Chapter 2
Hybrid Optimization Techniques for Industrial Production Planning:
A Review

P. Vasant
PETRONAS University of Technology, Malaysia

ABSTRACT

This chapter provides a review of new hybrid methods that deal with the continuous local and global optimization problems for constrained industrial production planning problems. In this chapter, details about all types of optimization methods and approaches for the local and global optimization are highlighted. Altogether there are eight famous methods in hybrid evolutionary optimization. In this research, the hybridization between evolutionary algorithms and other heuristic approaches such as simulated annealing, line search, pattern search, and mesh adaptive direct search are adopted. A particular evolutionary computation approach of genetic algorithm is used in this hybridization process. An intelligent performance analysis table is suggested in this chapter which is significantly important for decision makers and implementers in the industrial engineering of production planning. A brief summary on the conclusions of the main contributions and achievements in this chapter as well as future research directions are highlighted.

INTRODUCTION

Hybrid Evolutionary Computation (HEC) has been recognized as an incredible tool for solving optimization problems among Engineering, Science, Information Technology and Economics researchers over the last two decades. In this regard, the suitability of using hybrid evolutionary computation for optimization will be explored indicating the advantages and disadvantages from the optimization point of view.

In this section the major advantages of HEC have been briefly discussed. Based on these advantages, the objectives for this research work

DOI: 10.4018/978-1-4666-4450-2.ch002

have been identified. As per brief discussion on the following advantages, one can easily imagine why hybrid evolutionary computation should be used in solving optimization problems.

Properties of Functions

Consideration of convexity or concavity and continuity of functions are not necessary in evolutionary computation, however, these are a concern in most mathematical programming techniques. In evolutionary computation, the initial population (which is set of solutions) is generated randomly and then the subsequent generations (a new set of solutions) are usually produced numerically (using simple rules) from their previous populations. It does not matter whether the function is differentiable or not. Although both domains share the same concept of generate and test algorithm, the evolutionary search procedure is not directly comparable (no clear similarity) to the conventional search, even without using derivatives, such as the method of Hooke and Jeeves, and Rosenbrock's method (Bazaraa & Shetty, 1979). However, there is a very high possibility of incorporating any conventional search procedure into evolutionary computation (HEC) to make the algorithm effective and efficient.

Single Best Solution

The mathematical programming techniques provide a single best solution that is not the interest of many decision makers and implementers. For example, in the bidding problem, the decision maker is interested to have other solution options such as the second best, third best and so on. This is due to the fact that the solution of the optimization problem is usually used as one of many bid evaluation criteria (Seydel & Olson, 1990). The second best, third best and so on solutions can be obtained easily by using hybrid evolutionary computation. The solutions can also be manipulated to fit the decision maker's convenient and desired goals.

Infeasibility

The mathematical programming techniques cannot, apparently, help in decision making when the problem is infeasible. However, the incorporation of penalty functions and special feasible adaptive operators allows the identification of the infeasible constraints and helps to remove infeasibility by revising the constraints. Hybrid evolutionary computation is helpful in making the problem feasible by suggesting minimum changes in problem structure. It is common practice in HEC to use penalty function based methods for certain types of constrained optimization problem including non linear programming (Sarker, Runarsson, & Newton, 2001), although other methods such as repairing infeasible solutions (Whitley, Gordon, & Mathias, 1996), and rejecting infeasible solutions (Michalewicz & Schmidt, 2001) are sometimes used.

Domain Knowledge

It is easy to implement hybrid evolutionary algorithms, because they do not need any rich domain knowledge. However, domain knowledge can be possibly incorporated into hybrid evolutionary computation techniques (Yao, 2002). For example, the concept of classical search techniques can be replaced to search component in hybrid evolutionary algorithms. On top of that, the final hybrid evolutionary algorithms solutions can be refined using local search techniques. The generation of the initial population and the selection procedure can be redesigned using classical optimization concepts.

Robustness of HEC Algorithms

Theoretically, one common structure of hybrid evolutionary algorithms can be implemented for many single objective constrained mathematical programming models. Any single penalty function-based hybrid evolutionary algorithms can be used to solve many linear, integer and dif-