

The Dynamic Nearest Neighbor Policy for the Multi-Vehicle Pick-up and Delivery Problem

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Abstract

In this paper, a *dynamic* nearest neighbor (DNN) policy is proposed for operating a fleet of vehicles to serve customers, who place calls in a Euclidean service area according to a Poisson process. Each vehicle serves one customer at a time, who has a distinct origin and destination independently and uniformly distributed within the service area. The new DNN policy is a refined version of the nearest neighbor (NN) policy that is well known to perform sub-optimally when the frequency of customer requests is high. The DNN policy maintains geographically closest customer-to-vehicle assignments, due to its ability to divert/re-assign vehicles that may be already en-route to pick up other customers, when another vehicle becomes available or a new customer call arrives. Two other pertinent issues addressed include: the pro-active deployment of the vehicles by anticipating in which regions of the service area future calls are more likely to arise; and, imposition of limits to avoid prohibitively long customer wait times. The paper also presents accurate approximations for all the policies compared. Extensive simulations, some of which are included herein, clearly show the DNN policy to be tangibly superior to the first-come-first-served (FCFS) and NN policies.

Keywords and Phrases: Dynamic vehicle routing; Queueing; Anticipatory behavior