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Functional response estimation and population tracking in a Lotka-Volterra system using a Bayesian filtering technique

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Usually, biological control strategies are difficult to establish with scientific rigor because the current abundance of pest population and the properties of the predator functional response must be known.
In this paper, we propose a Rao-Blackwellized particle filter to both estimate the behavioural parameter of the functional response (i.e., the rate of effective search per predator) and the biomass of each population. The approach is based on a Lotka-Volterra functional response model and the proposed technique combines a sequential Monte Carlo sampling scheme for tracking the time-varying biomasses with the analytical integration of the unknown behavioural parameter.
We firstly validate the method using simulated data and then we apply it given experimental observations of an acarine predator-prey system, namely the pest mite *Tetranychus urticae* and the predatory mite *Phytoseiulus persimilis*.
Results show the capability of the approach to estimate the behavioural parameter and a good estimation of the population biomass evolution over time.

Keywords:
Prey-predator system; Parameter estimation;
Monte Carlo sampling; Mixture Kalman filtering.

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