

基于压缩感知的频率编码脉冲雷达高分辨距离成像方法

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High Resolution Range Imaging Method for Frequency-coded Pulse Radar Based on Compressive Sensing

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摘要

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摘要 针对频率编码脉冲雷达(Frequency-Coded Pulse Radar, FCPR), 该文提出一种基于压缩感知(Compressive Sensing, CS)的目标高分辨距离成像方法。利用目标场景的空间稀疏性, 建立FCPR目标回波稀疏信号模型, 提出基于CS的FCPR脉冲相参合成处理方法。该方法采用少量FCPR信号子脉冲对目标频域响应进行采样, 即可提取目标高分辨距离像信息。为了降低CS重构算法的运算复杂度, 提出一种基于FFT目标速度估计的动态构造降维感知矩阵的方法, 提高了采用CS进行FCPR脉冲相参合成处理的速度。仿真结果表明该方法较传统IFFT脉冲相干合成算法具有更小的目标强散射中心幅度估计误差, 对速度估计误差及噪声的鲁棒性更好。

关键词: 频率编码脉冲雷达 高分辨距离像 压缩感知 速度预估计

Abstract: A novel Compressive Sensing (CS) based high resolution target range imaging method for Frequency-Coded Pulse Radar (FCPR) is proposed in this paper. Considering spatial sparsity of the target scene, a FCPR target sparse signal model is derived. A FCPR pulses coherent synthesis processing method is presented. Target frequency domain response is sampled with only a few FCPR sub-pulses, from which target high resolution range information is reconstructed exactly. A dynamic creation of deduced dimension sensing matrix based on target velocity pre-estimation using FFT is proposed. This method reduces the computational complexity of CS recovery algorithms and promotes the speed of CS based FCPR pulses coherent synthesis processing. Computer simulations show that the presented method performs better than traditional IFFT pulses coherent synthesis processing algorithm with smaller magnitude estimation error of strong target scattering center and better robustness against velocity estimation error and noise.

Keywords: Frequency-Coded Pulse Radar (FCPR) High resolution range imaging Compressive Sensing (CS) Velocity pre-estimation

Received 2010-11-19;

本文基金:

南京理工大学自主科研专项计划(2010ZYTS028, 2010ZDJH05)和南京理工大学科研启动基金资助课题

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引用本文:

贺亚鹏, 庄珊娜, 李洪涛, 朱晓华. 基于压缩感知的频率编码脉冲雷达高分辨距离成像方法[J] 电子与信息学报, 2011, V33(7): 1678-1683

He Ya-Peng, Zhuang Shan-Na, Li Hong-Tao, Zhu Xiao-Hua. High Resolution Range Imaging Method for Frequency-coded Pulse Radar Based on Compressive Sensing[J], 2011, V33(7): 1678-1683

链接本文:

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