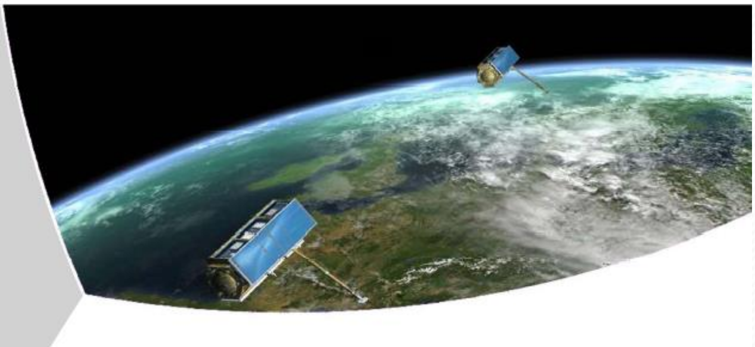
MEETING NOTICE : Buenaventura MTT-S/COMSOC/LMAG Chapters

Date and Time: Thursday, January 28th, 2016, 6:30PM

Location : Skyworks Solutions,
Conference Room,
649 Lawrence Drive,
Newbury Park, CA 91320
(Intersection of West Hillcrest Drive and Lawrence Drive.)



Agenda: 6:30PM Reception & Networking
(Free Pizza & Soda will be served)
7PM Presentation

Presenter : Mr. Kamalesh Sainath
Ohio State University

Layered-Medium EM Wave Guidance Effects on the Coherences of Polarimetric Interferometric Synthetic Aperture Radar (PolInSAR) Sensors: Models, Results, Validation, and Inversion

Kamalesh Sainath, MSEE (Ph.D. Candidate)
The Ohio State University ElectroScience Laboratory
Columbus, Ohio, USA 43212

Background. We propose a fully-polarimetric electromagnetic (EM) backscatter model to quantitatively predict the four (pixel-level) polarimetric interferometric coherences generated by single-pass, single spatial baseline PolInSAR systems that interrogate (locally) planar-layered, penetrable subsurface media. Initially proposed for generating high-resolution, 3-D global elevation maps by introducing a third independent measurement (i.e., range phase difference between two angularly-separated SAR observations of a scene), SAR interferometry has since been expanded to employ multiple baselines, polarimetry modes, and/or differential measurements. InSAR data has also witnessed exploitation for an ever-increasing number of remote sensing applications: For example, monitoring of natural hazards, snow and ice structures, vegetation, and soil moisture. Common to these and other applications of InSAR data, a physics-based model is required to understand under which geophysical conditions the interferometric data exhibits *practically* (i.e., despite confounding influences such as EM subsurface penetration) exploitable sensitivity to the remotely sensed geophysical parameters of interest.

Challenges, and Presentation Outline. Evaluation and normalization of the six-fold Fourier integral to compute the coherence, particularly when accounting for wave guidance, is not trivial however due to the presence of multiple terms involving products of two or more infinite series whose statistical expectations must be computed. To address this gap in the body of InSAR modeling research, we explored the previously uninvestigated scenario where the subsurface's dielectric profile lends itself to strongly *guiding* the incident radar wave within its layers (akin to a dielectric waveguide). Discussed in detail, wave guidance can engender a strong "interferometric resonance" arising from the *coherent* summation of interferometric contributions, where each contribution arises from computing the complex-valued covariance of two backscatter echoes (one directed to each radar) arising from closely-spaced scattering centers. This "resonance" phenomenon, we find, can lead to gross biasing of the coherence's phase and severe reduction of its magnitude, consequently increasing phase noise. Following discussion of the PolInSAR forward models, we show analytical and numerical results of the polarimetric coherences' phase and magnitude across illustrative subsurface scatter profiles. Finally, we discuss plans for inverse model development, as well as InSAR sensors whose data can be reanalyzed to validate the PolInSAR model predictions.

Bio. Mr. Sainath received his BS Electrical Engineering (BSEE) degree from the University of California Irvine (2011) and MSEE degree from The Ohio State University (2014). Supported by the NASA Space Technology Research Fellow (NSTRF) program, his Ph.D. EE (**Expected 08/2016**) research comprises development of robust spectral-domain numerical algorithms, as well as numerical and analytical models, to elucidate EM wave physics in planar-layered media, and the resultant quality and richness of data derived from polarimetric remote sensors.