A tutorial on Bayesian Filtering

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Abstract

In Bayesian filtering we are given two processes; one of them is hidden and the other one is observed, and the problem consists in restoring the hidden sequence from the available observations. This problem has a long history by now, and has found applications in such different fields as target tracking, statistical signal processing, digital communications, automatic speech recognition or bioinformatics.

Most often, it is assumed that the joint (hidden and observed) process is a so-called hidden Markov chain (HMC). Such statistical models have been used extensively because of their ability to model physical problems of interest, and because they enable the development of efficient filtering algorithms. The aim of this tutorial is to review the main Bayesian restoration techniques which have been proposed in HMCs or some of their recent extensions. We will start with the classical Kalman filter (KF) and some of its variants, such as extended or unscented KF. We will next address the rich class of sequential Monte Carlo algorithms, including particle filtering (PF) and auxiliary PF solutions. We will then review inference techniques in the presence of a third (the so called "jump") process, which models the different regimes of the HMC. Finally we will describe some recent extensions to multi-target filtering.

References

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