

Thesis: The Novel Parallel/Distributed Particle Filters.

Abstract: Particle filters have been widely used in estimating the states of dynamical systems by using stochastic sampling techniques. The parallel / distributed particle filters were introduced to improve the performance of sequential particle filters with multiple processing units (PUs). The classical resampling algorithm in parallel/distributed particle filters were in a centralized scheme, called centralized resampling, which needed a central unit (CU) to serve as a hub for data transfer. As a result, the centralized resampling procedures produced extra communication, which lowered the speedup factors in parallel computing. Even some efficient particle routing policies had been introduced, the centralized resampling still suffered from high communication cost. Decentralized resampling algorithm was introduced to decrease the communication cost in parallel / distributed particle filters. In decentralized resampling, each PU independently handled the particles on it. Because of the lack of global information, the estimate accuracy was relatively low compared to that of centralized resampling. Thus, the hybrid resampling algorithms were proposed to improve the performance by alternatively executing the centralized resampling and decentralized resampling, which can reduce the communication costs without losing the estimation accuracy. We had formalized various hybrid resampling algorithms to be a generic resampling algorithm and proved it to be uniformly convergent. The proof can provide theoretical foundation for the application. The performance of centralized resampling with different routing policies has been analyzed, which provided guidance in applying the centralized resampling algorithm. However, the performance of hybrid resampling algorithms and decentralized resampling algorithms has not been analyzed. Therefore, I propose to analyze the performance of hybrid resampling algorithms and decentralized resampling algorithms. The analysis is capable to provide the guidance in application and parameter settings of resampling algorithms in parallel/distributed particle filters.

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