电子与信息学报
JOURNAL OF ELECTRONICS & INFORMATION TECHNOLOGY

电子与信息学报 » 2012, Vol. 34 » Issue (7) :1609-1615 DOI: 10.3724/SP.J.1146.2011.01067

基于压缩感知理论的随机噪声雷达目标检测算法研究

武昕*①② 王岩飞① 刘畅①*

①(中国科学院电子学研究所 北京 100190) ②(中国科学院研究生院 北京 100039)

A Target Detection Algorithm Based on Compressive Sensing for Random Noise Radar

Wu Xin①② Wang Yan-fei① Liu Chang①*

①(Institute of Electronics, Chinese Academy of Sciences, Beijing 100190, China)
②(Graduate University of Chinese Academy of Sciences, Beijing 100039, China)

摘要 随机噪声雷达通常利用时域相关完成脉冲压缩从而进行目标检测。该文根据压缩感知理论提出一种适用于噪声雷达目标检测的新算法，它用低维投影测量和信号重建取代了传统的相关操作和压缩处理，将大量运算转移到后期处理。该算法以噪声雷达所检测的目标空间分布满足稀疏性为前提；利用发射信号形成卷积矩阵，然后通过随机抽取卷积矩阵的行构建测量矩阵；并采用迭代收缩阈值算法实现目标信号重建。该文对算法作了详细的理论推导，形成完整的实现框架。仿真实验验证了算法的有效性，并分析了对处理结果影响较大的因素。该算法能够有效地重建目标，具有良好的运算效率。与时域相关法相比，大幅度减小了目标检测误差，有效抑制了输出旁瓣，并保持了信号的相位特性。

关键词： 随机噪声雷达 目标检测 压缩感知 重建误差

Abstract： Random noise radar executes pulse compression via direct correlation in time domain for target detection. A novel algorithm is proposed based on compressive sensing for random noise radar system. Projection for low dimension data is adopted instead of correlation; Signal reconstruction is used to substitute signal compression; And much computational load is transferred to background processing. In this algorithm, detected targets in scene satisfy the requirement of sparsity peculiarity, and measurement matrix is constructed by selecting the rows of convolution matrix stochastically. Furthermore, two step iterative shrinkage/thresholding algorithm is applied to reconstruct target signals. With elaborate theoretical derivation, the whole processing of this algorithm is presented. Simulation results are provided to show that the algorithm is able to reconstruct targets efficiently with well computational efficiency. Moreover, factors highly influencing on the results are analyzed. In contrast to correlation operation, reconstruction error is significantly reduced and sidelobes are faithfully suppressed. In addition, phase characters of target information are preserved well.

Keywords： Random noise radar Target detection Compressive Sensing (CS) Reconstruction error

Received 2011-10-14;

通讯作者: 武昕 Email: 19861002wuxin@163.com

引用本文:
武昕, 王岩飞, 刘畅.基于压缩感知理论的随机噪声雷达目标检测算法研究[J] 电子与信息学报, 2012,V34(7): 1609-1615

Wu Xin, Wang Yan-Fei, Liu Chang.A Target Detection Algorithm Based on Compressive Sensing for Random Noise Radar[J] , 2012,V34(7): 1609-1615

链接本文:
http://jeit.ie.ac.cn/CN/10.3724/SP.J.1146.2011.01067 或 http://jeit.ie.ac.cn/CN/Y2012/V34/I7/1609