A Dynamic Capacitated Arc Routing Problem for Optimal Evacuation Strategies in Disasters: Formulation and Solution Algorithms

by

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Abstract: The Department of Homeland Security (DHS) is concerned with robust evacuation planning in the event of major disasters, such as bombing of major facilities or mass public gathering places in Central Business Districts (CBD). Such disasters trigger significant traffic congestion on road networks. Developing optimal evacuation policies in the face of such disasters is a challenging problem, especially due to the dynamic nature of the level of congestion that builds up on the road network. We formulate a Dynamic Capacitated Arc Routing Problem (DCARP) in which the capacity on the arcs is treated to vary dynamically over time as a probabilistic function. As the level of traffic increases over time, some highly traveled road intersections are labeled as “choke points” requiring re-routing of traffic through alternate intersections.

We first present the formulation of the so-called DCARP and suggest several algorithms to solve it depending on the level of complexity. First, we present a distance-transform algorithm for solving relative easier cases. Secondly, we present two Artificial Intelligence (AI)-based heuristic approaches, one based on Ant Colony Optimization (ACO) and another using Genetic Algorithms (GAs). We present some preliminary results using an artificial road network and one using the City of Baltimore as an example. This research connects well with two related projects at CCICADA, namely Public Health Evacuation Tools, and Operational Traffic Incident Management for Safe, Secure, and Productive Transportation Systems.

Selected References: