

Nonlinear filtering of continuous systems: Foundational problems and new results

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This paper is to extend the work of Xu (1999) on discrete nonlinear filtering to the continuous systems. The new results are summarized as follows: (i) we work out a second order unbiased prediction of the true state governed by a vector stochastic differential equation; (ii) we derive a set of coupled differential equations for a new truncated second order nonlinear filter and its variance-covariance matrix from the frequentist point of view. The new filter is proved to be unbiased to the second order approximation; and most importantly, (iii) comparing our new filtering and accuracy results with the literature on nonlinear filtering has indicated that more than forty years of nonlinear filtering of continuous systems may have had fundamental defect in the foundation.