Abstract

Multi-parent genetic algorithms (MPGAs) generalize genetic algorithms (GAs) by allowing more than two parents participating in crossover and have received a considerable number of satisfactory results. However, various issues arising from the increase of parents are still left open: What is the beneficial number of parents? Who should be mated? When will MPGAs outperform GAs? Why do MPGAs perform better?

This thesis addresses these open issues through design and analysis of MPGAs. First, a novel mating strategy is designed to deal with the mating issue and the number of parents in MPGAs. Parents are filtered according to the tactics of tabu search for a balance of maintaining population diversity and supplying selection pressure. The resultant validity of mating is further used to adjust the number of parents adaptively.

Second, we conduct theoretical analysis to discover when and why MPGAs outperform GAs. Inceptively, we analyze the influence of increasing the number of parents over the performance of crossover, under the assumption of uniform population. Next, a Markov model for MPGAs in the Generalized OneMax problem domain is built. This model considers the separate as well as the integral effects of all MPGA operators. As a result, the proposed Markov model can explicitly predict the behavior of MPGAs and helps to find out the optimal setting for them, which is of great benefit to extend and improve the utility of MPGAs.