The pollution-routing problem with stochastic travel times

Moncef Ilies Nasri*[1], Tolga Bektaş†[1], and Gilbert Laporte[2]

[1]CORMSIS and Southampton Business School – University of Southampton, Southampton SO17 1BJ, United Kingdom, United Kingdom

[2]Centre interuniversitaire de recherche sur les reseaux d'entreprise and HEC (CIRRELT and HEC) – HEC Montreal, 3000, chemin de la Côte-Sainte-Catherine Montréal, Canada H3T 2A7, Canada

Abstract

The amount of greenhouse gases emitted by a vehicle is related to the quantity of fuel consumed, which, in turn, is affected by a number of parameters including speed and load. A variant of the classical VRP where pollution has been explicitly accounted for is the Pollution-Routing Problem (PRP). In addition to finding routes, the PRP determines optimal speeds at which vehicles should travel on each leg of the route to serve a number of customers under time window constraints, so as to minimize a comprehensive cost function including fuel consumption. The PRP imposes fixed limits on vehicle speeds on each leg, which is assumed to be known with certainty at the time of planning the routes. In reality, however, vehicle speed is often affected by factors that are not known in advance with certainty, such as congestion or weather, which will change speed limits and consequently impact the optimal speeds computed. This talk will introduce a new variant of the PRP with stochastic speed limits. We will describe two formulations for this problem. The first formulation is a single-stage stochastic programming model with complete recourse. In this case, the recourse variables correspond to any delays experienced in servicing the customers and any violation of the speed limits. The second is a two-stage stochastic programming model that takes advantage of a fast speed re-optimization procedure, used in the second stage, and applied after the realization of a scenario as a "corrective" action, in the expectation of a further cost minimization.

*Speaker

†Corresponding author: T.Bektas@soton.ac.uk