信号处理 2012, 28(6) 827-833 DOI: ISSN: 1003-0530 CN: 11-2406/TN

算法研究

基于贝叶斯压缩感知的子空间拟合DOA估计方法

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摘要：

经典加权子空间拟合算法需进行多维非线性优化，初始参数的难以设置和较大的计算量限制了其应用。结合压缩感知理论，本文提出了一种基于改进贝叶斯压缩感知的子空间拟合DOA估计新方法。该方法首先通过低复杂度的子空间分解算法PASTd估计信号加权子空间，进而基于入射信号的空域稀疏性，将信号子空间拟合建模为多测量值稀疏重构问题，并应用贝叶斯压缩感知算法进行求解。算法在贝叶斯压缩感知的迭代求解中引入了基于相对阈值判决的基消除机制，加快收敛速度的同时避免了矩阵奇异问题。仿真结果表明本文算法在低信噪比、小快拍情况下空间分辨率优于MUSIC和l1-SVD算法，可直接用于相干源的估计，并对信源数目的估计误差具有较强鲁棒性。

关键词： 波达方向；子空间拟合；贝叶斯压缩感知；基消除；PASTd

A Novel Subspace Fitting Method for DOA Estimation Based on Bayesian Compressive Sensing

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Abstract:

The application of conventional Weighted Subspace Fitting (WSF) algorithm, which involves multidimensional nonlinear optimization, is limited for its huge computational burden and difficult initial parameter setting. Combing compressive sensing theory, a novel WSF algorithm for narrowband DOA estimation based on modified Bayesian Compressive Sensing (BCS) is proposed in this paper. The Projection Approximation Subspace Tracking deflation (PASTd) algorithm is utilized to efficiently estimate both the signal eigenvalues and corresponding eigenvectors, which significantly reducing the computation burden compares to the singular value decomposition of the sample covariance matrix. Exploiting the prior knowledge of spatial sparsity, we reformulate the WSF to a sparse signal reconstruct problem in the context of the multiple measurement vectors. Furthermore, a basis pruning mechanism via iterative relative thresholding is presented to speed up the convergence rate and avoid the matrix singular drawback during the original BCS iteration. Computer simulation results are presented and analyzed, demonstrating a number of advantages of the proposed method, including increased spatial resolution with low SNR and limited number of snapshots compared with MUSIC and l1 SVD, improved robustness to the source number estimation error and can be directly applied to the scenarios where highly correlated or coherent sources are presented without any preprocessing.

Keywords: direction-of-arrival subspace fitting Bayesian compressive sensing basis pruning PASTd

收稿日期 2011-12-31 修回日期 2012-05-06 网络版发布日期 2012-06-25

DOI:

基金项目:

“新一代宽带无线移动通信网”国家科技重大专项课题（2010ZX03006-002-04）

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