M. Ledvina, and P. M. Kintner, Jr., “GPS carrier tracking loop performance in the presence of ionospheric scintillations,” in *Proceedings of the ION GNSS Meeting*, (Long Beach, CA), Institute of Navigation, Sept. 2005 [pdf](#)  
**Best presentation award in session of 8 papers.**
- C80 T. E. Humphreys, B. M. Ledvina, M. L. Psiaki, and P. M. Kintner, “Analysis of ionospheric scintillations using wideband GPS L1 C/A signal data,” in *Proceedings of the ION GNSS Meeting*, (Long Beach, California), pp. 399–407, Institute of Navigation, 2004 [pdf](#)
- C81 T. E. Humphreys, M. Kelley, and P. M. Kintner, Jr., “GPS-based measurement of atmospheric tides,” in *Proceedings of the ION GNSS Meeting*, (Long Beach, California), pp. 864–880, Institute of Navigation, 2004
- C82 T. E. Humphreys, “Attitude determination for small satellites with modest pointing constraints,” in *Proc. 2002 AIAA/USU Small Satellite Conference*, (Logan, Utah), 2002

### Other Major Publications

- M1 Z. Clements, P. B. Ellis, and T. E. Humphreys, “Pinpointing GNSS interference from low earth orbit,” *Inside GNSS*, vol. 18, no. 5, pp. 42–55, 2023
- M2 R. Tenny and T. E. Humphreys, “Robust navigation for urban air mobility,” *Inside GNSS*, vol. 18, no. 2, pp. 47–47, 2023
- M3 Z. Clements, J. E. Yoder, and T. E. Humphreys, “GNSS spoofing detection: An approach for ground vehicles using carrier-phase and inertial measurement data,” *GPS World*, vol. 34, no. 2, pp. 36–41, 2023

- M4 J. E. Yoder, P. A. Iannucci, L. Narula, and T. E. Humphreys, “Seeing and inertial integrating is believing: Multi-antenna vision-and-inertial-aided CDGNSS for micro aerial vehicle pose estimation,” *Inside GNSS*, vol. 16, no. 3, pp. 46–53, 2021
- M5 M. J. Murrian, L. Narula, T. E. Humphreys, B. W. O’Hanlon, and S. Budzien, “Characterizing GNSS interference from low-earth orbit,” *Inside GNSS*, vol. 15, no. 1, pp. 54–59, 2020
- M6 M. J. Murrian, C. W. Gonzalez, T. E. Humphreys, K. M. P. Jr., D. P. Shepard, and A. J. Kerns, “Low-cost precise positioning for automated vehicles,” *GPS World*, vol. 27, pp. 32–39, September 2016
- M7 M. L. Psiaki and T. E. Humphreys, “Attackers can spoof navigation signals without our knowledge. here’s how to fight back GPS lies,” *IEEE Spectrum*, vol. 53, pp. 26–53, August 2016
- M8 T. E. Humphreys, “Statement on the security threat posed by unmanned aerial systems and possible countermeasures,” *United States House of Representatives Committee on Homeland Security: Subcommittee on Oversight and Management Efficiency*, Mar. 2015
- M9 K. M. Pesyna, Jr, R. W. Heath, Jr., and T. E. Humphreys, “Accuracy in the palm of your hand: Centimeter positioning with a smartphone-quality GNSS antenna,” *GPS World*, vol. 26, pp. 16–31, Feb. 2015
- M10 M. L. Psiaki, B. W. O’Hanlon, S. P. Powell, J. A. Bhatti, T. E. Humphreys, and A. Schofield, “GNSS lies, GNSS truth: Spoofing detection with two-antenna differential carrier phase,” *GPS World*, vol. 25, pp. 36–44, Feb. 2014
- M11 K. D. Wesson and T. E. Humphreys, “Hacking drones,” *Scientific American*, vol. 309, no. 5, pp. 54–59, 2013
- M12 D. P. Shepard, J. A. Bhatti, and T. E. Humphreys, “Drone hack: Spoofing attack demonstration on a civilian unmanned aerial vehicle,” *GPS World*, Aug. 2012
- M13 D. P. Shepard, T. E. Humphreys, and A. A. Fansler, “Going up against time: The power grid’s vulnerability to GPS spoofing attacks,” *GPS World*, Aug. 2012
- M14 T. E. Humphreys, “Statement on privacy issues related to the domestic use of unmanned aerial vehicles,” *United States House of Representatives Committee on the Judiciary: Subcommittee on Crime, Terrorism, and Homeland Security: Field Forum*, Oct. 2012
- M15 T. E. Humphreys, “Statement on the vulnerability of civil unmanned aerial vehicles and other systems to civil GPS spoofing,” *United States House of Representatives Committee on Homeland Security: Subcommittee on Oversight, Investigations, and Management*, July 2012
- M16 T. E. Humphreys, “The GPS dot and its discontents: Privacy vs. GNSS integrity,” *Inside GNSS*, vol. 7, Mar./Apr. 2012
- M17 R. Mitch, R. Dougherty, M. Psiaki, S. Powell, B. O’Hanlon, J. Bhatti, and T. E. Humphreys, “Know your enemy: Signal characteristics of civil GPS jammers,” *GPS World*, Jan. 2012
- M18 K. D. Wesson, D. P. Shepard, and T. E. Humphreys, “Straight talk on anti-spoofing: Securing the future of PNT,” *GPS World*, Jan. 2012
- M19 T. E. Humphreys, J. Bhatti, and B. M. Ledvina, “The GPS Assimilator: Upgrading receivers via benign spoofing,” *Inside GNSS*, vol. 5, pp. 50–58, June 2010
- M20 P. M. Kintner, Jr., T. E. Humphreys, and J. Hinks, “GNSS and ionospheric scintillation: How to survive the next solar maximum,” *Inside GNSS*, vol. 4, pp. 22–30, July 2009
- M21 P. Y. Montgomery, T. E. Humphreys, and B. M. Ledvina, “A multi-antenna defense: Receiver-autonomous GPS spoofing detection,” *Inside GNSS*, vol. 4, pp. 40–46, April 2009
- M22 T. E. Humphreys, B. M. Ledvina, M. L. Psiaki, B. W. O’Hanlon, and P. M. Kintner, Jr., “Assessing the spoofing threat,” *GPS World*, vol. 20, pp. 28–38, Jan. 2009
- M23 T. E. Humphreys, *Modeling Ionospheric Scintillation and its Effects on GPS Carrier Tracking Loops and Two Other Applications of Modeling and Estimation*. PhD thesis, Cornell University, Ithaca, New York, 2008

