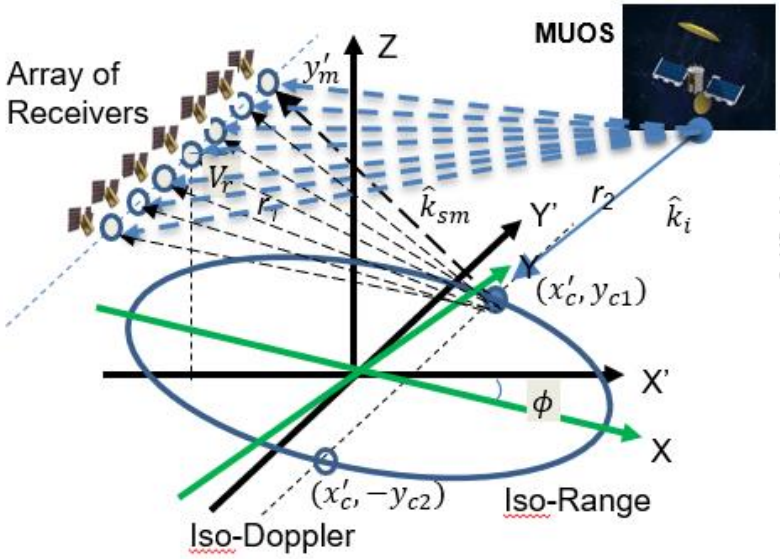
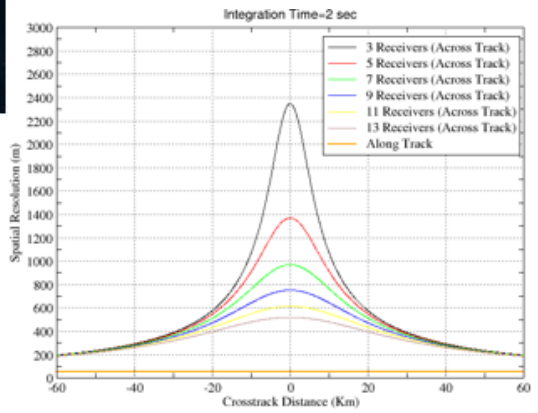
National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

A Satellite Synthetic Aperture Radar Concept Using P-Band Signals of Opportunity

Yueh, Shah, Xu, Stiles, Bosch-Lluis, Feb 2021. IEEE JSTARS. DOI 10.1109/JSTARS.2021.3059242





SoOpSAR concept with a formation flight of small satellites. Each satellite has a receiver to record the direct signal from MUOS and reflected signal by land surfaces. The spatial resolution may reach 10m x 200m, comparable to existing active SAR technologies.

Problem: High resolution (a few hundred meters) remote sensing of root zone soil moisture (RZSM) and snow water equivalent (SWE) is critical for modeling of land surface hydrological processes and applications to water resource management and precision farming. However, conventional low frequency (a few hundred MHz) active microwave spaceborne synthetic aperture radars (SAR) are expensive (~$Bs).

Methods: A satellite SAR concept based on the P-band Signals of Opportunity (SoOp) reflectometry with a sparse array of receivers flying in formation at low earth orbits (LEO) using the transmit signals from the United States Navy's Mobile User Objective System (MUOS) operating on a geosynchronous altitude has been developed.

Findings: The P-band SoOpSAR concept can achieve a swath width of better than 100 km with a spatial resolution reaching as high as 10 m x 200 m, comparable to the performance of current P-band SAR technologies as long as high precision formation flight and instrument timing technologies are available.

Impact: The P-band SoOpSAR concept may allow a cost-effective (x5 cost reduction) with respect to the existing active SAR technology for a spaceborne snow and soil moisture mission.