# Integration of Vehicles and Drones in Last Mile Delivery

Necati Aras[*1]

[1]Department of Industrial Engineering, Bogazici University – Boğaziçi University Department of Industrial Engineering 34342, Bebek, Istanbul, Turkey, Turkey

**Abstract**

Last mile delivery is an important aspect to be considered by logistics service providers.The increase in online shopping from e-commerce firms results in a boost in the number of home deliveries. If the logistics company does not offer a service that includes a specific time window agreed with the customers, the parcel may arrive the customer's address any time during the day and there is a high likelihood that the customer will not be home. In such cases, the parcel is brought back to the local store of the logsitcs service provider, and the customer is asked to retrieve the parcel from the store which creates customer dissatisfaction. One possible remedy is to ask the customer about his current location when he is not found at his address, and carry the parcel to the vehicle that performs drop offs at delivery addresses close to the current location of the customer. In this study, we assume that vehicles are equipped with drones and if a customer is not found at the delivery address, the parcel is transported by the drone to another vehicle that will make the delivery to the customer at the new location. To this end, we formulate a mixed-integer linear programming model to determine at which point the drone has to depart from one vehicle and at which point it has to land on another vehicle that will make the delivery to the customer's new address. The model is solved for randomly generated instances by a commercial solver.

**Keywords:** drone, synchronization, integer programming

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[*]Speaker