算法研究

基于贪婪算法的高分辨信号源DOA估计

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摘要：

确定辐射源的来波方向(DOA)是阵列信号处理的重要研究内容，已经广泛应用于雷达、声纳和无线通信等领域。本文研究了远场窄带信号源的DOA高分辨估计问题。利用信号来波方向在空域具有稀疏性的特点，建立了远场窄带信号源的稀疏表示模型。根据协方差矩阵的特征值分解和贪婪匹配追踪算法原理提出了一种基于特征值分解的多重正交匹配追踪算法（EIG   MOMP）。首先，利用特征值分解对阵列接收数据进行降维处理。这一降维操作使得问题转化为了一个具有多重观测向量（MMV）的欠定方程求解问题。接着利用MOMP算法对降维后的数据进行处理，最终得到信号的DOA估计值。该算法实现了在低信噪比下远场窄带信号源的高分辨DOA估计，并具有较低的运算复杂度。将本文提出的算法与传统的Capon算法、多重信号分类算法（MUSIC）以及正交匹配追踪算法（OMP）进行了对比。结果证明，该算法在低信噪比下能取得较好的DOA估计效果，可以针对任意的相干信号源，并且具有高分辨率的优点。

关键词： DOA估计；稀疏表示；特征值分解；贪婪迭代算法

A high resolution DOA estimation method based on greedy algorithm

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Abstract:

It is important research contents to determine the direction-of-arrival (DOA) of radiation sources in the array signal processing, which has been widely used in radar, sonar and wireless communication system. This paper studies the (DOA) estimation problem of far field narrowband signal sources. We build up the sparse representation model of far field narrowband using the spatial sparse property of the DOA of the incident sources. We propose a DOA estimation method combined the eigenvalue decomposition and multiple orthogonal matching pursuit algorithm (MOMP) based on the eigenvalue decomposition of array output covariance matrix and the theory of greedy matching pursuit algorithm. Firstly, we use eigenvalue decomposition to reduce the dimension of the received data form array output. The reduction operation transforms the DOA estimation problem into solving a multiple measurement vectors (MMV) problem which is appropriate for the MOMP algorithm. Then, the MOMP algorithm is employed to estimate the DOA from the data of reduced dimension. High resolution DOA estimation is achieved in low signal to noise ratio (SNR) and less computational complexity is guaranteed. The performance is compared with the representative DOA estimation methods including MUSIC, Capon and OMP. Simulation experiments are conducted to validate the effectiveness of the proposed method regardless of the coherence of the incident signals.

Keywords: Direction-of-arrival (DOA) estimation sparse representation eigenvalue decomposition greedy algorithm

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