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A Hybridization Approach to Solve the Capacitated Asymmetric Allocation Hub Location Problem

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Abstract

This paper deals with a capacitated asymmetric allocation hub location problem (CAAHLP). We determine the number of hubs, the locations of hubs, and asymmetric allocation of non-hub nodes to hub with the objective of minimum total transportation costs satisfying the required service level. To solve the problem optimally, we present a 0-1 integer programming model and find an optimal solution using CPLEX. As the CAAHLP has impractically demanding for the large-sized problem, a solution method based on combined ant colony optimization algorithm and genetic algorithm is developed which solve hub location problem and node allocation problem respectively. We investigate performance of the proposed solution method through the comparative study.

Key Words: Hub Location, Asymmetric Allocation, Ant Colony Optimization, Genetic Algorithm

1. Introduction

The problem of locating interacting hub facilities arises in designing telecommunications networks, airline passenger networks, and several logistics network including postal delivery networks. The problem arises in instances where traffic between nodes on a network has to be routed via a set of nodes, designated as hubs. The hubs serve as trans-shipment points or switching points for flow between non-hub nodes [1].

There are several variants of hub location problems. For example, the number of hubs is fixed a-priori. These are referred to as *p*-hub median problems. Hub location problems may include single or multiple allocations of non-hub nodes to hubs. Further, the capacity constraints may or may not be placed on the hubs. For an extensive review and classification of hub location problems see Campbell [2].

While much attention has been focused on uncapacitated versions of the problem, there has been less effort concentrated on capacitated versions. Some studies are conducted by Ebery et al. [3], Chamberland et al. [4], Ernst and Krishnamoorthy [5], Randall [6]. In this paper, the more difficult version of this problem is considered in which the number of hub