Research on the method of low sidelobe pulse suppression of Geosynchronous orbital Doppler weather radar

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The observation of global rainfall distribution and vertical structure contributes to the study of global atmospheric energy distribution and change rule, and is conducive to the study of global climate evolution and environmental change. The geosynchronous orbital Doppler weather radar (GDWR) has the characteristics of high frequency scanning, high measurement accuracy and wide monitoring range. It can directly observe the refined global rainfall structure with high time resolution, and can track and monitor the move path of hurricanes and strong storms. So, GDWR is the development trend of the future space-borne precipitation radar. However, the future precipitation measurement mission of GDWR will be affected by surface clutter, especially in light rainfall conditions. The surface clutter with high echo reflectivity factor will seriously affect the accurate measurement of rainfall through the main lobe and sidelobes of antenna and the range sidelobes of pulse compression. According to NASA's next-generation spaceborne precipitation radar, the Geostationary Doppler Weather Radar (GDWR) research plan, this paper mainly studies the problem of the surface clutter interference caused by range sidelobes of pulse compression based on the GDWR scanning strategy and basic system parameters.

The pollution degree of the surface clutter caused by the pulse compression range side lobes from GDWR observation are quantitatively evaluated. Besides, the impact of the pollution extent and range by setting different pulse compression range side lobes indicators are also quantitatively analyzed and evaluated. The results show that the surface clutter pollution range will decrease when the pulse compression range side lobes decrease, but when the parameter is reduced to a certain extent, the range of clutter pollution will tend to be stable. From the echo power of surface clutter, when the pulse compression range sidelobe suppression ratio is above 55 dB, the precipitation echo is substantially unaffected by them.

Based on the conclusion on the suppression ratio of pulse compression range sidelobes in the evaluation of GDWR surface clutter, considering the requirements of the spaceborne precipitation radar system and the characteristics of the pulse compression signal, a method for pulse compression low-range sidelobe suppression of LFM signal is studied. The results show that under the BT=54 condition, the pulse compression filter designed by combining the two-way weighted improvement method with the spectral correction method can make the pulse compression main sidelobe ratio higher than 75dB and the loss of SNR, main lobe broadening coefficient are meet the requirements of spaceborne precipitation radar.

Keywords: GDWR, surface clutter interference, pulse compression, range sidelobes