Title of the Presentation: Exploiting signals of opportunity: a new approach to microwave remote sensing

Signals of Opportunity (SoOp) is an emerging field in microwave remote sensing that uses existing anthropogenic signals (typically from communications or navigation satellites) in a non-cooperative manner as sources of illumination for bistatic radar. SoOp observations exhibit some properties common to either active radar or passive radiometry, but also have unique features distinct from these two classical approaches. Realizing the full potential of SoOp has required the development of new instruments, signal processing algorithms, geophysical model functions, and data assimilation methods.

This presentation will provide a review of progress made to advance the SoOp technique. Three different examples will be presented in approximate order of technical maturity. First, Global Navigation Satellite System Reflectometry (GNSS-R) is the most advanced SoOp technique. CYGNSS, launched in 2016, provides ocean winds observations and various land surface observations (e.g. soil moisture and flood inundation) in the tropics. A large and growing science community has evolved around the use of CYGNSS data. Second, P-band (<400 MHz) frequencies are required to penetrate through dense vegetation and soil. This frequency range is also heavily utilized for communications with limited allocations for science. Radio frequency interference (RFI) is thus a significant risk in P-band. SoOp techniques could advantageously use these communications transmissions to offer a new capability for sensing Root-Zone Soil Moisture (RZSM), an essential climate variable that, at present, is only produced through assimilation of surface soil moisture observations. SNOOPI (SigNals Of Opportunity: P-band Investigation) is a cubesat mission launched in April, 2024 to demonstrate spaceborne P-band SoOp remote sensing. Finally, wide-band (~1GHz) communications broadcast signals in Ku-band (12-18 GHz) and higher can theoretically provide altimetry (sea surface height) at cm-level precision. A constellation of passive SoOp receivers could be launched for a fraction of the cost of a single active radar altimeter, substantially increasing coverage, particularly in coastal regions.

Prof. Garrison will conclude the talk with some speculative concepts and ideas for future research directions.

Biography

James L Garrison is a Professor in the School of Aeronautics and Astronautics at Purdue University with a courtesy appointment in the School of Electrical and Computer Engineering and the Ecological Sciences and Engineering Interdisciplinary Graduate program. He was elected a University Faculty Scholar in 2022. His research interests include Earth

remote sensing using Global Navigation Satellite Systems (GNSS) and signals of opportunity. He is the Principal Investigator for SNOOPI, a NASA mission to demonstrate remote sensing with P-band signals of opportunity. Prior to his academic position, Prof. Garrison was with the National Aeronautics and Space Administration (NASA). 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. He is a fellow of the IEEE and the Institute of Navigation (ION). From 2018 to 2022 he was the Editor in Chief of IEEE Geoscience and Remote Sensing Magazine.