- M24 T. E. Humphreys, L. Young, and T. Pany, “Considerations for future IGS receivers,” in *Position Paper of the 2008 IGS Workshop*, 2008
- M25 M. L. Psiaki, T. E. Humphreys, S. Mohiuddin, S. P. Powell, A. P. Cerruti, and J. Paul M. Kintner, “Searching for Galileo: Reception and analysis of signals from GIOVE-A,” *GPS World*, vol. 17, pp. 66–72, June 2006
- M26 T. E. Humphreys, “Attitude determination for small satellites with modest pointing constraints,” Master’s thesis, Utah State University, Logan, Utah, 2003

### Book Chapters

- B1 M. L. Psiaki and T. E. Humphreys, *Position, Navigation, and Timing Technologies in the 21st Century: Integrated Satellite Navigation, Sensor Systems, and Civil Applications*, vol. 1, ch. Civilian GNSS Spoofing, Detection, and Recovery, pp. 655–680. Wiley-IEEE, 2020
- B2 T. E. Humphreys, “Interference,” in *Springer Handbook of Global Navigation Satellite Systems*, pp. 469–503, Springer International Publishing, 2017

### INVITED PRESENTATIONS

- P1 February 7, 2024, “The Final Frontier is the Next One: Low-Earth Orbit’s Geostrategic Role,” Space Cybersecurity and Resilience, University of Colorado, Colorado Springs, CO.
- P2 October 12, 2023, “Interference Patterns: Results from 5 years of GNSS Interference Monitoring from LEO,” Association of Old Crows (virtual).
- P3 September 15, 2023, “Pseudoranges from Starlink,” (panel presentation) ION GNSS+ Conference, Denver, CO.
- P4 September 15, 2023, “Interference Patterns,” (panel presentation) ION GNSS+ Conference, Denver, CO.
- P5 June 29, 2023, “Starlink Signal Structure for Navigation,” International Technical Symposium on Navigation and Timing, ENAC, Toulouse, France.
- P6 June, 2023 “Extraterrestrial 6G,” Keysight World Conference (virtual).
- P7 April 18, 2023, “Low-Cost Inertial Aiding for Deep-Urban Tightly-Coupled Multi-Antenna Precise GNSS,” Institute of Navigation Webinar. [video](#)
- P8 April 13, 2023, “PNT from LEO Mega-Constellations,” SatCom LEO and MEO Space Technical Information Meeting & Exchange, Naval Postgraduate School, Monterey, CA.
- P9 March 17, 2023, “Spoofing the Signal: Pinpointing Pirates and Putin,” Presentation in connection with ECE Alumnus of the Year Award, Utah State University, Logan, UT.
- P10 March 17, 2023, “The Final Frontier is the Next One: The Geopolitics of Low-Earth Orbit,” Center for Anticipatory Intelligence, Utah State University, Logan, UT.
- P11 March 15, 2023, “Reverse Engineering the Starlink Downlink,” Munich Satellite Navigation Summit, Munich, Germany.
- P12 August 11, 2022, “Rolling Sensor Calibration: Lessons from the Vehicle Sensorium Project,” Vision-Based Navigation Workshop (virtual).
- P13 May 4, 2022, “First Results from Three Years of GNSS Interference Monitoring from Low Earth Orbit,” STEP PNT Situational Awareness Workshop, Washington, D.C.
- P14 February 7, 2022, “First Results from Three Years of GNSS Interference Monitoring from Low Earth Orbit,” Institute of Navigation Webinar (virtual). [video](#)
- P15 August 24, 2021, “Resilient and Robust PNT,” (plenary presentation) Joint Navigation Conference, Cincinnati, Ohio. [slides](#)
- P16 June 24, 2021, “Global GNSS Interference Activity,” International Technical Symposium on Navigation and Timing, ENAC, Toulouse, France (virtual). [video](#)

