

控制理论与实践

联合高斯回归的平方根UKF方法

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摘要:

针对传统的滤波方法容易受系统动态模型不确定性和噪声协方差不准确的限制这一问题,提出一种将高斯过程回归融入平方根不敏卡尔曼滤波(unscented Kalman filter,UKF)算法中的滤波算法。该算法用高斯过程对训练数据进行学习,得到动态系统的回归模型及系统噪声的协方差;采用标准的平方根UKF算法,状态方程和观测方程,相应的噪声协方差由高斯过程实时自适应调整。将应用于飞行器SINS/GPS组合导航,结果表明,该方法能够自适应系统噪声,收敛速度快,导航精度高。

关键词: 平方根不敏卡尔曼滤波 高斯过程回归 组合导航

Square root unscented Kalman filter incorporating Gaussian process regression

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Abstract:

In classical filter algorithms, the predictive capabilities are limited by the uncertainty of system model and noise covariance. To solve this problem, Gaussian process regression and the square root unscented Kalman filter (UKF) are used in conjunction to derive a new filter algorithm. This new algorithm includes two parts. First, Gaussian process regression is used to learn training data, so the regression models and noise covariance of the dynamic system are gotten. Then the standard square root UKF filter is adopted, the state equation and observation equation are replaced by their regression models respectively, relevant noise covariance is adjusted by Gaussian kernel function adaptively and real timely. Applied in SINS/GPS integrated navigation of an aerial vehicle, this new algorithm shows its strong adaptability to system noise, good convergence rate and excellent navigation accuracy.

Keywords: square root unscented Kalman filter Gaussian process regression integrated navigation

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