A SHADOW PERCENTAGE ESTIMATION METHOD FOR RADAR LOOK ANGLE SELECTION IN SPACEBORNE INSAR APPLICATION

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ABSTRACT: Spaceborne INSAR (Interferometric Synthetic Aperture Radar) is an important remote sensing tool for topographic mapping, while there are inevitably shadow areas in Radar images. Shadow area has no radar echo signal or low coherence SNR (signal noise ratio). In this paper, Shadow area percentage estimation according to Radar look angle is proposed. Digital elevation model of natural terrains and ascending and descending orbits are used in simulation. This estimation method is suitable for incidence angle considerations in the phase of INSAR system design.

1. INTRODUCTION

For most geodesic applications, it has been hold that the value of radar imagery is greatest when obtained with relatively large incidence angles (small radar look angles) because geometric distortion is minimal and radar backscattered energy is strong. In radar system design, look angle is one of key system parameters should be considered carefully and make a tradeoff with other factors, such as swath wide, power of radar transmitter. To evaluate shadow area percentages under different look angles in nature terrains, here an estimation work by simulation is to being conducted with computing the local incidence angle, backscattered coefficients and minimization by combination of ascending and descending orbits.

2. DEFINIATION OF SHDOW IN INSAR

Traditionally, shadow is defined as one kinds of geometric distortion in airborne SAR, showed in Figure 1. When with spaceborne INSAR, the same area may be not a shadow by observation of ascending and descending orbits. It can be called as geometric shadow, which only relevant to local incidence angle.

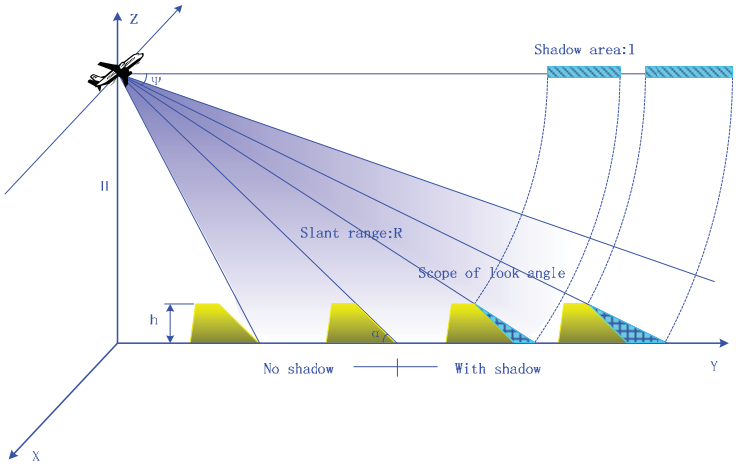

Figure 1

Additionally, there are areas with low coherence or SNR, which relevant to backscattered coefficients and local incidence angle. These areas also can be looked as shadows, here defined it with correlation, SNR (thermal noise alone), $NE\sigma_0$ (Noise equal backscattered coefficient) of INSAR radar system.

$$\gamma_{th} = \frac{1}{\sqrt{1+SNR_1^{-1}}\sqrt{1+SNR_2^{-1}}} \quad \text{(Eq. 1)}$$

$$\sigma - NE\sigma_0 < SNR_{\min} \quad \text{(Eq.2)}$$

From requirement of correlation in INSAR (Eq.1), the minim SNR can be obtained, and then the area with backscattered coefficients satisfies (Eq.2) is regarded as shadow.

3. CALCULATION OF LOCAL INCIDENCE ANGLES AND BACKSCATTERED COEFFICIENTS

With the definition of shadow of spaceborne INSAR in chapter 2, to calculate local incidence angles and backscattered coefficients, two natural terrains with DEM are used, N30E89 (north latitude 30^o,east longitude 89^o, Figure2) and N27E89(north latitude 27^o,east longitude 89^o, Figure3). The two DEM data are from open published SRTM products, each with 1024*1024 points and 30m*30m ground resolution. For backscattered coefficients calculation, little facet model and radar backscattered model proposed by (Currie, 1987) are used.

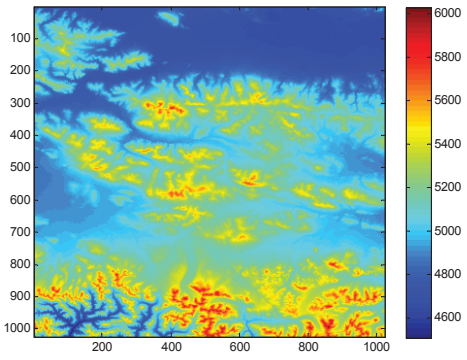

Figure 2

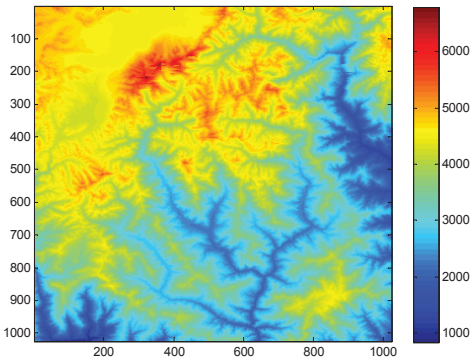

Figure 3

4. SIMULATION RESULTS

Based on chapter 2 and 3, the shadow area percentages under radar look angle of 28^o and 45^o with different kinds of coverage of ground surface(such as city, soil, grass,ice) are simulated for both ascending and descending orbits, and the minimization of shadow by orbit combination.

5. CONCLUSION

An estimation method of shadow area percentages for spaceborne INSAR application is discussed with simulation results. From this work, how the radar look angle will influence the shadow percentage for topographic mapping can be quantificationally analyzed, which will be an aid for INSAR system design.

References

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