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Energy-Efficient Location-Routing Problem: Generic Formulation, Hard and Soft Time Windows, and Time-Dependent Demand

Shokoufeh Mirzaei[1] and Krishna Krishnan[2]

[1]California State Polytechnic University, Pomona

[2]Wichita State University, Wichita, Kansas

Corresponding author's Email: Krishna.Krishnan@wichita.edu

Abstract: Sustainability and energy savings have attracted considerable attention in recent years. However, in the traditional location-routing problem (LRP), the objective function has yet to minimize the distance traveled regardless of the amount of energy consumed. Although, distance is one of the major factors determining the energy consumption of a distribution network, it is not the only factor. Therefore, this chapter explains the development of a novel formulation of the LRP that considers energy minimization, which is called the energy-efficient location-routing problem (EELRP). The energy consumed by a vehicle to travel between two nodes in a system depends on many forces. Among those, rolling resistance (RR) and aerodynamic drag are considered in this chapter to be the major contributing forces. The presented mixed-integer non-linear programming (MINLP) finds the best location-allocation routing plan with the objective function of minimizing total costs, including energy, emissions, and depot establishment. The proposed model can also handle the vehicle-selection problem with respect to a vehicles' capacity, source of energy, and aerodynamic characteristics. One example is presented to illustrate the formulations presented in this chapter.

Keywords: Mixed-Integer Non-Linear Programming, Vehicle-Routing Problem, Location-Routing Problem, Energy-Efficient Location-Routing Problem with Hard and Soft Time Windows, Location-Routing Problem with Time-Dependent Demand