Evolutionary and population dynamics of 3 parents differential evolution (3PDE) using self-adaptive tuning methodologies

Abstract

Differential Evolution is known for its simplicity and effectiveness as an evolutionary optimizer. In recent years, many researchers have focused on the exploration of Differential Evolution (DE). The objective of this paper is to show the evolutionary and population dynamics for the empirical testing on 3-Parents Differential Evolution (3PDE) for unconstrained function optimization (Teng et al. 2007). In this paper, 50 repeated evolutionary runs for each of 20 well-known benchmarks were carried out to test the proposed algorithms against the original 4-parents DE algorithm. As a result of the observed evolutionary dynamics, 3PDE-SAF performed the best among the preliminary proposed algorithms that included 3PDE-SACr and 3PDE-SACrF. Subsequently, 3PDE-SAF is chosen for the self-adaptive population size for testing dynamic population sizing methods using the absolute (3PDE-SAF-Abs) and relative (3PDE-SAF-Rel) population size encodings. The final result shows that 3PDE-SAF-Rel produced a better performance and convergence overall compared to all the other proposed algorithms, including the original DE. In terms of population dynamics, the population size in 3PDE-SAF-Abs exhibited disadvantageously high dynamics that caused less efficient results. On the other hand, the population size in 3PDE-SAF-Rel was observed to be approximately constant at ten times the number of variables being optimized, hence giving a better and more stable performance.