**華中科技大学**

本科生毕业设计（论文）开题报告

题 目：智慧物流中带时间窗的车辆路由问题的

智能算法研究

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# 1 研究背景

## 1.1 课题目的与意义

当前物流业向全球化、信息化、一体化发展，智慧物流的需求日益迫切，这种环境下高效低成本的物流配送系统变得极为重要。车辆路由问题（Vehicle Routing Problem, VRP），最早由Dantzig 与 Ramser[1]在他们对卡车调度问题的研究中提出，成为了近年来智慧物流领域的研究热点。VRP是旅行商问题（TSP）在多车辆和多路径情形下的分支，属于经典组合优化和整数规划问题，也是交通、物流配送等领域重要问题之一。其常见形式：给定数量的客户，各自有不同数量的货物需求，配送中心向客户提供货物，由一个车队负责分送货物，组织适当的行车路线，目标是使得客户的需求得到满足，并能在一定的约束下（如车辆容量、时间窗等）使得运送成本最小。

在不同约束条件下，VRP存在许多变种问题，如多仓库、带时间窗口（客户仅在时间窗内接收货物）、混合车队（依赖外部承运商）、容量相异车队等。尽管有大量不同形式的问题模型，企业所面临的实际问题通常要比科学文献中的标准化问题形式更加复杂，为此需要建立更加符合实际情况、满足企业需求的问题模型，并相应提出行之有效的解决方案。

## 1.2 国内外研究概况

鉴于VRP的复杂度和重要性，国内外有大量相关研究。这些研究针对VRP的不同变种给出了许多解法。总结如下：

带时间窗的车辆路由问题（VRPTW）引入了货物配送过程中的时间限制，包括服务时间和时间窗口，客户仅在时间窗口内接受服务，从而增加了货物装载卸载、车辆早到等时间开销。Solomon在[2]中提出了解决VRPTW的tour-building算法，包括四种启发式方法：节约法、面向时间的最近邻域启发式（寻找路径中新加入客户的“最近”邻居）、插入启发式、面试时间的扫描法（分为聚集阶段和调度阶段，聚集阶段利用扫描法为客户指派车辆，调度阶段分别对每条路径使用tour-building算法）。

假设车队中车辆具有不同容量情形下的VRP称作HVRP（H表示异质）。Baldacci等在[3]中总结了多种HVRP的解法，主要利用了构造启发式和元启发式方法。最近出现的一些构造启发式HVRP解法包括基于列生成的方法 [4, 5], Choi 与TCHA ），基于扫描的算法[6]（Renaud 与Boctor）。Semet 与Taillard在[7]中提出了首个HVRP的启发式方法，在[8, 9, 10]中提出使用禁忌搜索来解决这个问题。Osman 与Salhi[16]，Gendreau[10]，Wassan[17]，[11]中给出了基于确定性变量模拟退火算法的解决方法。

带时间窗的HVRP（HVRPTW）相较HVRP很少被研究。Liu 与SY在[12]中完成了首份对HVRPTW的研究，其中他们利用了基于节约法的构造启发式。他们还创造了三组实例用于测试此新问题变体。最近，Dell'Amico等[13]提出了一个基于并行插入过程的算法，Bräysy等[14]使用确定性退火元启发式算法来解决此问题。

带私人车队和公共运营商VRP（VRPPC）描述的情形：订单总需求超过内部车队的运载能力，因而有必要利用外部转运（公共运营商）。在这种情况下，问题是双面的：选择应当由外部载体送达的订单和定义内部车队服务剩余客户的路径。公共运营商服务订单的成本固定，不依赖任何路径。Volgenant 与Jonker在 [15]中建立了单一车辆VRPPC的模型，并且 [16]中提出的方法给出了问题最优解（对于n <200）。[17]中Chu正式提出VRPPC并给出了启发式解法：首先采用了经典节约算法的修改版本(Clarke 与Wright [18])，其次是线路之间本地交换。Bolduc等[19] 提出了名为SRI的启发式算法，包含三个步骤：选择外部承运人负责的客户，构造问题解（路径），通过复杂的交换优化问题解。随后，Bolduc等 [20]提出了一个扰动启发式，称为RIP（随机构造，改进，扰动），本质上是下降法与多元化策略的融合。近日Côté与Potvin在[21]中通过禁忌搜索的VRPPC解法获得了一组基准上的已知最好结果。

# 2 预计目标

# 3 关键技术

## 3.1 Local Search算法

## 3.2 禁忌搜索

# 4 方案设计

# 5 计划安排

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