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## 黄海军教授研究组在国际运筹学顶级刊物《Operations Research》和《Transportation Science》发表成果

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最近, 美国运筹学与管理科学学会 (Informs—Institute for Operations Research and Management Sciences) 的网站上提前刊登了我院黄海军教授研究组的两项成果, 这两项成果将分别发表在该学会拥有的旗舰刊物《Operations Research》和《Transportation Science》上。

在《OR》上发表的论文An Intersection-Movement-Based Dynamic User Optimal Route Choice Problem提出了一个基于交叉口决策行为的动态用户最优网络路径选择模型, 研究了模型解的存在性和唯一性, 并发展出一种充分利用约束集分解特性的外梯度算法, 若车辆行驶时间函数是伪单调和Lipschitz连续的, 该算法收敛。模型和算法在不同尺寸的网络上完成了检验。第一作者龙建成曾在该院做博士后研究工作, 2011年底出站后被聘为合肥工业大学“黄山青年学者”教授。该文的合作单位有北京交通大学和香港大学。

在《TS》上发表的论文Congestion Behavior and Tolls in a Bottleneck Model with Stochastic Capacity研究随机能力瓶颈的拥挤行为和收费问题, 当瓶颈通行能力为均匀分布时, 推导出广义出行成本期望均衡下的所有关于出发时刻、出发率、排队长度和期望成本的解析表达式, 发现能力的随机性显著延长高峰期和提高个人期望出行成本。还研究了时变收费和单步阶梯收费的效果。第一作者是我院在读博士生肖玲玲, 合作单位为英国Leeds大学。

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### CONTEXTUAL AREAS

## An Intersection-Movement-Based Dynamic User Optimal Route Choice Problem

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In this paper a novel variational inequality (VI) formulation of the dynamic user optimal (DUO) route choice problem is proposed using the concept of approach proportion. An approach proportion represents the proportion of travelers that select a turning or through movement when leaving a node. Approach proportions contain travelers' route information so that the realistic effects of physical queues can be captured in a formulation when a physical-queue traffic flow model is adopted, and so that route enumeration and path-set generation can be avoided in the solution procedure. In addition, the simple structure of the approach proportion representation allows us to decompose the constraint set for solving large-scale DUO route choice problems. This paper also discusses the existence and uniqueness of the solutions to the VI problem and develops a solution algorithm based on the extragradient method to solve the proposed VI problem. This solution algorithm makes use of the decomposition property of the constraint set and is convergent if the travel time functions are pseudomonotone and Lipschitz continuous. It is not necessary to know the Lipschitz constant of the travel time functions in advance. Finally, numerical examples are given to demonstrate the properties of the proposed model and the performance of the solution algorithm.

**Subject classifications:** dynamic traffic assignment; dynamic user optimal; approach proportion; variational inequality; extragradient method.

**Area of review:** Transportation.

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## Congestion Behavior and Tolls in a Bottleneck Model with Stochastic Capacity

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In this paper we investigate a bottleneck model in which the capacity of the bottleneck is assumed stochastic and follows a uniform distribution. The commuters' departure time choice is assumed to follow the user equilibrium principle according to mean trip cost. The analytical solution of the proposed model is derived. Both the analytical and numerical results show that the capacity variability would indeed change the commuters' travel behavior by increasing the mean trip cost and lengthening the peak period. We then design congestion pricing schemes within the framework of the new stochastic bottleneck model, for both a time-varying toll and a single-step coarse toll, and prove that the proposed piecewise time-varying toll can effectively cut down, and even eliminate, the queues behind the bottleneck. We also find that the single-step coarse toll could either advance or postpone the earliest departure time. Furthermore, the numerical results show that the proposed pricing schemes can indeed improve the efficiency of the stochastic bottleneck through decreasing the system's total travel cost.

**Key words:** bottleneck model; stochastic capacity; departure time choice; congestion pricing

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