

算法研究

稳定分布噪声下基于高斯近似粒子滤波的干扰源定位算法

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摘要:

民航地空通信受到无线电干扰会严重危及民航飞机的正常飞行, 本文在深入研究利用接收飞机散射信号的多普勒频移信息定位地面干扰源方法的基础上, 提出基于高斯近似粒子滤波(GAPF)的定位算法。本文的主要贡献可以总结为: 第一, 对多普勒频移与干扰源坐标之间非线性关系进行深入研究, 构建状态方程及观测方程。第二, 考虑更能准确描述散射信道模型的对称alpha稳定分布(SaS)噪声作为叠加的背景噪声, 并提出 噪声下的高斯近似粒子滤波算法。计算机仿真实验表明, 与扩展卡尔曼滤波(EKF)及无迹卡尔曼滤波(UKF)算法相比, 本文算法的估计性能优势明显, 并且对SaS噪声具有较强的鲁棒性。

关键词: 干扰源定位; 高斯近似粒子滤波; 多普勒频移; SaS分布噪声

An Interference Localization Algorithm Based on Gaussian Approximation Particle Filtering with Stable Distribution Noise

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Abstract:

The ground-air communication of civil aviation is interfered by radios, which has seriously endangered the normal flight of civil airplanes. This paper proposes a Gaussian approximation particle filtering (GAPF) algorithm based on study of the method of interference localization that utilizes Doppler frequency shifts of the scattered signals from airplanes. The main contribution of this paper can be summarized as follows. First, study on the nonlinear relationship between Doppler frequency shifts and the coordinates of the interference, and construct the state-space equation and the measurement equation. Second, use the additive symmetric alpha stable (SaS) distribution noise to describe the scattered channel model, and propose the Gaussian approximation particle filtering algorithm under the assumption of SaS noise. Numerical simulations demonstrate that the proposed algorithm can achieve better estimation performance and robustness for additive noise, compared with the extended Kalman filter (EKF) and the unscented Kalman filter (UKF).

Keywords: interference localization Gaussian approximation particle filter Doppler frequency shift SaS distribution noise

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