Chapter 104
A Gravitational Search Algorithm Approach for Optimizing Closed-Loop Logistics Network

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ABSTRACT

Since late in the 20th century, various heuristic and metaheuristic optimization methods have been developed to obtain superior results and optimize models more efficiently. Some have been inspired by natural events and swarm behaviors. In this chapter, the authors illustrate empirical applications of the gravitational search algorithm (GSA) as a new optimization algorithm based on the law of gravity and mass interactions to optimize closed-loop logistics network. To achieve these aims, the need for a green supply chain will be discussed, and the related drivers and pressures motivate us to develop a mathematical model to optimize total cost in a closed-loop logistic for gathering automobile alternators at the end of their life cycle. Finally, optimizing total costs in a logistic network is solved using GSA in MATLAB software. To express GSA capabilities, a genetic algorithm (GA), as a common and standard metaheuristic algorithm, is compared. The obtained results confirm GSA's performance and its ability to solve complicated network problems in closed-loop supply chain and logistics.

1. AN INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

Many descriptions for Supply Chain Management (SCM) have proposed, most commonly as roughly including a system of managing activities and facilities beginning with purchasing raw material, moving to producing goods, and finally distributing product to customers. All vendors and manufacturers, service providers, distributers, warehouses and retailers are linked in SCM. Furthermore, SCM can be considered a set of concepts used to integrate all elements in supply chain efficiently from suppliers to retailers to producing and distributing goods in the right quantities and right locations, at the best time. The

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main objective of SCM is minimizing costs and maximize profits simultaneously to reach service level requirements (SHEN, 2007; Simchi-Levi, Kaminsky, & Simchi-Levi, 2003).

The most important questions to consider when designing a supply chain are:

- How many raw material suppliers and partners should be selected and which ones are best?
- What kind of physical structure should be use for the supply chain?
- How many manufacturers should be included in the supply chain and where should be they established?
- How many products should be produced by each factory? When and where should those products be stored?
- What kind of logistics should we use in our supply chain?
- How many products should be transferred from one location to another location and when?
- Beyond economical figures, what other issues should be adverted in designing a supply chain?
- Are there any governmental roles based on environment issues that they should be considered?
- Which drivers may be existed entire the supply chain that can help companies to be more competitiveness?

When supply chains are being develop for a company, these questions should be answered and investigated via modeling. These models, however, might be complicated and need to use novel tools and methods to solve. In this chapter, we try to illustrate empirical applications of the gravitational search algorithm (GSA) as a new optimization algorithm to solve complicated logistics mathematical models.

The remainder of this chapter is organized as follows. Section 2 presents the basic concepts and reviews related work. Then, a mathematical model will be developed to optimize the total cost in a closed-loop logistic for gathering automobile alternators at the end of their cycle life. In section 4 metaheuristics algorithm, GSA theories and it's applications will be discussed. Finally, optimizing the total cost in a developed logistic network will be solved by using GSA in MATLAB software. To express GSA abilities and compare GSA with other algorithm, applying a genetic algorithm as common and a standard metaheuristic algorithm for optimization. Experimental results related to collecting automobile alternators is presented in Section 5. We conclude the paper in Section 6.

2. BASIC CONCEPT AND RELATED WORK

2.1 The Green Supply Chain

These days people are more cautions and careful with the environment and concerned about climate change such that businesses are taking an increasing active on in society (McWilliams & Siegel, 2000). The supply chain concept has been changed by environmental concerns so that, not only is an efficient supply chain based on economic conditions, but also interest is growing in integrating environmental issues into the entire supply chain such that they are more "green" and produce zero waste.

Literature surveys show that after the quality revolution of the 1980s and the supply chain revolution of the 1990s, Green Supply Chain Management (GrSCM) has been adverted by researchers and scientists (Srivastava, 2007). In the business world, some conflict derivers note that some theories encourage practitioners in supply chain management to "be green" and some not only do not encourage greening the supply chain, but also force and emphasis to run it throughout the supply chain. In other words, from one perspective, customers' concern for the environment