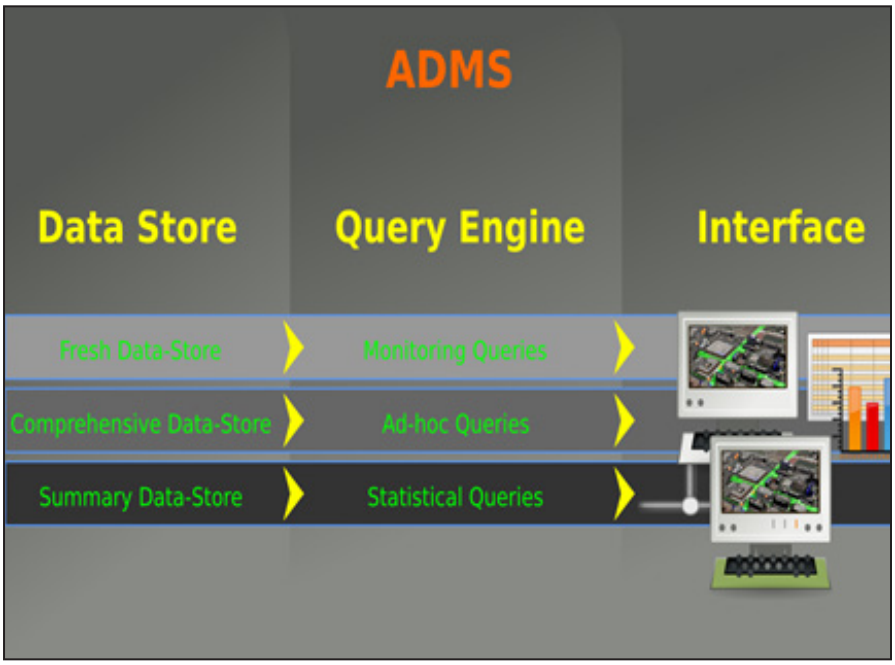
# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-407 (project 517) | December 2019

## Route Planning for Enhanced Transportation Network Utilization: A System Optimization Approach for Route Planning in Advanced Traveler Information Systems




## the ISSUE

Online mapping systems offer route guidance for travelers, but may also increase congestion. As more technologies are introduced into the road network, it becomes increasingly relevant to consider how they might impact the network. Existing route guidance/recommendation techniques resolve each route request independently, despite the fact that they receive route requests in batch. Due to a phenomenon referred to as Nash Equilibrium in Game Theory, this results in poor sub-optimal utilization of road networks as increasing volumes of traffic are routed to vital network corridors. Alternative guidance technologies could provide fair route alternatives for travelers while optimizing use of the transportation network.

## the RESEARCH

In this project, we introduce an enhanced approach for route guidance, motivated by the relevance of a "system optimal" equilibrium strategy, while also maintaining fairness to the individual. With this approach the objective is to optimize the global road network utilization (as measured by, e.g., mobility, or global emissions) by selecting from a set of generally fair user route alternatives in a batch setting. Toward this end, for the first time we present an approximate, anytime algorithm based on Monte Carlo Tree Search and Eppstein's Top-K Shortest Paths algorithm to solve this complex dual optimization problem in real-time. This approach attempts to identify and avoid the harmful network effects of sub-optimal route combinations.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming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## Project Title

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## Sponsors | Partners

University of Colorado Denver

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## the **FINDINGS**

Our experiments show that with our proposed approach, in a microscopic traffic simulation with a network congestion-minimizing objective, mobility optimization over real road networks of Rye and Golden, Colorado, can achieve an average travel time improvement of 12% while maintaining route fairness.

## the **IMPACT**

We are motivated by the realistic scenario in which our proposed route guidance solution is implemented as a mobile and/or desktop application (perhaps sponsored by regional USDOT agencies, and/or city and state partners which are interested in such "smart-cities" capabilities) and offered to general public for their daily use. While such an application will not necessarily provide the optimal (but perhaps near-optimal) route for each individual traveler, the public can be incentivized to use this application (instead of the existing commercial route planning applications that merely focus on traveler interests) for improved network utilization.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=979


For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.