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基于贝叶斯压缩感知的合成孔径雷达高分辨成像

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SAR Imaging Based on Bayesian Compressive Sensing

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摘要 基于压缩感知(CS)的合成孔径雷达成像方法可以显著减少数据采样时间、数据量以及节省信号带宽。然而，基于CS的方法对噪声和杂波相当敏感，在信噪比较低的时候，成像质量较差。该文结合CS理论提出了合成孔径雷达中的随机孔径贝叶斯压缩感知(BCS)高分辨2维成像方法。在距离向应用CS减少采样数据的同时，在方位向随机抽取部分孔径位置发射和接收信号，以少量的测量孔径和测量数据获得重建目标空间的足够信息。基于贝叶斯的分析方法由于考虑了成像场景中的杂波以及压缩采样过程中的加性噪声，因而能够更好地重建目标空间。仿真结果表明，基于贝叶斯方法得到的图像比基于FFT方法得到的图像更加尖锐，比基于CS方法得到的图像更加稀疏，因而具有更高的分辨率。

关键词： 合成孔径雷达 压缩感知 高分辨 贝叶斯压缩感知 超宽带

Abstract： The Compressive Sensing (CS) based SAR imaging method can reduce the sampling time, the data volume and save signal band width. However, the CS based methods are sensitive to noise and clutter. In this paper, a new imaging modality based on Bayesian Compressive Sensing (BCS) is proposed along with a novel compressed sampling scheme. This new imaging scheme requires minor change to traditional used system and allows both range and azimuth compressed sampling. Also, the Bayesian formalism accounts for additive noise encountered in the compressed measurement process. Experiments are carried out with noisy and cluttered imaging scenes to verify the new imaging scheme. The results indicate that the Bayesian formalism can provide a sharp and sparse image absence of side-lobes which is the common problem in conventional imaging methods and have fewer artifacts compared to the previous version of CS based methods.

Keywords： Synthetic Aperture Radar (SAR)　Compressive Sensing (CS)　High resolution　Bayesian Compressive Sensing (BCS)　Wide-band

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