DYNAMIC RESOURCE LOCATION PROBLEMS: NEW APPLICATIONS, MODELS AND ALGORITHMS

By

Jiaming Qiu

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Approved by the
Examining Committee:

Thomas C. Sharkey, Thesis Adviser

Xuegang (Jeff) Ban, Member

Mukkai S. Krishnamoorthy, Member

John E. Mitchell, Member

Jennifer K. Ryan, Member

Rensselaer Polytechnic Institute
Troy, New York

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ABSTRACT

We examine three practically motivated dynamic resource location problems: 1) integrated dynamic single facility location and inventory planning problems; 2) dynamic officer (or control sensor) deployment problems during emergency evacuations; and 3) dynamic endpoint covering and scheduling problems. These three problems fall under the unified framework of dynamic resource location problems where we wish to determine the optimal location/relocation plan of the resources over a finite planning horizon. Different solution techniques are developed to conquer these problems respectively.

In the integrated dynamic single facility location and inventory planning problems, we develop algorithms to jointly determine the optimal relocation and inventory plan of the facility. The problem is considered under a multi-objective scheme which tries to minimize the total logistical costs and to minimize the maximum service cost (e.g., the maximum distance from the facility to any customer) at the same time. Dynamic programming algorithms are designed to generate the efficient frontier of this problem in polynomial time. We further conduct a computational study on a realistic data set representing the relief operations after the Haiti earthquake and provide evidence for the practical deployment of these dynamic programming algorithms.

In the dynamic officer deployment problems, we consider the problem of locating police officers at intersections in order to aid in the emergency evacuation of a traffic network. Both static and dynamic deployment strategies are specifically modeled in our mixed-integer programming formulations and heuristics for these problems. Our models and heuristics are implemented on a case study for the traffic network in Logan, Utah in the United States. We demonstrate that our heuristics can find solutions of high-quality efficiently and focus on the 'value' of allowing the deployment strategy to vary over time.

The dynamic endpoint covering and scheduling problem is a multi-period problem, which integrates coverage decisions and scheduling decisions. The motivation

of this problem is to monitor and collect information about a traffic network, where each edge's monitoring requires sensors being pair-wisely installed on its endpoints for a certain amount of time simultaneously. We analyze the complexity of the dynamic endpoint covering and scheduling problem and develop a constant factor approximation algorithm for the problem concerned with minimizing makespan on a grid-like network.