Bayesian Estimation in Nonlinear Dynamic Systems using Nonlinear Update

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Abstract

Recursive Bayesian approaches have been widely used for state and parameter estimation. More recently, sampling based approaches have become popular since they circumvent the issue of approximating the conditional density by selecting samples (either deterministically or stochastically) and subsequently propagating these through the nonlinear dynamics. In this work, we propose an analytical framework to evaluate the a posteriori density using Bayes’ rule for nonlinear state estimation. In this approach, a priori density is modeled as a sum of Gaussians, which are centered on the propagated samples. These are used along with the likelihood function in the Bayes’ rule to obtain the posteriori density thereby resulting in a Nonlinear Update Based Gaussian Sum Filter (NUGSF). Our simulations show that for a scalar case problem when used with large number of samples the estimation was superior to UKF. However, with limited number of samples as in UKF, the simulation performance of NUGSF deteriorates. We used the insight obtained from the limited number of samples to identify the cause for poor performance.

Keywords: Nonlinear state estimation; Bayes’ approach; Nonlinear update; Gaussian sum filter

References

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