Range Sidelobe Suppression Using Quasi-Point-Target Echoes for Hainan Coherent Phased Array Radar (HCOPAR)

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Hainan COherent Phased Array Radar (HCOPAR) is a VHF radar with 72 (18×4) antennae. It uses 7/13 bits Barker –coded modulating and matched-filter decoding to increase the range resolution. However, Barker code instrinctly results in range sidelobes, therefore strong echo at certain range gate contaminates neighboring range gates and further reduce the performance of the radar. There are several range sidelobe-suppressing methods having been proposed. For example, placing weighting networks after the matched filter can reduce the range sidelobes to an arbitrary low level (by designing the networks). And using a special dismatched-filter decoding can make pulse compression without range sidelobe. However, mismatched-filter decoding will result in additional SNR loss as compared to the matched filter decoding. Moreover, when the length of subpulse is not integral multiple of its sampling interval (the ratio is about 1.7 for HCOPAR), the effect of sidelobe-free decoding filter will reduce obviously.

In this paper, a signal processing method to suppress the impact of range sidelobes is presented. According to the relationship of the targets, system response function (close to the auto-correlate function of the modulation function) and radar signal, range sidelobes can be removed by deconvoluting the irregularity echo with meteor echo. In principle, deconvolution is a sidelobe-free method. But it is impossible for real system because of noise. Furthermore, it is required for this method that the system response function has no zero in frequency domain.

During observing the ionosphere, a lot of meteor echoes are observed by HCOPAR. Some of the meteors are sufficiently strong and behave as quasi ideal point targets. In this paper, dedicated selection of the meteor echo is used as system response function. Raw data processing of HCOPAR shows that the sidelobes are visibly suppressed in an order of 5dB, and the clutters on the background have been efficiently removed.

This paper mainly addresses the methodology, implementation and improved range-gate-intensity map, Doppler shift and spectral width of the HCOPAR.