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Robust extended Kalman filtering for nonlinear stochastic systems with random sensor delays, packet dropouts and correlated noises

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Abstract: In this paper, the robust filtering problem is investigated for nonlinear stochastic systems with random sensor delays, packet dropouts and correlated noises. The stochastic multiplicative noises which enter into both state equation and measurement equation are modeled as random variables with bounded variance, and a Bernoulli distributed random sequence is introduced to describe the random delays and packet dropouts. Then, the system is converted to the stochastic parameterized one through introducing a group of new variables. Moreover, the two-step prediction framework is employed to achieve the goal of noise decoupling. The objective of the addressed estimation problem is to design a filter, such that in the presence of random delays, packet dropouts, multiplicative noises and correlated noises, the upper bounds for the prediction error and estimation error covariance can be guaranteed. Subsequently, the upper bounds are minimized by designing the optimal prediction gain and filter gain. Finally, the attitude estimation example is used to demonstrate the effectiveness of the proposed robust extended Kalman filter.

Keywords: random sensor delays; packet dropouts; correlated noises; multiplicative noises; attitude estimation; robust extended Kalman filter

1. Introduction

In the past few years, the filtering or state estimation theory has received extensive attention because of its successfully applications in many fields, such as, pose estimation, target tracking, guidance or