THE EFFECTS OF MULTI-PATH SCATTERING ON THE SAR IMAGE OF CYLINDER CAVITY

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The multi-path scattering mechanism always exists in the real complex targets, especially the cavity. The theory of SAR image formation invokes an assumption, which is that only single reflection of the wave is received. That is to say, conventional theory does not consider the effects of multi-bounce (MB), so the efforts of MB always generate the ghost regions in the SAR image. In 2002, G.A. Garren presented a model of MB in Spot-SAR [1], and then he use the way of parameter estimation and filter which is similar to wavelets to separate the MB and single bounce (SB) [2-5]. But his approach has an assumption that the MB doesn't change with azimuth time, and this assumption rarely happen in the real situation.

In this paper, in order to show clearly of the effects of multi-path scattering mechanisms on SAR imagery, we choose a cylinder cavity with underside closed as our target. Considering the change of the MB in different azimuth time, the SAR image of cylinder cavity is precisely given and the effects of multi-path scattering on SAR image is deduced through range Doppler algorithms (RDA).

The simulation environment of our experiments is showed in Figure 1. The radar frequency is 10GHz and the resolution is 0.5x0.5m. The cylinder cavity is geometrically modeled using facets. The shooting and bouncing ray (SBR) technique is used to calculate the scattered field of the cylinder cavity. The detailed can be found in [6]. The backscattering from the exterior of the cylinder cavity and the field from the inner are considered separately. In the traditional simulation of SAR image, the return data is generated by 2-D convolution of the distribution of the RCS coefficients. If we still use the traditional ways, the multiple path effect is lost in the final image. In this paper, we generate the return based on each ray tube but not the ideal return of the point target. The simulated SAR images are showed in Figure 2.

The effect of multi-path scattering mechanism on SAR imagery is deduced approximately in RDA. And we get the following two conclusions:

(1)The energy of the range compressed signal is still centered in spite of the multi-path scattering, and the cloud through the down range in the SAR image of cylinder cavity is not a disperse phenomenon, while it is corresponding to focus mechanisms.

(2)Because of the multi-path scattering, the RDA can not correctly implement the range variation of the range cell migration (RCM), and after range cell migration correction (RCMC), the range envelope of the signal is still dependent of azimuth frequency.

From the deducing, we pointed out for the first time that the cloud spread through the down range and across the range is different in mechanism. The former is a focus phenomenon, while the latter is a defocus phenomenon. Furthermore, the results show the two features well. We realize that the resulting representation is highly parsimonious and allows additional research into the multi-path scattering characteristics.

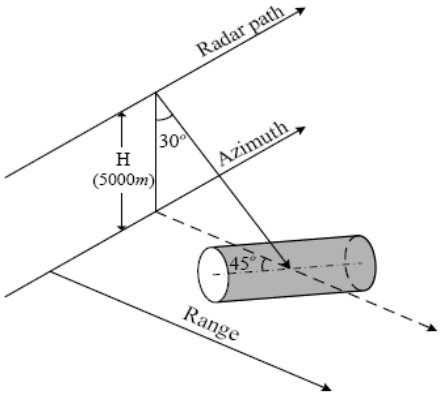
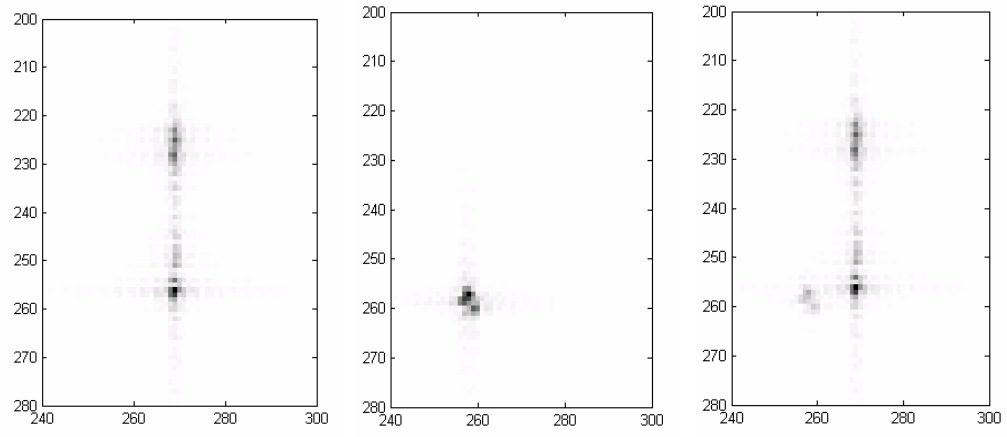


Fig. 1. Data acquisition geometry.



(a) (b) (c)

Fig. 2. (a) The SAR image of the inner cylinder cavity; (b) The SAR image of the exterior cylinder cavity; (c) The SAR image of the cylinder cavity.

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