

Effects on SAR imaging by ionosphere irregularity

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The synthetic aperture radar (SAR) provides high-resolution image by coherently processing the signals returned from the ground. There has been increasing interests in use of space-borne very high frequency SAR (VHF-UHF SAR) for measuring forest biomass and for detecting underground facilities in which longer wavelengths are required. But the perturbations in the signal propagation path, including in the ionosphere and in troposphere, could lead to phase change within the effective aperture of the system. Especially, the phase perturbation caused by the irregularity structure of the refractive index in the ionosphere can be severe at VHF-UHF frequency and will distort the SAR image.

In this paper, a modified model of effects of ionosphere irregularity on SAR imaging is proposed. The two-frequency and two-position coherence function is derived based on the phase screen theory, which can be adaptable to analyses of propagation of SAR signal in the turbulent ionosphere. By using this function the resolution of SAR distorted by ionosphere turbulence can be studied properly.

Unlike previous result, the conclusion is that the range resolution should be affected by the ionospheric irregularity. These effects are decided by the signal center frequency, out scale of the ionospheric irregularity and look angle of SAR etc. It is shown that in many cases the effects from the irregularity can be very serious on the SAR imaging.