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非圆实信号MIMO雷达中基于实值ESPRIT的角度估计

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Angle Estimation in MIMO Radar with Non-circular Signals Based on Real-valued ESPRIT

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摘要

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摘要

研究单基地多输入多输出(MIMO)雷达中的波达角(DOA)估计问题,提出了一种基于非圆(NC)实信号的实值旋转不变性信号参数估计(ESPRIT)算法。首先对接收信号进行降维变换,降低运算复杂度;之后根据非圆实信号特性构造中心Hermitian对称矩阵,通过酉(Unitary)变换将复数运算转为实数,进一步降低复杂度;最后根据ESPRIT得到角度估计。该算法无需谱峰搜索,运算复杂度较NC ESPRIT和Unitary ESPRIT大大降低,且该算法的角度估计性能优于后两种算法。论文分析了所提算法的复杂度,并推导了克拉美-罗界(CRB)。仿真结果验证了该算法的有效性。

关键词: 多输入多输出雷达 非圆实信号 角度估计 ESPRIT 克拉美-罗界

Abstract:

In this paper, the direction of arrival (DOA) estimation in a monostatic multiple-input multiple-output (MIMO) radar is studied, and a real-valued estimation of signal parameters via rotational invariance techniques (ESPRIT) algorithm for the estimation based on non-circular (NC) signals is proposed. Through a reduced-dimensional transformation, the received data is transformed to be low-dimensional, which lead to lower complexity. Thereafter, a center-Hermitian matrix is constructed based on the characteristics of the NC real-valued signals. Then a unitary matrix is used to transform the complex computations into real-valued ones, thus further reducing the complexity. Finally, ESPRIT is employed to estimate the angles. The proposed algorithm requires no peak searching, and has lower complexity but better angle estimation performance than the NC ESPRIT and Unitary ESPRIT. The complexity of the algorithm is analyzed, and the Cramer-Rao bound (CRB) for the angle estimation in MIMO radar is derived. In the simulation, these algorithms are compared, which verifies the effectiveness of our algorithm.

Keywords: multiple-input multiple-output radar non-circular signal angle estimation ESPRIT Cramer-Rao bound

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