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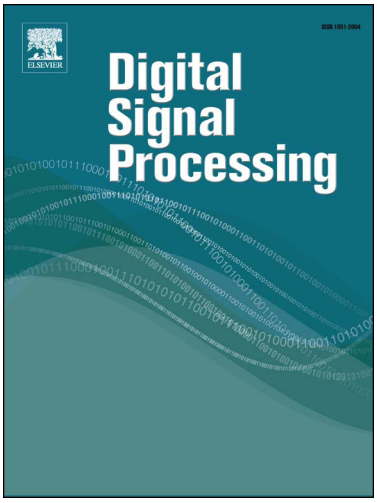

Adaptive genetic particle filter and its application to attitude estimation system

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Adaptive genetic particle filter and its application to attitude estimation system

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Abstract: The particle filter is a class of sequential Monte Carlo method, which can be applied to any nonlinear and non-Gaussian random system that can be represented by the state space model. However, the resampling procedure in the particle filter may introduce particle impoverishment. To mitigate this problem, an adaptive genetic particle filter is developed in this paper. It employs an unscented Kalman filter for a low-dimensional state estimation and a cubature Kalman filter for a high-dimensional system to generate the importance proposal distribution to take full advantage of the latest measurements within a particle filter framework. The crossover and improved mutation strategies are used together to increase the particle diversity, where the loss of particle diversity is a specific manifestation of particle impoverishment. To optimize the selection of parameters, make the genetic algorithm converge to the global optimal solution and improve the work efficiency, an adaptive strategy is designed so that the mutation probability of the algorithm is self-determined. Two experiments, one is the univariate growth model, and one is the synthetic experiment, both show the superiority and effectiveness of the proposed algorithm. Finally, the adaptive genetic particle filter is applied to the attitude estimation system, and the results show that the novel algorithm possesses higher accuracy and faster convergence rate compared with the multiplicative extended Kalman filter and the unscented quaternion estimator.

Keywords: particle filter; genetic algorithm; adaptive strategy; attitude estimation