University of Colorado at Boulder

AEROSPACE ENGINEERING SCIENCES

Invited Guest Seminar

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Signals of Opportunity (SoOp) Reflectometry for Earth Remote Sensing (the "+" in GNSS+R)

Reflectometry, a comparatively new technique in microwave remote sensing, extracts measurements from forward-scattered signals usually transmitted for other purposes (hence "signals of opportunity"). Reflectometry combines features of both passive radiometry and active radar. Forward scattering geometry combined with the reutilization of high power coherent sources can enable scientifically useful measurements to be made with small antennas, leading to instrument designs that are feasible on small satellites and unpiloted aerial vehicles (UAVs). The availability of a strong direct signal can also simplify the calibration problem.

Global Navigation Satellite System (GNSS) signals were the first sources studied for reflectometry. Airborne experiments have successfully demonstrated retrievals of ocean winds/roughness and soil moisture using GNSS reflectometry (GNSS-R). The first spaceborne GNSS-R demonstration was conducted on the UK-DMC satellite in 2004. CYGNSS, a satellite constellation of microsatellites for tracking tropical cyclone development, is expected to be launched by NASA in 2016.

GNSS, however, uses very low power L-band signals (typically 16 dB below the noise floor on the Earth's surface). In contrast, communication satellites presently transmit in nearly every band penetrating the Earth's atmosphere with signal to noise ratios above unity. Efficient compression and encryption produce signals with noise-like properties and the direct signal can be used as a reference to cross-correlate with the reflected signal. These properties have allowed the application of GNSS-R techniques to a communication satellite signals.

In this presentation, results from recent experiments in ocean reflectometry using the S-band (2.3 GHz) signals from the XM

of Aeronautics and Astronautics. He has held courtesy appointments in the School of Electrical and Computer Engineering and Division of Environmental and Ecological Engineering. From 1988 to 2000 he was employed by NASA, at the Langley Research Center in Hampton VA and later at the Goddard Space Flight Center in Greenbelt MD. He earned a PhD from Boulder in 1997 and also holds a BS (Rensselaer Polytechnic Institute) and an MS (Stanford University). He is the author or co-author of 26 journal articles, 52 conference proceedings, 3 US Patents, and has served as the Chair of GNSS+R 2012, an IEEE sponsored conference. Prof. Garrison has numerous awards including the NASA Exceptional Space Act Award, a NASA New Investigator grant, an Institute of Navigation Early Achievement Award, a NASA Research Initiative grant. He is a member of the CYGNSS science team and the Principal Investigator for the SoOp NASA Instrument Incubator Program. Current research interests of Prof. Garrison include Earth remote sensing using Global Navigation Satellite Systems signals of opportunity.