A Signal Model of Moon-Based SAR Imaging of Earth

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Abstract

The Moon-based Synthetic Aperture Radar (Moon-based SAR), using the Moon as a platform, has a great potential to offer global-scale coverage of the earth's surface with a high revisit cycle and is able to meet the scientific requirements for climate change study. However, operating in the lunar orbit, Moon-based SAR imaging is confined within a complex geometry of the Moon-based SAR, Moon and Earth, where both rotation and revolution have effects. The extremely long exposure time of Moon-based SAR presents a curved moving trajectory and the protracted time-delay in propagation violates the "stop-and-go" assumption. Consequently, the conventional SAR imaging technique is no longer valid for Moon-based SAR. This paper develops a Moon-based SAR theory in which a signal model is derived. The Doppler parameters in the context of lunar revolution with the removal of 'stop-and-go' assumption are first estimated, then characteristics of Moon-based SAR imaging's azimuthal resolution are analyzed.

The results show the Moon-based SAR has an unparalleled peculiarity in imaging. In addition, a signal model of Moon-based SAR and its 2-D spectrum are further derived. Numerical simulation using point targets validates the signal model and enables Doppler parameter estimation for image focusing. This talk will also discuss several silent effects that affect the imaging of Moon-based SAR, such as a significantly smaller signal-to-noise ratio due to the extra-long propagation distance and atmospheric effects, including ionospheric effects and tropospheric effects.