Comparative Analysis of Low Discrepancy Sequence-Based Initialization Approaches Using Population-Based Algorithms for Solving the Global Optimization Problems

ABSTRACT

Metaheuristic algorithms have been widely used to solve diverse kinds of optimization problems. For an optimization problem, population initialization plays a significant role in metaheuristic algorithms. These algorithms can influence the convergence to find an efficient optimal solution. Mainly, for recognizing the importance of diversity, several researchers have worked on the performance for the improvement of metaheuristic algorithms. Population initialization is a vital factor in metaheuristic algorithms such as PSO and DE. Instead of applying the random distribution for the initialization of the population, quasirandom sequences are more useful for the improvement the diversity and convergence factors. This study presents three new low-discrepancy sequences named WELL sequence, Knuth sequence, and Torus sequence to initialize the population in the search space. This paper also gives a comprehensive survey of the various PSO and DE initialization approaches based on the family of quasirandom sequences such as Sobol sequence, Halton sequence, and uniform random distribution. The proposed methods for PSO (TO-PSO, KN-PSO, and WE-PSO) and DE (DE-TO, DE-WE, and DE-KN) have been examined for well-known benchmark test problems and training of the artificial neural network. The finding of our techniques shows promising performance using the family of low-discrepancy sequences over uniform random numbers. For a fair comparison, the approaches using low-discrepancy sequences for PSO and DE are compared with the other family of low-discrepancy sequences and uniform random number and depict the superior results. The experimental results show that the low-discrepancy sequences-based initialization performed exceptionally better than a uniform random number. Moreover, the outcome of our work presents a foresight on how the proposed technique profoundly impacts convergence and diversity. It is anticipated that this low-discrepancy sequence comparative simulation survey would be helpful for studying the metaheuristic algorithm in detail for the researcher.