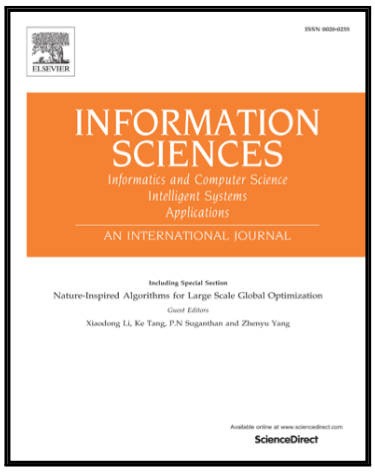


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# Globally-optimal Prediction-based Adaptive Mutation Particle Swarm Optimization

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*Abstract*—Particle swarm optimizations (PSOs) are drawing extensive attention from both research and engineering fields due to their simplicity and powerful global search ability. However, there are two issues needing to be improved: one is that the classical PSO converges slowly; the other is that classical PSO tends to result in premature convergence, especially for multi-modal problems. This paper attempts to address these two issues. Firstly, to improve the convergent efficiency, this paper proposes an asymptotic predicting model of the globally-optimal solution, which is used to predict the global optimum based on extracting the features reflecting the evolutionary trend. The predicted global optimum is then taken as the third exemplar, in a way similar to the individual historical best solution and the swarm historical best solution in guiding the evolutionary process of other particles. To reduce the probability that the population is trapped into a local optimum due to the premature phenomenon, this paper proposes an adaptive mutation strategy, which is used to help the trapped particles to escape away from the local optimum by using the extended non-uniform mutation operator. Finally, we combine the two entities to develop a globally-optimal prediction-based adaptive mutation particle swarm optimization (GPAM-PSO). In numerical experimental parts, we compare the proposed GPAM-PSO with 11 existing PSO variants by using 22 benchmark problems of 30-dimensions and 100-dimensions, respectively. Numerical experiments demonstrate that the proposed GPAM-PSO could improve the accuracy and efficiency remarkably, which means that the combination of the globally-optimal prediction-based search and the adaptive mutation strategy could accelerate the convergence and reduce premature phenomenon effectively. Generally speaking, GPAM-PSO performs most efficiently and robustly. Moreover, the performance on an engineering problem demonstrates the practical application of the proposed GPAM-PSO algorithm.

*Index Terms*—adaptivity, function fitting, global prediction, non-uniform mutation, Particle swarm optimization

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