Hybrid Genetic Algorithms: Modeling and Application to the Quadratic Assignment Problem

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Abstract

Presented in this paper are 'hybrid genetic algorithms' (HGA), which are collaborative performances of 'genetic algorithms' (GA) and local searches. Such algorithms are also called memetic algorithms. Firstly, some of the local searches used in the hybrid algorithms, such as 'simulated annealing' (SA), steepest ascent, and a modification improvement strategy called 'tabu search' (TS) are briefly described. Then, the hybrid algorithms models, combining the robust TS and CHC algorithms are conceptually introduced, formulated and mathematically represented. Finally, the defined HGA, which are practically applied to different instances of the 'quadratic assignment problem' (QAP) by and their results to the best-known QAPLIB problems from the QAP library are discussed.

The competitiveness of the HGA is demonstrated through experimental results since 12 of the 16 considered QAP instances produce the best-known solutions. Factors of that performance and competitiveness are also highlighted in this paper.

Keywords: *Tabu search, steepest ascent, simulated annealing, genetic algorithms, hybrid genetic algorithms, quadratic assignment problem.*

Introduction

'Hybrid genetic algorithms' (HGA), also called 'memetic algorithms' in some other literature, are combination performances of 'genetic algorithms' (GA) and local search, i.e. steepest ascent, steepest descent, 'tabu search' (TS), and 'simulated annealing' (SA).

Traditional GA often explore the candidate solution encoded in chromosomes and exploit those with better fitness iterally till the solution is reached. The local search by itself explores the solution space using specific move in its neighborhood. The HGA combine those two aspects by using the local (traditionally randomized) of the GA and the chromosomes that are produced by genetic operators (N-points search to improve the initial population crossover operator with N≥1 and mutation operator with its associated mutation rate). The improvement versions of chromosomes are then carried out by the traditional genetic algorithms as shown in Fig.1.

The key idea of the HGA is to use traditional GA to explore in parallel several regions of the search space and simultaneously incorporates a good mechanism like SA to intensify the search around some selected regions. In addition, the improvement strategy like TS may be used to keep track of some states that should be avoided for the second visit.

In 1995, Whitley described how to model a basic form of HGA in the context of the existing models for GA (Whitley 1995). This model takes into consideration a deterministic local search called 'steepest ascent'. With this basic form of HGA, it is possible to modify the model by integrating other search techniques in replacement of steepest ascent. Even though Whitley (1995) used a deterministic

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