- P17 February 26, 2021, “GNSS Spoofing, Jamming, and Tomfoolery,” SpaceX Seminar (virtual).
- P18 December 3, 2020, “Radionavigation and Wireless Communications,” NSF SII Workshop on Challenges and Opportunities for 6G and Navigation (virtual).
- P19 July 10, 2020, “Cooperative Sensing for Automated Vehicles,” Semiautonomous Seminar, U.C. Berkeley. [video](#)
- P20 March 10, 2020, “All-Weather 50-cm Localization for Self-Driving Cars,” Hexagon/NovAtel, Calgary, Canada. [video](#)
- P21 December 13, 2019, “Belt-and-Suspenders PNT for Automated Vehicles,” Joby Aviation, Santa Cruz, CA.
- P22 November 19, 2019, “GNSS Radio Frequency Interference Detection from Low Earth Orbit,” (keynote presentation) Royal Institute of Navigation International Navigation Conference, Edinburgh, Scotland.
- P23 November 18, 2019, “Adding Resilience: Secure Perception for Autonomous Systems,” Royal Institute of Navigation International Navigation Conference, Edinburgh, Scotland.
- P24 October 16, 2019, “Collaborative Sensing for Self-Driving Cars: Security Implications,” NSF Assured Autonomy Workshop, Washington, D.C.
- P25 September 19, 2019, “Belt-and-Suspenders PNT for Self-Driving Cars and Air Taxis,” (panel presentation) ION GNSS+ Conference, Miami, FL.
- P26 September 18, 2019, “Insights from Two Years of GNSS Interference Observations from Space,” (panel presentation), ION GNSS+ Conference, Miami, FL.
- P27 July 10, 2019, “Automated Vehicle Control based on Secure Collaborative Sensing,” American Control Conference: NSF CAREER awardee session, Philadelphia, PA.
- P28 June 6, 2019, “GNSS Radio Frequency Interference Detection from LEO,” National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, Washington, DC.
- P29 March 22, 2019, “The GPS Interference and Countermeasures Arms Race,” Utah State University ECE Seminar, Logan, UT.
- P30 January 15, 2019, “Deep Urban Unaided Precise GNSS Vehicle Positioning,” West Virginia University.
- P31 October 17, 2018, “Deep Urban Unaided Precise GNSS Vehicle Positioning,” Technical University of Munich (TUM), Munich, Germany.
- P32 October 16, 2018, “Bracing for the Future: Next-Generation Demands in PNT,” German Aerospace Center (DLR), Munich, Germany.
- P33 April 20, 2018, “Collaborative All-Weather Sensing for Automated Vehicles,” Engineering Seminar, UT San Antonio.
- P34 March 15, 2018, “Collaborative All-Weather Sensing for Automated Vehicles,” Engineering Seminar, Tufts University.
- P35 March 2, 2018, “Bracing for the Future: Next-Generation Demands in PNT,” Aero-Astro seminar, Stanford University.
- P36 March 1, 2018, “Collaborative All-Weather Sensing for Automated Vehicles,” Apple Inc., special projects division.
- P37 Dec. 15, 2017, “Collaborative All-Weather Sensing for Automated Vehicles,” Apple Inc.
- P38 Nov. 14, 2017, “Robust and secure perception for automated vehicles,” (keynote presentation) International Technical Symposium on Navigation and Timing, ENAC, Toulouse, France.
- P39 Oct. 9, 2017, “Robust and secure perception for automated vehicles,” Engineering Seminar, Virginia Tech.
- P40 Sept. 28, 2017, “Counter UAV challenges: Is GNSS spoofing effective,” (panel presentation) ION GNSS+ panel session on hostile MAV threats, detection and countermeasures, Portland, OR.

