A Hybrid EKF and Switching PSO Algorithm for Joint State and Parameter Estimation of Lateral Flow Immunoassay Models

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In this paper, a hybrid extended Kalman filter (EKF) and switching particle swarm optimization (SPSO) algorithm is proposed for jointly estimating both the parameters and states of the lateral flow immunoassay model through available short time-series measurement. Our proposed method generalizes the well-known EKF algorithm by imposing physical constraints on the system states. Note that the state constraints are encountered very often in practice that give rise to considerable difficulties in system analysis and design. The main purpose of this paper is to handle the dynamic modeling problem with state constraints by combining the extended Kalman filtering and constrained optimization algorithms via the maximization probability method.

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Kalman Filter (UKF) employing the Mean Square Error (MSE) as the fidelity criterion in recovering the parameters of gene regulatory networks from synthetic data and real biological data. The proposed particle filter based network inference algorithm outperforms EKF and UKF, and therefore, it can serve as a natural framework for modeling gene regulatory networks with nonlinear and sparse structure.

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