Image Reconstruction of Radar Targets using the Ramp Response Technique in Bistatic Configuration

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Among radar target identification problems, the scattering characterization of stealth targets is a relevant topic. The stealthiness is efficient in usual radar frequency bands, but it can be countered by using lower frequencies. These lower frequency bands correspond to the Rayleigh region and the resonance region for object dimensions respectively small and of the same order compared to electromagnetic wavelengths. Contrary to high frequency imaging, low frequency methods cannot provide high resolution but they give information on the overall dimension and approximate shape of the target.

Three dimensional microwave imaging requires a considerable number of directions of the incident wave for image reconstruction by inverse scattering methods. On the contrary, a method proposed by Young (J.D. Young, "Radar imaging from ramp response signatures," IEEE Trans. Ant. Prop., Vol. AP-24, pp. 276-282, May 1976), known as the ramp response technique, needs no more than 3 viewing angles to generate an image. The time domain ramp waveform was first suggested by Kennaugh and Moffatt (E.M. Kennaugh and D.L. Moffat, "Transient and impulse response approximations", Proc. IEEE, vol. 53, pp. 893-901, Aug. 1965) for radar identification: The transient field backscattered by a target is directly related to the transverse cross-sectional area of this target as a function of the distance along the line-of-sight, called the profile function. This property can be used for generating a 3D image of the target, as proposed by Young.

However the profile function of a target is generally lengthened in its shadow region, because in this region the contribution to the target backscattered response comes from creeping waves traveling on the surface of the target with a resulting additional delay. Consequently, reconstructed objects are elongated.

That is why, to correct profile functions in shadow regions, we propose to use target backscattering responses as well as target forward scattering responses in bistatic configurations. Indeed, using forward scattering responses, we can obtain better information about the profile function of the target in its shadow region.

We will present the ramp response technique in bistatic configuration.