- P41 Sept. 28, 2017, “Assured navigation and timing,” (panel presentation) ION GNSS+ panel session on assured navigation and timing, Portland, OR.
- P42 Sept. 27, 2017, “Robust precise location,” (panel presentation) ION GNSS+ panel session on ubiquitous navigation, Portland, OR.
- P43 Feb. 18, 2017, “Secure Perception for Automated Vehicles,” Hack the Machine, Austin, TX.
- P44 Feb. 7, 2017, “Protecting Drivers and their Data,” Texas Transportation Forum, Austin, TX.
- P45 Dec. 15, 2016, “Trusted Automated Vehicles,” IEEE Computer Society and COMSOC/SP Joint Chapters Meeting, Austin, TX.
- P46 Dec. 5, 2016, “Robust and secure perception for automated vehicles,” Nokia Bell Laboratories.
- P47 Dec. 4, 2016, “Robust and secure perception for automated vehicles,” (keynote presentation) Globecom location workshop, Washington D.C.
- P48 Nov. 14, 2016, “Robust and secure perception for automated vehicles,” Engineering Seminar, UCLA.
- P49 Sept. 26, 2016, “Robust and secure perception for automated vehicles,” Engineering Seminar, UC Riverside.
- P50 April 25, 2016, “Low-cost precise positioning for automated vehicles,” Hyundai Distinguished Lecture, UC Berkeley.
- P51 February 9, 2016, “Precise Positioning for the Mass Market,” (keynote presentation) International GNSS Service Workshop, Sydney, Australia. [video](#)
- P52 October 13, 2015, “Low-Cost Precise Positioning and Perception Security,” Google[X], Mountain View, CA.
- P53 October 29, 2015, “Low-Cost Centimeter-Accurate Mobile Positioning,” (keynote presentation) Texas GIS Forum, Austin, TX.
- P54 October 1, 2015, “Low-Cost Centimeter-Accurate Mobile Positioning,” University of Minnesota Roadway Safety Institute, Minneapolis, MN. [video](#)
- P55 July 15, 2015, “Secure Perception for Autonomous Systems,” (keynote presentation) International GNSS Conference, Gold Coast, Australia.
- P56 June 11, 2015, “Toughening Techniques for GPS Receivers: Navigation Message Authentication,” National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, Washington, DC.
- P57 March 18, 2015, “Unmanned aerial system threats: Exploring security implications and mitigation technologies,” U.S. House Subcommittee on Homeland Security Oversight hearing, Washington, DC. [link](#)
- P58 February 25, 2015, “Navigation Under Threat,” (keynote presentation) International Navigation Conference, Manchester, UK.
- P59 November 21, 2014, “Drones: Myths, Facts, Hacks, and the Future,” Hot Science Cool Talks, The University of Texas at Austin Environmental Science Institute. [link](#)
- P60 April 15, 2014, “Secure Perception for Autonomous Systems,” University of Texas Student Engineering Council Symposium, Austin, TX.
- P61 March 13, 2014, “Secure Perception for Autonomous Systems,” University of Illinois at Urbana-Champaign, Urbana, IL.
- P62 March 6, 2014, “Secure Perception for Autonomous Systems, (keynote presentation) Cornell Sibley Graduate Research Symposium, Ithaca, NY.
- P63 March 7, 2014, “Location Deception,” SXSW Interactive, Austin, TX. [audio](#)
- P64 November 14, 2013, “Secure PNT for Autonomous Systems,” Stanford PNT Symposium, Stanford University, Stanford, CA.

