

## LSGI Distinguished Lecture

# Topic: From GNSS-R to GNSS+R: Remote Sensing with Signals of Opportunity

### Overview

It was our pleasure to invite Dr. James L. Garrison, Associate Professor of the School of Aeronautics and Astronautics, Purdue University, USA, to deliver a seminar of the LSGI Distinguished Lecture Series on 22 July 2016.



Dr. Garrison discussed remote sensing with signals of opportunity in the lecture. His lecture began with the Global Navigation Satellite System (GNSS) signals, which were the first sources studied for reflectometry in the late 1990's. He believed the early airborne experiments successfully demonstrated retrievals of ocean winds/roughness and soil moisture from GNSS-reflectometry (GNSS-R). The first spaceborne GNSS-R observations came with the UK-DMC satellite in 2004. He mentioned that there had been a significant growth in GNSS-R remote sensing, including satellite developments by the UK recently (TDS-1, 2014), NASA (CYGNSS, 2016) and ESA (GEROS-ISS, 2019).

However, GNSS used very low power L-band signals (typically 16 dB below the noise floor on the Earth's surface). In contrast, he found that communication satellites transmitted in nearly every band penetrating the Earth's atmosphere with signal to noise ratios far above unity. Efficient compression and encryption produce signals with noise-like properties, enabling the application of cross-correlation techniques developed for GNSS-R to communication satellite signals. Basic research had been conducted on remote sensing using satellite transmission across the spectrum, from P-band to Ku-band, with applications ranging from ocean winds to sub-surface soil moisture.

### Dr. James L. Garrison



He is Associate Professor in the School of Aeronautics and Astronautics at Purdue University, with courtesy appointments in the School of Electrical and Computer Engineering and Environmental and Ecological Engineering. Prior to his academic position, he had a 12-year career with the National Aeronautics and Space Administration (NASA), first at the Langley Research Center in Hampton VA, and later at the Goddard Space Flight Center in Greenbelt MD. He earned a PhD from the University of Colorado Boulder in 1997 and also holds a BS from the Rensselaer Polytechnic Institute and an MS from Stanford University. Research interests of Prof. Garrison include Earth remote sensing using Global Navigation Satellite Systems (GNSS) and signals of opportunity.