

VARIABLE WIND INFLUENCE ON INSAR IMAGERY OF FORESTS

Michael Benson, Leland Pierce, Kamal Sarabandi

The University of Michigan
The Radiation Lab, EECS Dept,
1301 Beal Ave, Ann Arbor, MI 48109-2122
mlbenson@umich.edu

ABSTRACT

The horizontal and vertical (3D) structure of Earth's forested ecosystems are of great significance to their ecological functioning and societal uses. An InSAR approach is one methodology whereby a forest's structure and height in particular can be successfully estimated. Critical to the successful estimation is a high correlation between multiple SAR images. Regardless of a forest's location on the Earth, wind can significantly alter a forest's appearance to an L-band SAR system and so decrease this necessary correlation.

In order to investigate the wind-induced decorrelation, we have developed a model for the repeat-pass interferometric SAR response of a forested area taking into account wind effects. The simulation consists of multiple interconnected parts including static tree geometry generation, a wind simulator to apply to a static tree, and an electromagnetic model to allow us to calculate the interferometric SAR response. The static tree geometry generation process generates a pseudo-random tree based on a given DNA file which specifies a species specific structure. This geometry is then modified by the wind simulator producing snapshots of tree-geometry as a function of time. Each snapshot is then used in the interferometric SAR simulator to synthesize the wind-blown geometry's InSAR response. Results present coherence as a function of wind speed and forest structure.

An important feature of this research is the usage of a physically based realistic wind model that is based on measurements of wind effects on trees as well as realistic models of fluid flow and simple harmonic branch resonators. Allowing branches to bend and move out of the plane of the incident wind field enables our model to capture numerous features of a physical tree blowing in the wind. This realistic model is necessary for a realistic simulation of the effects that wind has on a given InSAR imaging system.

Index Terms— SAR, INSAR, forest structure, wind model, fractal tree