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基于空域稀疏性的宽带DOA估计

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Wideband DOA Estimation Based on Spatial Sparseness

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摘要

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摘要 利用宽带阵列接收信号的空域稀疏性,将宽带信号的波达方向(DOA)估计转化为一个稀疏信号重构的问题,提出了一种新的宽带信号DOA估计算法。该算法将宽带信号分解为多个子带信号,联合利用多个子带信号的空域稀疏性进行重构。它是对用于稀疏重构的标准的稀疏贝叶斯学习算法的推广,可适用于多冗余字典的信号模型。另外,通过对多快拍的阵列接收信号进行奇异值分解(SVD),提取信号子空间作为算法的输入数据,可以在有效减少运算复杂度的同时,提高对噪声的稳健性。与传统的宽带阵列DOA估计方法相比,该算法能够用于低信噪比、快拍有限和信源相关性较高的场合,同时算法的性能对信源个数的估计值不太敏感。仿真实验表明,该算法相对现有的基于子空间类的方法,具有更好的DOA估计性能。

关键词: 阵列信号处理 波达方向 压缩感知 稀疏重构 高分辨 宽带 谱估计

Abstract: With the utilization of spatial sparseness of wideband sources, a wideband direction of arrival (DOA) estimation problem can be translated into a sparse reconstruction problem, based on which a novel wideband DOA estimation algorithm is presented. It decomposes a wideband signal into multiple sub-band signals, and utilizes jointly the common spatial sparse pattern of these sub-band signals. The proposed algorithm can be viewed as an extension of the original sparse Bayesian learning method to the case of multiple redundant dictionaries. Additionally, by the singular value decomposition (SVD) performed on the multiple snapshots of the array received signal, the signal subspace is extracted as the input of the algorithm, which effectively reduces the computational complexity and simultaneously improves the robustness to noises. Compared with classical wideband DOA estimation methods, this algorithm performs better even in the cases of low signal-to-noise ratio, limited available snapshots and high correlations of sources. Its performance is insensitive to a biased estimate of source number. Simulation results verify its performance advantages over existing subspace-based wideband DOA estimation methods.

Keywords: array signal processing direction of arrival compressed sensing sparse reconstruction high resolution wideband spectral estimation

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