Magnitude Differences Between Trial and Donor Vector for Ancestor Differential Evolution and Standard Differential Evolution Over CEC2015 Bound Constrained Single-Objective Computationally Expensive Numerical Optimization Problems

Siti Khadijah Mohd Salleh
Dr. Diarmuid O'Donoghue

Abstract - Evolutionary Algorithm uses mechanisms inspired from biological evolution: reproduction, mutation, recombination and selection. One of its methods is Differential Evolution, introduced by Storn and Price in 1995. Differential Evolution has become popular because of its simple method of implementation. Besides that, Differential Evolution has been proved as one of the most reliable algorithms in dealing with optimization problems. Differential Evolution is been used in global optimization problems such as in engineering, statistic and finance. A basic variant of the DE algorithm works by having a population of candidate solutions (called agents). These agents are moved around in the search-space by using simple mathematical formulae to combine the positions of existing agents from the population. If the new position (called donor vector) of an agent is an improvement it is accepted and forms part of the population, (by comparing the donor vector with the trial vector) otherwise the new position is simply discarded. The process is repeated until it reaches the stopping criteria. The process contains *initialisation*, *mutation*, *recombination*, and *crossover*.

Differential Evolution is depending on it convergence technique to allow it to survive in order to find better solution. However the search landscape may change in one area to another because it been affected by mutation and crossover mechanism. This may cause the algorithm to be unable to react to the changes. Instinctively one way to overcome this drawback is by increase the diversity. Therefore, we observed the result from Lolle et al regarding *Arabidopsis* plant transferring genetic information from grandparents to the current individual, as well as other Multi Objectives Algorithms that using archives as additional population to prodive diversity. These sources may become the concrete supporter for a new proposed Ancestor Differential Evolution (AncDE). This algorithm is using ancestor vector as to keep the histrory from previous population as additional archive population. The ancestor vector will not only provide diversity during mutation stage but also create posssiblity to restore good vectors for next generation.

We compute the magnitude of the difference vectors between the target vector and the trial vector for each generation for DE and AncDE. This experiment focuses on the value of jump size between target vector and trial vector thus it represent distance between current solution and new solution. This is an effective measure of the steps eyes employed while the solutions traverse across the problem space towards the optimal values. We test both DE and AncDE on *CEC2015 Bound Constrained Single-Objective Computationally Expensive Numerical Optimization Problems*. Our findings indicate that ancestors can help overcome some of the local variation in solutions quality and improve solution quality by improving population diversity.