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基于小波稀疏表示的压缩感知SAR成像算法研究

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A Compressive Sensing Imaging Approach Based on Wavelet Sparse Representation

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摘要 高分辨大场景合成孔径雷达(SAR)成像给数据存储和传输系统带来沉重负担。该文对条带式体制下的SAR成像，提出基于场景方位向小波稀疏表示的压缩感知成像方法。该方法首先沿方位向进行随机稀疏采样得到降采样的原始数据，然后在距离向采用传统匹配滤波方法实现脉冲压缩处理，方位向则利用小波基作为场景散射系数的稀疏基，并通过求解最小l_1范数优化问题重构方位向散射系数。所提算法在方位向严重降采样下仍能够实现无模糊的SAR成像，实测数据成像结果表明所提算法具有较好的有效性和一定的实用性。

关键词： 合成孔径雷达 压缩感知 小波稀疏基 优化算法

Abstract： High resolution and wide swath Synthetic Aperture Radar (SAR) imaging increases severely data transmission and storage load. To mitigate this problem, a compressive sensing imaging method is proposed based on wavelet sparse representation of scatter coefficients for stripmap mode SAR. In the presented method, firstly, the signal is sparsely and randomly sampled in the azimuth direction. Secondly, the matched filter is used to perform pulse compression in the range direction. Finally, the wavelet basis is adopted for the sparse basis, and then the azimuth scatter coefficients can be reconstructed by solving the l_1 minimization optimization. Even if fewer samples can be obtained in the azimuth direction, the proposed algorithm can produce the unambiguous SAR image. Real SAR data experiments demonstrate that the effectiveness and stability of the proposed algorithm.

Keywords： SAR Compressive Sensing (CS) Wavelet sparse basis Optimization algorithm

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