International Journal of Innovative Computing, Information and Control
Volume **3**, Number **1**, February **2007**

ICIC International ©2007 ISSN 1349-4198
pp. **189–198**

AN INTELLIGENT SOLUTION SYSTEM FOR A VEHICLE ROUTING PROBLEM IN URBAN DISTRIBUTION

Xiangpei Hu and Minfang Huang

Institute of Systems Engineering
Dalian University of Technology
Dalian City, Liaoning Province 116023, P. R. China
drhxp@dlut.edu.cn

Amy Z. Zeng

Department of Management
Worcester Polytechnic Institute
Worcester, MA 01609, USA
azeng@wpi.edu

Received July 2006; revised October 2006

Abstract. *In this paper, we present an intelligent solution system for a vehicle routing problem (VRP) with rigid time window in urban distribution. The solution has three stages. The first stage uses Clustering Analysis in Data Mining to classify all customers by a number of attributes, such as distance, demand level, the density of customer, and city layout. The second stage introduces how to generate feasible routing schemes for each vehicle type. Specifically, a depth-first search algorithm with control rules is presented to generate feasible routing schemes. In the last stage, an integer programming model is constructed to identify the optimal routing schemes. Finally, we present a real VRP case to show that the approach and the system are efficient and provide a new way to solve the VRP problems with time-windows.*
Keywords: Vehicle routing problem (VRP), Artificial intelligence (AI), Routing schemes, Urban distribution

1. **Introduction.** The Vehicle Routing Problem (VRP) is a very important issue in urban distribution. Its basic version can be described as a set of customers having deterministic demands that have to be satisfied from a central depot with a fleet of delivery trucks of known capacity. Usually, the objective of VRPs is to minimize the total distance traveled by the truck fleet, but it is also common to minimize the total transportation costs. Because of the intrinsic nature of the problem, even the simplest VRP has been proven to be NP-Hard [1]. More detailed study of this problem can be found in reference [2].

To date, a large amount of research results regarding VRP solutions have been reported in terms of theories, methods and algorithms; for example, the traveling salesman problem (TSP) and the complicated dynamic route planning problem have been widely studied and discussed in the literature. Generally, the solution approaches presented for the VRPs can be classified into exact methods and heuristics. With respect to exact approaches, the classical branch-and-cut algorithm, Gomory cuts, and dynamic programming method