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**本科毕业设计(论文)调研报告**

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| 题 目： | 基于粒子群算法的车辆路径规划 |
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基于粒子群算法的车辆路径规划

摘要

近年来，我国物流运行保持回升态势，随着实体经济的复苏，物流需求快速增长，物流供应服务体系和供应链进一步完善，但物流成本一直居高不下，如何降低物流成本、提高客户满意度一直是业界关注的问题。研究表明，运输成本占物流成本的很大一部分，其中燃料和路费约占运输成本的 70%，客户满意度也随着时间和成本的提高而降低。

为了解决上述问题，本研究将实际情况抽象为多目标优化车辆路径问题（VRP），以总成本最低和满意度最高为优化目标，采用改进的粒子群算法（PSO）求解。VRP是给定一系列发货点和收货点，如何组织车辆以最小的总成本或最短的总时间完成所有送货任务，并返回到起始点。PSO是模仿鸟类群体觅食，以单一粒子来做为鸟类族群之中的单一个体，于算法中赋予该粒子（个体）拥有记忆性，并能够透过与粒子群体中的其他粒子之间的互动而寻求到最适解。

由于VRP问题是经典的 NP-难问题，使用精确求解器很难得到大规模问题的最优解，因此本研究采用了改进的粒子群算法。本研究采用混沌映射法对粒子群进行初始化，以提高粒子群的多样性；采用莱维飞行算法和轮盘算法提高粒子的探索和学习能力；采用 k-opt方法对历史最优解进行优化，以提高解的质量。

本研究使用高德的城市拥堵数据、Homberger 数据集和Solomon车辆数据集来验证结果的有效性，并与经典算法遗传算法（GA）和蚁群算法（ACO）进行比较。

**关键词：**PSO VRP 客户满意度 多目标优化

Vehicle Routing Problem Based on Particle Swarm Algorithm

ABSTRACT

In recent years, China's logistics operation to maintain the rebound trend, with the recovery of the real economy, logistics demand is growing rapidly, logistics supply service system and supply chain to further improve, but the logistics cost has been high, how to reduce logistics costs and improve customer satisfaction has been the industry's concern. Research shows that transportation costs account for a large part of logistics costs, of which fuel and road costs account for about 70% of the transportation costs, and customer satisfaction also decreases with the increase of time and cost.

In order to solve the above problems, this study abstracts the practical situation into a multi-objective optimization vehicle routing problem (VRP), which is solved by an improved particle swarm algorithm (PSO) with the optimization objectives of lowest total cost and highest satisfaction.The VRP is how to organize the vehicles to complete all the delivery tasks at the smallest total cost or the shortest total time, given a series of shipping and receiving points, and to return to the starting point.The PSO mimics bird flock foraging by using a single particle as a single individual in the flock, and the algorithm gives the particle (individual) memory and the ability to seek the optimal solution through interaction with other particles in the flock.

Since the VRP problem is a classical NP-hard problem and it is difficult to obtain an optimal solution for large-scale problems using an exact solver, a modified particle swarm algorithm is used in this study. In this study, the chaotic mapping method is used to initialize the particle swarm in order to improve the diversity of the particle swarm; the Lévy flight algorithm and the roulette wheel algorithm are used to improve the exploration and learning ability of the particles; and the k-opt method is used to optimize the historically optimal solution in order to improve the quality of the solution.

In this study, urban congestion data from Gaode, Homberger dataset and Solomon vehicle dataset are used to verify the validity of the results and compare them with the classical algorithms Genetic Algorithm (GA) and Ant Colony Algorithm (ACO).

Key words:：PSO VRP Customer satisfaction Multi-objective optimization