James Garrison

Professor at Purdue University

Summary

Research in applied Earth observations and remote sensing using global navigation satellite systems (GNSS) and signals of opportunity (SoOp). Some areas of application for my research include oceanography, tropical meteorology, hydrology, agriculture, natural hazards, and test treaty verification.

Experience

Professor at Purdue University
May 2017 - Present

Associate Professor at Purdue University
June 2006 - May 2017 (11 years)

Faculty member in the School of Aeronautics and Astronuatics with a courtesy appointment in the School of Electrical and Computer Engineering.

Visiting Scientist at Starlab Barcelona S.L.
June 2007 - May 2008 (1 year)

Sabbatical leave from Purdue University

Assistant Professor at Purdue University
June 2000 - May 2006 (6 years)

Senior Engineer at NASA Goddard Space Flight Center
August 1998 - August 2000 (2 years 1 month)

Research and development of spaceborne GPS receiver technology.

Aerospace Technologist at NASA Langley Research Center
May 1988 - July 1998 (10 years 3 months)

Education

University of Colorado Boulder
PhD, Aerospace Engineering Sciences, 1993 - 1997
Stanford University
MS, Aeronautics and Astronautics, 1989 - 1990
Rensselaer Polytechnic Institute
BS, 1984 - 1988
springfield high school

1980 - 1984

Honors and Awards

Tycho Brahe Award, Seeds of Success Award

James Garrison

Professor at Purdue University

Contact James on LinkedIn

PURDUE UNIVERSITY

School of Aeronautics and Astronautics

James L. Garrison

2000 - Professor of Aeronautics and Astronautics
Associate Professor of Electrical and Computer Engineering (by courtesy)

Degrees

PhD University of Colorado at Boulder, 1997
MS Stanford University, 1990
BS Rensselaer Polytechnic Institute, 1988

Contact

701 W. Stadium Ave.
West Lafayette, IN 47907-2045

Office: ARMS 3311
Office Phone: +1 765 49-67482
Email: jgarriso@purdue.edu
Webpage: http://www.linkedin.com/in/gvector

Interests

Earth remote sensing, Global Navigation Satellite Systems (GNSS), bistatic radar, signals of opportunity.

Awards and Major Appointments

National Academies Keck Futures Initiative, 2012
ASEE/AFRL Summer Faculty Fellow, 2008
Institute of Navigation, Early Achievement Award, June 2002
NASA Exceptional Space Act Award, December 2000
First Place: GPS World Applications Contest, 1998

Research Areas

Professor Garrison's research interests lie in the development of new instruments, algorithms and missions for Earth remote sensing, utilizing Global Navigation Satellite Systems (GNSS) and other "Signals of Opportunity" (SoOps). He performed some of the earliest theoretical and experimental work (1996-2002) demonstrating that reflections of GNSS signals contain valuable information on surface scattering and that this information could be used for remote sensing, particularly in oceanography. That seminal research sparked subsequent development of, arguably, the first entirely new Earth remote sensing instrument concept to be proposed in decades. Research by multiple institutions around the world culminated in NASA's selection of the CYGNSS mission, scheduled for a 2016 launch. Prof. Garrison is on the science team for CYGNSS, which will observe tropical storm development using GNSS reflections from a constellation of 8 micro-satellites.

Recently, he has been investigating the application of reflectometry methods to the general class of Signals of Opportunity, or SoOps. Ocean remote sensing using commercial satellite S-band and Ku-band transmissions has been demonstrated from aircraft and fixed-tower experiments. Applications of these methods to remote sensing in agriculture and hydrology are of particular interest with the use of low-frequency satellite transmissions to penetrate the soil to decimeter depths and the retrieval of phase measurements from high signal to noise ratio reflections. Professor Garrison was awarded a NASA Instrument Incubator Program (IIP) grant to develop an airborne demonstration instrument for measuring root-zone soil moisture, an important variable not directly observable from any current or planned satellite instrument. He has partnered with the Jet Propulsion Laboratory (JPL) to begin fundamental experimental research in the sensing of snow and ice properties through observing phase, amplitude, and polarization variations in reflected signals. SoOp instruments will also soon fly on the NOAA Hurricane Hunter aircraft.

In addition to reflectometry, Prof. Garrison is actively studying methods for airborne GNSS radio-occultation (RO) and detecting traveling waves in the ionosphere. Working with the Scripps Institution of Oceanography, he has been improving signal processing methods for retrieving humidity profiles from RO measurements made within developing hurricanes to test the hypothesis that changes in these profiles can indicate the onset of storm intensification. He has developed new wavelet-based array-processing methods to extract coherent wave structure in the total electron content (TEC) time-series measured from large arrays of dual-frequency GNSS receivers. These methods have shown multiple ionospheric structures induced from atmospheric waves following Earthquakes and have detected waves produced from the 2006 and 2009 North Korean underground nuclear weapons tests.

