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低信噪比下稳健压缩感知成像

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Robust Compressive Sensing SAR imaging in Low SNR Conditions

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摘要 由于基于 l_1 范数的压缩感知理论模型无法充分挖掘信号的稀疏性,因此在重建过程中无法实现对待重构系数的等权值约束,进而导致在信噪比较低时,噪声分布的不稀疏性会严重影响目标信息重建,造成成像结果中会出现大量虚假目标,成像性能急剧下降。本文在深入分析了加权 l_1 范数模型的基础上,提出了一种更加稳健的适用于含噪模式下的高分辨率压缩感知微波成像模型。该模型在借鉴常规加权 l_1 范数模型的基础上,针对权重选择及加权方式进行了修正,使得权值的变化程度和权值大小分离,可以做到相同的惩罚约束,从而实现成像过程中噪声分量的有效抑制,实验结果说明了低信噪比下所提模型的有效性。

关键词: 低信噪比 压缩感知 雷达成像 加权范数 高分辨

Abstract: The l_1 -norm based compressed sensing (CS) model cannot fully explore the sparsity property of a signal, and the weighted constraint of the restored coefficients is seldom equally arranged during the reconstruction. Therefore, the characteristic of the non-sparsity of the noise will seriously affect the restoration of the target information in low signal-to-noise (SNR) conditions, which may result in quite many false targets during imaging, leading to a sharp decline of the imaging quality. This paper provided a detailed analysis of the reweighted l_1 -norm model for CS reconstruction, and proposed a robust high resolution imaging model with corrupted echo. The main idea is inspired by the canonical reweighted l_1 -norm based CS model, but the selection of the weight parameters are improved, which equally penalize the variation and separation of large and small weights, and the noise components can be effectively suppressed during the imaging. Simulation results testify the validity of the proposed model in low SNR conditions.

Keywords: low SNR compressive sensing radar imaging weighted norm high-resolution

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