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# In this Issue

## **Designing Railroad Operating Plans: Dual Adjustment Method for Implementing Lagrangian Relaxation**

Railroad technology allows a single train, with a single crew to move a large number of individual freight cars. To achieve the economies of running long trains, cars bound for many final destinations must be consolidated into trains at rail classification yards. A typical car will be sorted at a number of intermediate yards before reaching its destination. An operating plan governs car and train movements. The plan should provide the most economical way of moving all required traffic subject to customer service requirements and technological constraints on train and yard capacity. "Designing Railroad Operating Plans: A Dual Adjustment Method for Implementing Lagrangian Relaxation" presents an optimization model which incorporates the essential features needed to develop such a plan. The paper presents an efficient solution procedure which makes it possible to obtain near-optimal solutions to problems of realistic size.

## **Design of Regular Intercity Driver Route for the LTL Motor Carrier Industry**

Less-than-truckload (LTL) motor carriers often design *regular driver routes* to satisfy the 60–80% of the intercity freight transportation demand which is known to have a high degree of certainty. This enables carriers to provide customers with reliable service, to offer drivers a choice of routes, to improve equipment utilization and to enhance dispatching operations. Regular routes are designed to cover demands derived from a tactical transportation plan, while respecting government and labor contract rules. The objective is to provide on-time delivery of the freight at minimum cost. Route costs depend on a myriad of factors including the extent to which productive driver hours are actually used, the time required to hook up and change trailers, maintenance time, and overtime. "Design of Regular Intercity Driver Routes for the LTL Motor Carrier Industry" describes this problem and identifies its main characteristics. A solution approach is presented that ensures the efficient and "optimal" gen-

eration and selection of regular routes. The paper illustrates the substantial performance improvements the approach may yield for motor carriers.

## **Numerical Methods for Simulating Transient, Stochastic Queueing Networks—I: Methodology**

## **Numerical Methods for Simulating Transient, Stochastic Queueing Networks—II: Experimental Design**

Many transportation systems can accurately be modelled as a network of queues. Customers (people or freight) in such systems travel from an origin to a destination passing through a number of facilities. At these facilities, a customer undergoes a sorting process and then waits in a departure queue for an available vehicle destined for the next node on a predetermined path to the customer's destination node. For example, in LTL trucking (a problem also discussed in "Design of Regular Intercity Driver Routes for the LTL Motor Carrier Industry") packages arrive at a "breakbulk" terminal where they are unloaded and sorted; a departure queue is composed of packages waiting for truck departures between breakbulk terminals. In railroad operations, classification yards handle unloading and sorting, while trains represent vehicles whose capacity depends on the number of available locomotives. In passenger networks (e.g., bus and train services) passengers unload and sort themselves; vehicle departures are like vehicles with random capacities. Traditionally, such systems have been modeled using either steady-state queueing models or detailed simulation models. In the former approach, the transient effects must be ignored. Simulation tends to be costly and time consuming. The pair of papers, "Numerical Methods for Simulating Transient, Stochastic Queueing Networks—I: Methodology and II: Experimental Design," presents a numerical, discrete-time approach to simulating such queueing networks that is based on algebraic operations (addition, subtraction and splitting) of the relevant probability distributions. Experiments with the approach indicate it is sensitive to the

vehicle dispatching strategies employed and the network traffic intensity.

### **Variational Problems for Determining Optimal Paths of a Moving Facility**

Reconnaissance vehicles must traverse a region while maintaining surveillance of specified locations. Similarly police patrol vehicles must remain in radio contact with several dispatching stations so that they can respond to calls over several regions. The general problem faced in these and similar situations is that of traversing a path of maximum benefit subject to constraints on the form of the path. "Variational Problems for Determining Optimal Paths of a Moving Facility" poses this problem and presents solutions for the problem using the Manhattan and Euclidean distance metrics under a variety of constraints on the path. A wide variety of problem extensions are outlined in the conclusion of the paper offering an exciting menu for future research.

### **Optimal Positioning of Service Units Along A Coordinate Line**

Location models generally assume that demands are located at discrete locations and that the facili-

ties that serve these demands are also located at stationary locations. In many contexts—emergency vehicles responding to highway accidents for example—demands occur at random anywhere along a link. "Optimal Positioning of Service Units Along a Coordinate Line" relaxes the assumption of discrete demand locations by representing demand using a continuous random variable. Also, facilities are allowed to move randomly along the line. The nearest of  $n$  units is assumed to respond to the demand. The paper shows that, under very general conditions, a stationary strategy minimizes the mean travel distance. An algorithm for finding the optimal stationary locations of the facilities is presented.

### **Technical Note: On The Complexity of Some Classes of Location Problems**

Many location problems of interest of NP-complete. However, when sufficiently constrained, location problems can be solved in polynomial time. "On the Complexity of Some Classes of Location Problems" presents improvements on known complexity results for four problems that have recently appeared in the literature.