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The drone-assisted variable speed asymmetric traveling salesman problem

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Incorporating autonomous vehicles, such as drones and robots, into last-mile logistics offers several advantages, e.g., faster deliveries, avoidance of traffic jams, and reduction of transportation times and costs. Nevertheless, these technologies also bring new logistics challenges, such as limited payload for parcels and limited reach due to the battery capacity. Hence, exploiting the advantages of each transportation mode, it is interesting to investigate the use of truck-and-drone tandems as a new concept that involves autonomous vehicles in last-mile delivery. In this area, limited attention has been given to the impact of weather conditions on drone trajectories and delivery schedules. This presentation stems from a doctoral research project centered on the analysis and enhancement of diverse multi-modal last-mile delivery systems. Consequently, we introduce a truck-and-drone delivery system called the drone-assisted variable speed asymmetric traveling salesman problem (VS-ATSP-D). Our study is specifically concentrated on the intersection of variable drone speeds, weather conditions, parcel weight, and energy consumption. Therefore, the VS-ATSP-D considers asymmetric drone transportation times as a result of weather conditions and the drone's variable speeds. The experiments show the differences between the symmetric and asymmetric approaches to draw insights into the feasibility of the VS-ATSP-D delivery schedules. In this presentation, we (i) introduce the VS-ATSP-D as a mixed integer linear program (MILP) and (ii) develop a multi-neighborhood tabu search (MTS) and a variable neighborhood descent (VND) algorithm. The computational experience shows that the MTS is able to find optimal solutions for small-size instances and beat the MILP for large-size instances. Furthermore, the MTS also outperforms VND for the whole set of instances.