AN EVOLUTIONARY TOPOLOGICAL ELITIST MECHANISM TO PRE-INSPECT MULTIMODAL LANDSCAPES OF OPTIMIZATION PROBLEMS

CĂTĂLIN STOEAN and RUXANDRA STOEAN

Recommended by Horia-Nicolai Teodorescu, corresponding member of the Romanian Academy

Earlier knowledge on the landscape of an optimization problem is highly important and desirable for a subsequent beneficial choice of the appropriate algorithm and the accurate setting of the involved parameters. The primary form of this prior information is represented by the number of existing optima, which must be properly determined together with some indication of their position while at an inexpensive computational cost. It is with these aims that the current paper puts forward a novel technique that estimates the number of peaks and their approximate locations by means of an evolutionary algorithm. The approach embraces a problem-independent topological discrimination among basins of attraction for optima and considers an elitist methodology for the preservation of possible solutions, at a minimum expenditure of calls to the objective criterion. Since knowledge on the multimodality of the problem may be alternatively directly derived from a clustering procedure, the proposed evolutionary technique is put against two well-performing such methods. To show the general nature of the approach and make the comparison more impartial, the test suite comprises of artificial functions and a practical clustering instance, all defined over real-valued domains.

Key words: multimodal optimization, evolutionary algorithm, landscape topology, clustering.

1. INTRODUCTION

The existence of multiple global and local optima within the search space of an optimization problem is customary to real-world complex instances. Various modern artificial intelligence evolutionary techniques seek to achieve the maintenance of several sets of candidate solutions to track the possible basins of attraction for these peaks. The design of multimodal algorithms must generally address the separation into niches through the definition of regions where the parallel search is to be conducted. These radii delineating subpopulations depend in number (obviously) and relative size on the amount of existing optima. Nevertheless, for the majority of practical problems, such information is not available beforehand, making the optimization process become rather trial and error. An a priori swift insight into the shape of the landscape may prove to be thus