Professor Garrison works closely with the Earth science and applications community at Purdue and internationally. He is on the executive committee for the Purdue Climate Change Research Center (PCCRC) and a faculty affiliate of the Ecological Sciences and Engineering (ESE) program.

Publications

(Most Recent)

Shah, R., Garrison, J. L., "Application of the ICF Coherence Time Method for Ocean Remote Sensing using Digital Communication Satellite Signals," IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2014, in press

Haase, J.S., Murphy, B., Muradyan, P., Nievinski, F., Larson, K., Garrison, J.L., and Wang, K-N., "First Results from an Airborne GPS Radio Occultation System for Atmospheric Profiling," Geophysical Research Letters, February 6, 2014, DOI: 10.1002/2013GL058681.

Garrison, J.L., Larson, K. M., and Burrage, D., "Advancing Reflectometry," Eos, Transactions, American Geophysical Union, Vol. 94, No. 21, May 21, 2013, p 193, DOI: 10.1002/2013EO210010

Yang,Y-M, Garrison, J.L., and Lee, S-C, "Ionospheric Disturbances Observed Coincident with the 2006 and 2009 North Korean Underground Nuclear Tests," Geophysical Research Letters. Vol. 39, No. 2, Jan. 27, 2012, L02103 DOI:10.1029/2011GL050428

Shah, R., Garrison, J.L., and Grant, M.S., "Demonstration of Bistatic Radar for Ocean Remote Sensing using Communication Satellite Signals," IEEE Geoscience and Remote Sensing Letters, Vol. 9, Issue 4, July 2012, pp 619-623, DOI:10.1109/LGRS.2011.2177061

Garrison, J.L., Voo, J.K., Yueh, S.H., Grant, M.S., Fore, A.G., and Haase, J.S., "Estimation of Sea Surface Roughness Effects in Microwave Radiometric Measurements of Salinity Using Reflected Global Navigation Satellite System (GNSS-R) Signals," IEEE Geoscience and Remote Sensing Letters, Vol. 8, No. 9, p 1170-1174, Nov. 2011, DOI:10.1109/LGRS.2011.2159323

(Highly Cited - Google Scholar, April 2014)

Garrison, J. L., Komjathy, A., Zavorotny, V.U., and Katzberg, S.J., “Wind Speed Measurement using Forward Scattered GPS Signals,” IEEE Transactions on Geoscience and Remote Sensing, Vol. 40, No. 1, Jan. 2002, pp. 50-65, DOI:10.1109/36.981349 (185 citations)

Garrison, J. L.*, Katzberg, S. J., and Hill, M. I., “Effect of Sea Roughness on Bistatically Scattered Range Coded Signals from the Global Positioning System,” Geophysics Research Letters, Vol. 25, No. 13, July 1, 1998, pp. 2257-2260 (127 citations)

Oleson, K.W., Sarlin, S., Garrison, J., Smith, S., Privette, J. L. and Emery, W. J., “Unmixing Multiple Land-Cover Type Reflectances from Coarse Spatial Resolution Satellite Data,” Remote Sensing of Environment, Vol. 54, 1995, pp. 98-112 (68 citations)

Ziedan, N. and Garrison, J. L., “Unaided Acquisition of Weak GPS Signals Using Circular Correlation and Double-Block Zero Padding,” IEEE Position, Location and Navigation Symposium (PLANS), Monterey, CA, April 26-29, 2004 (50 citations)

Conference Proceedings, Presentations, Invited Lectures

(Last two years)

Rodriguez-Alvarez, N., Garrison, J.L., Ruf, C., and Clarizia, M.P., “Optimizing an Observable for Ocean Wind Speed Retrieval from Calibrated GNSS-R Delay-Doppler Maps,” Abstract FGH2-6, presented at the USNC–URSI National Radio Science Meeting, Boulder, CO, 8-11 January, 2014.

Shah, R., and Garrison, J.L., "Estimation of Significant Wave Heights Using Reflected Digital Communication Signals," IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2013), Melbourne, Australia, July 21-26, 2013, pp 3899-3902

Wang, K-N., Muradyan, P., Garrison, J.L., Haase, J.S., Murphy, B., Acikoz, U., and Lulich, T., "Open-Loop Tracking of Rising and Setting GNSS Radio-Occultation Signals from an Airborne Platform: Signal Model and Statistical Analysis," IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2013), Melbourne, Australia, July 21-26, 2013, pp 3367-3370.

“GNSS in Remote Sensing and Earth Science,” Institute of Navigation (ION) Panel at the China Satellite Navigation Conference (CSNC 2013), May 15-17, 2013, Wuhan, China. INVITED

Ashman, B.W., and Garrison, J.L., “Tracking of Direct and Reflected Global Navigation Satellite System (GNSS) Signals in Hubble Servicing Mission 4,” Proceedings of The Institute of Navigation Pacific PNT 2013, Honolulu, HI, April 23-25, 2013, pp 1117-1124.