- P65 September 26, 2013, “Maritime Navigation Security,” International Hydrographic Organisation & Professional Yachters Association Sea Changes Seminar, Monaco.
- P66 March 8, 2013, “Extreme GPS,” SXSW Interactive, Austin, TX.
- P67 March 6, 2013, “Drones in the Classroom,” SXSW Edu, Austin, TX.
- P68 February 13, 2013, “Secure Navigation and Timing,” (keynote presentation) Royal Institute of Navigation Interference Conference, Teddington, UK.
- P69 February 12, 2013, “UAV Integration: Privacy and Security Hurdles,” Royal Institute of Navigation UAV Conference, Teddington, UK.
- P70 February 7, 2013, “GPS Vulnerabilities and Implications for Telecom,” international webinar.
- P71 December 5, 2012, “Navigation and Timing Security,” U.S. Air Force GPS Directorate, Los Angeles, CA.
- P72 November 15, 2012, “Future Directions in GNSS Research,” international GPS World webinar.
- P73 October 25, 2012, “Privacy Issues Related to the Domestic Use of Unmanned Aerial Vehicles,” statement to the U.S. House Judiciary Subcommittee on Crime, Terrorism, and Homeland Security field forum, Houston, TX. [pdf](#)
- P74 October 17, 2012, “Secure Civil Navigation and Timing,” Sandia National Laboratory, Albuquerque, NM.
- P75 September 17, 2012, “Receiver Certification for Hardening Against Spoofing,” Civil GPS Service Interface Committee, Nashville, TN.
- P76 September 10, 2012, “Secure Civil Navigation and Timing,” Aerospace Corporation research seminar, virtual from Austin, TX.
- P77 July 20, 2012, “Secure Civil Navigation and Timing,” MITRE corporation and government customers, McLean, VA.
- P78 July 19, 2012, “Radionavigation Robustness and Security,” Office of Naval Research, Arlington, VA.
- P79 July 19, 2012, “The vulnerability of civil unmanned aerial vehicles and other systems to civil GPS spoofing,” U.S. House Subcommittee on Homeland Security Oversight hearing on drone security, Washington, DC. [video](#), [pdf](#)
- P80 June 6, 2012, “Privacy vs. GPS Integrity,” Civil GPS Service Interface Committee (CGSIC) Meeting, Austin, TX.
- P81 February 22, 2012, “PVT Security: Privacy and Trustworthiness,” (keynote presentation) Royal Institute of Navigation Conference on GNSS Vulnerability: Present Dangers, Future Threats 2012, Teddington, UK.
- P82 February 11, 2012, “How to fool a GPS,” TEDxAustin, Austin, TX. [video](#)
- P83 December 2, 2011, “Radionavigation Robustness and Security,” Draper Laboratory, Cambridge, MA.
- P84 December 1, 2011, “Cubesat-Sized Radio Occultation Experiments,” Massachusetts Institute of Technology Aeronautics and Astronautics Department, Cambridge, MA.
- P85 April 4, 2011, “State of the art and future trends in radionavigation,” US Patent and Trademark Office, virtual presentation from Austin, TX.
- P86 March 10, 2011, “Briefing to DHS and DOD on GPS Security and Integrity,” Austin, TX.
- P87 October 4, 2010, “Spoofing the timing signal: What else is vulnerable?” National Executive Committee on Position Navigation and Timing, Advisory Board Meeting, Washington, DC.
- P88 June 25, 2010, “Advances in GNSS Equipment,” 2010 IGS Workshop, International GNSS Service, Newcastle upon Tyne, UK.
- P89 January 12, 2010, “Riding out the rough spots: Scintillation-robust GNSS carrier tracking,” 2010 Air Force Orion Conference, Dayton, OH.
- P90 March, 2009, “Assessing the GPS spoofing threat,” Cornell University, Ithaca, NY.



