Strategic Design of Drone Delivery Systems

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Home delivery by drones as an alternative to traditional delivery by trucks is attracting considerable attention from major retailers and service providers (Amazon, UPS, Google, DHL, Wal-mart, etc.), as well as from startups. While drone delivery may offer considerable economic savings, the fundamental issue of how best to deploy drones for home delivery is not well understood. Operations Research has a long tradition in analyzing location, logistic and routing problems and drone delivery provides some new opportunities for research. This presentation first provides an overview of drone delivery systems and highlights research opportunities, especially using drones is conjunction with trucks. Then we present a strategic analysis for the design of truck-drone delivery systems using continuous approximation modeling techniques to derive general insights. We formulate and optimize models that consider hybrid truck-drone delivery (where truck-based drones make deliveries simultaneously with trucks), truck-only delivery and drone delivery from depots. Results show that truck-drone hybrid delivery can be very economically advantageous in many settings, especially in more rural areas and with multiple drones per truck, but that the benefits depend strongly on the relative operating costs and marginal stop costs. Results also examine locating depots for drones, especially to achieve high service levels.