Yang, Y-M., Garrison, J.L., Komjathy, A., “Detection and Analyses of Traveling Ionospheric Disturbances from two Successive Earthquakes and Tsunami Waves,” Abstract NH41A-1595, presented at the AGU Fall Meeting, San Francisco, CA, 3-7 December, 2012.

Haase, J.S., Murphy, B., Chen, X.M., Chen, S-H., Muradyan, P., Nievinski, F.G., Larson, K.M., Garrison, J.L., Wang, E.K., Chen, S-Y., “Preliminary results from the retrieval and assimilation of GPS radio occultation refractivity observations during tropical storm development,” Abstract A43F-0221, presented at the AGU Fall Meeting, San Francisco, CA, 3-7 December, 2012.

Mashiku, A.K., Garrison, J.L., and Carpenter, J.R., "Representation of Probability Density Functions from Orbit Determination Using the Particle Filter," 23rd International Symposium on Space Flight Dynamics, Pasadena, California, October 29 – November 2, 2012

Wang, K-N., Muradyan, P., Haase, J.S., Garrison, J.L., “Airborne and Spaceborne GPS Radio Occultation Signal Strength and Performance Comparison,” presented at Sixth FORMOSAT-3/COSMIC Data Users Workshop (Student Poster Session), 30 October to 1 November 2012, Boulder, CO, USA

Quindara, N., Garrison, J., “Ocean Wave Slopes from XM-Radio Reflections for Brightness Temperature Corrections,” presented at Sixth FORMOSAT-3/COSMIC Data Users Workshop (Student Poster Session), 30 October to 1 November 2012, Boulder, CO, USA

Burrage, D., Wesson, J., Wang, D., Garrison, J., Quindara, N., Ganoe, G. and Katzberg, S., “Airborne Observation of Ocean Surface Roughness Variations Using a Combination of Microwave Radiometer and Reflectometer Systems – The second Virginia Offshore (Virgo II) experiment,” presented at Workshop on Reflectometry using GNSS and Other Signals of Opportunity (GNSS+R), October 10-11, 2012, Purdue University, West Lafayette, IN.

Lin, Y-C., Sun, G., and Garrison, J., “Multi-Frequency Remote Sensing of Soil Moisture with SoOps,” presented at Workshop on Reflectometry using GNSS and Other Signals of Opportunity (GNSS+R), October 10-11, 2012, Purdue University, West Lafayette, IN.

Ruf, C., Garrison, J., Gleason, S., Jelenak, Z., Katzberg, S., Ridley, A., Rose, R., Scherrer, J., and Zavorotny, V., “The Cyclone Global Navigation Satellite System (CYGNSS) Mission,” presented at Workshop on Reflectometry using GNSS and Other Signals of Opportunity (GNSS+R), October 10-11, 2012, Purdue University, West Lafayette, IN.

Mashiku, A., Garrison, J.L., and Carpenter, J.R., "Statistical Orbit Determination using the Particle Filter for incorporating Non-Gaussian Uncertainties," AIAA/AAS Astrodynamics Specialist Conference, Minneapolis, Minnesota, 13-16 August 2012, AIAA 2012-5063

“Applications of GNSS to GEEO & GEOSS”, GfG2 Summer School, University of Nottingham, UK, 13 August, 2012. KEYNOTE

Garrison, J.L., "Modeling and Simulation of Bin-Bin Correlations in GNSS-R Waveforms," IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2012), Munich, Germany, July 22-27, 2012.

Shah, R., and Garrison, J.L., "Correlation Properties of Direct Broadcast Signals for Bistatic Remote Sensing," IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2012), Munich, Germany, July 22-27, 2012.

Garrison, J.L., “Contributions of Donald R. Thompson to GNSS Reflectometry,” IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2012), Munich, Germany, July 22-27, 2012.

Katzberg, S.J., Garrison, J.L., and Holloway, R.F., "Reflected GPS and other Signals of Opportunity as Multipurpose Sensors for UAS Applications," 2012 International Conference on Unmanned Aircraft Systems (ICUAS-12), Philadelphia, PA, June 12-15, 2012.

Muradyan, P., Haase, J.S., Acikoz, U., Garrison, J.L., Xie, F., “Profiling the Atmosphere with the Airborne Radio Occultation Technique Using GPS Signals Recorded in Open-Loop Mode,” presented at the International Radio Occultation Working Group 2nd Workshop (IROWG-2), Estes Park, CO,USA, 28 March – 3rd April 2012.

Y.-C. Lin, J. L. Garrison, and K. Cherkauer, "Remote Sensing of Soil Moisture with Signals of Opportunity [Poster]," presented at the AGU Chapman Conference on Remote Sensing of the Terrestrial Water Cycle, Kona, Hawaii, USA, 19-22 February 2012.

Edit

Manage Faculty and Staff

Our People