P91 June 5, 2008, “Considerations for future IGS receivers,” 2008 IGS Workshop, International GNSS Service, Miami Beach, FL.

P92 March, 2006, “The semidiurnal variation in GPS-derived zenith neutral delay,” 2006 IGS Workshop, Darmstadt, Germany.

### Patents

P1 W. J. Bencze, C. E. Cohen, B. T. Galusha, T. E. Humphreys, B. M. Ledvina, and M. L. Psiaki, “Practical method for upgrading existing GNSS user equipment with tightly integrated nav-com capability,” July 12 2011. US Patent 7,978,130

P2 K. J. Hayworth, K. V. Shcheglov, T. E. Humphreys, and A. D. Challoner, “Electrostatic spring softening in redundant degree of freedom resonators,” Nov. 30 2004. US Patent 6,823,734

### Software

W1 T. E. Humphreys, J. A. Bhatti, D. P. Shepard, and M. Murrian, “General radionavigation interfusion device (GRID) software suite (GSS),” 2021. UTA Tech ID 7912 HUM

W2 T. E. Humphreys, J. A. Bhatti, D. P. Shepard, and M. Murrian, “General radionavigation interfusion device (GRID) software suite (GSS),” 2019. UTA Tech ID 7417 HUM

W3 T. E. Humphreys, J. A. Bhatti, D. P. Shepard, A. J. Kerns, and K. M. P. Jr., “The precise positioning engine,” 2019. UTA Tech ID 7245 HUM

W4 T. E. Humphreys, J. A. Bhatti, and D. P. Shepard, “Radionavigation security testbed software,” 2012. UTA Tech ID 6199 HUM

W5 T. E. Humphreys, J. A. Bhatti, and D. P. Shepard, “General radionavigation interfusion device (GRID) software suite (GSS),” 2010. UTA Tech ID 5900 HUM

### RESEARCH TOPICS

Application of optimal detection and estimation techniques to problems in secure, collaborative, and high-integrity perception, with an emphasis on positioning, navigation, and timing.

### CONSULTING

U.S. Department of Homeland Security Risk Assessment, March - September, 2011 Coherent Navigation, August 2009 - August 2012

### PH.D. SUPERVISION COMPLETED

1. L. Narula, *Towards Secure and Robust PNT for Automated Systems*. PhD thesis, The University of Texas at Austin, Dec. 2020. Current position: Senior Engineer at Google StreetView. **2021 Bradford Parkinson Best Dissertation Award from the Institute of Navigation.**
2. G. N. Green, *Advanced Techniques for Safety-of-Life Carrier Phase Differential GNSS Positioning with Applications to Triplex Architectures*. PhD thesis, The University of Texas at Austin, Dec. 2017. Current position: Senior engineer at CTSi and **Adjunct Professor, Electrical Engineering, LeTourneau University**
3. J. Bhatti, *Sensor Deception Detection and Radio-Frequency Emitter Localization*. PhD thesis, The University of Texas at Austin, Aug. 2015. Current position: Navigation software lead at Joby Aviation.
4. K. M. Pesyna, Jr., *Advanced Techniques for Centimeter-Accurate GNSS Positioning on Low-Cost Mobile Platforms*. PhD thesis, The University of Texas at Austin, Dec. 2015. Primary supervisor: Humphreys; Co-Supervisor: Robert Heath (ECE). **2015 Marconi Society Young Scholar Award.** Current position: Senior engineer at Apple, Inc.
5. Z. M. Kassas, *Analysis and Synthesis of Collaborative Opportunistic Navigation Systems*. PhD thesis, The University of Texas at Austin, May 2014. Primary supervisor: Humphreys; Co-supervisor: Aristotle Apostathis (ECE). Current position: **Associate Professor, Mechanical and Aerospace Engineering, U.C. Irvine.**

6. K. Wesson, *Secure Navigation And Timing Without Local Storage Of Secret Keys*. PhD thesis, The University of Texas at Austin, May 2014. Primary supervisor: Humphreys; Co-supervisor: Brian Evans (ECE). Current position: Regulatory Engineer at SpaceX.

