Advances in compact Differential Evolution

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Abstract

Compact Evolutionary Algorithms (cEAs) have been developed in order to address optimization problems characterized by limited memory resources. This situation is typical of robotics and control problems where a full power computing device may be unavailable due to cost and/or space limitations. These algorithms do not store and process an entire population and all its individuals therein but make use of a statistic representation of the population in order to perform the optimization process. In this way, a much smaller number of real numbers must be stored in the memory. The main drawback of these algorithms is that, since cEAs simulate the population by means of a statistical representation, they are subject to premature convergence, especially when the dimensionality grows. Nevertheless, among cEAs, compact Differential Evolution (cDE) has proven successful for a broad set of problems, but still it can be improved. In the first part of this talk I will describe several different novel cDE based algorithmic structures for solving continuous global optimization problems, proposed during my first research activities. These structures can be roughly divided in two categories: (1) structures which introduce additional components to standard cDE framework or (2) distributed structures which use cDE as a local search unit. In the first case the standard structure of cDE is modified, providing additional moves in order to further improve the search logic. In the latter case, several compact units evolve simultaneously and interact (with a global supervision or not) in order to solve the optimization problem, exploring the decision space from diverse perspectives. The structures introduced appear to be very promising as they allow the improvement of the results obtained by standard cDE. Numerical results show that the resulting algorithms proposed display a promising performance for a set of challenging test problems and they are competitive with the state-of-the-art algorithms. In the last part of this talk, I will introduce a possible real-world application of cDE based algorithms, specifically the minimization of the disturbance, due to motion, to the base of an anthropomorphic robotic arm installed on a spacecraft, by simulating the implementation of a compact algorithm within the robot micro-controller.