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基于时频分析的双通道SAR自旋目标检测

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Rotating Targets Detection with Dual-channel SAR Based on Time-frequency Analysis

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摘要 强地杂波背景给微动目标检测带来很大困难,为此在详细分析距离向压缩数据域自旋目标回波特性基础上,提出了基于双通道合成孔径雷达相位中心偏置天线(SAR/DPCA)和沿航迹干涉(ATI)杂波抑制的两类自旋目标检测方法,并作比较分析。在DPCA模式下,微多普勒频率沿频率(m-D)轴有一整体平移量,其与目标自旋中心的方位向坐标成正比,由此可在估计目标微动参数的同时对其定位;在ATI模式下,不能直接由干涉信号虚部作时频变换来获取微多普勒特征,为此提出了一种基于干涉信号虚部重建自旋目标复信号的微多普勒提取方法。从避免微多普勒模糊的角度,指出在较小基线长度的情况下,ATI模式较DPCA模式对雷达脉冲重复频率(PRF)的要求更宽松,更适宜于大旋翼类目标检测。不同模式下的仿真数据验证了理论分析和所述方法的正确性。

关键词: 合成孔径雷达 相位中心偏置天线 沿航迹干涉 微多普勒 时频变换

Abstract: It is very difficult to detect micro-motion targets against a strong ground clutter background. In order to solve this problem, this paper proposes respectively the methods of dual-channel synthetic aperture radar/displaced phase center antenna (SAR/DPCA) and along-track interferometry (ATI) based on a detailed study of the echo features of rotating targets in the range-compressed data domain. Under the mode of SAR/DPCA, the entire micro-Doppler (m-D) signature undergoes a shift along the frequency axis which is proportional to the azimuth position of the revolving center. Therefore, the target can be located while the micro-motion parameters are estimated. Under the mode of SAR/ATI, the m-D signature cannot be directly obtained from the imaginary part of the interferometric signal by time-frequency transform, so a method is proposed of reconstructing the complex signal of a rotating target based on the imaginary part. In order to avoid m-D ambiguity, the paper points out that when the length of baseline is comparatively short, the method of SAR/ATI is more suitable for detecting targets with big rotating blades than the method of SAR/DPCA, because it requires lower pulse repetition frequency (PRF), The results of simulation tests for these modes testify the validity of the theoretical analysis and the proposed methods.

Keywords: synthetic aperture radar displaced phase center antenna along-track interferometry micro-Doppler time-frequency transform

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