### **M.S. SUPERVISION COMPLETED**

1. Hailey Nichols, H. A. Nichols, M. J. Murrian, and T. E. Humphreys, "Software-defined GNSS is ready for launch," in *Proceedings of the ION GNSS+ Meeting*, (Denver, CO), 2022
2. J. E. Yoder, "Low-cost inertial aiding for deep-urban tightly-coupled multi-antenna precise GNSS," Master's thesis, The University of Texas at Austin, 2021
3. R. X. T. Kor, "A comprehensive proposal for securing radionavigation systems," Master's thesis, The University of Texas at Austin, 2021
4. W. Lies, "Extending the range of low SWaP-C FMCW radar," Master's thesis, The University of Texas at Austin, 2021
5. Tucker Haydon, 2019
6. Connor Brashar, 2018
7. Greg Anders, 2017
8. Andrew Kerns, 2015
9. D. Shepard, "Fusion of carrier-phase differential GPS, bundle-adjustment-based visual slam, and inertial navigation for precisely and globally-registered augmented reality," Master's thesis, The University of Texas at Austin, May 2013.
10. M. W. Bright, "GPS L2C signal survey and the development of the emergent MATLAB L2C (EMAL2) receiver," Master's report, The University of Texas at Austin, Aug. 2012. Primary supervisor: Humphreys; Co-supervisor: Bob Schutz.
11. A. J. Joplin, "Development and testing of a miniaturized, dual-frequency, software-defined GPS receiver for space applications," Master's thesis, The University of Texas at Austin, Dec. 2011. Primary supervisor: Glenn Lightsey; Co-supervisor: Humphreys.

### **PH.D. SUPERVISION IN PROGRESS**

1. Daniel Lachapelle
2. Andrew Graff
3. Zach Clements
4. Zacharias Komodromos
5. Robert Tenny
6. Wenkai Qin
7. Alperen Duru
8. Sam Morgan

### **POST-DOCTORAL FELLOW SUPERVISION**

1. Peter Iannucci, 2019-2022

### **OTHER STUDENT RESEARCH COMMITTEES (Current)**

Ph.D. Defense Committees - 3

M.S. Committees - 1

**OTHER RESEARCH SUPERVISION**

**Ph.D. Qualifying Committees**

Kien Trung Truong, Kumar Appaiah, Thomas Novlan, Vidur Bhargava, Ehab Hussein Hassan, Yousof Mortazavi, Drew Jones, Jaegan Ko, Jing Lin, Chao Jia, Yezhou Wang

**M.S. Report Committees**

Constance McDaniel Wyman

**Undergraduate Honors Projects**

Daniel Shepard, Shubhodeep Mukherji, Siddarth Kaki, Tung To, James Yoder

**Other Undergraduate Research Supervised**

Vatsa Gandhi, Saura Elghonimi, Vish Selvakumar, Shaurya Gupta, Luciana Schement, Paige Whittington, Anum Aslam, Andrew Higdon, Sydney Norrell, Reese Shetrone, Zachary Tschirhart

**Todd E. Humphreys, Professor**

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Todd E. Humphreys holds the Ashley H. Priddy Centennial Professorship in Engineering in the department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. He is Director of the Wireless Networking and Communications Group (24 faculty) and of the UT Radionavigation Laboratory. He specializes in the application of optimal detection and estimation techniques to problems in secure, collaborative, and high-integrity automated situational awareness. His publications are among the most cited in the field of positioning, navigation, and timing. His awards include The University of Texas Regents' Outstanding Teaching Award (2012), the National Science Foundation CAREER Award (2015), the Institute of Navigation Thurlow Award (2015), the Qualcomm Innovation Fellowship (2017), the IEEE Walter Fried Best Paper Award (2012, 2020, 2023), the Presidential Early Career Award for Scientists and Engineers (PECASE, 2019), and the Institute of Navigation Kepler Award (2023). He is a Fellow of the Institute of Navigation and of the Royal Institute of Navigation. He earned his B.S. and M.S. in Electrical and Computer Engineering from Utah State University, and his Ph.D. in Aerospace Engineering from Cornell University.