MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-327 (project 464) | July 2017

Development of Network-Based Measures and Computational Methods for Evaluating the Redundancy of Transportation Networks

the ISSUE

Government and communities are becoming aware of the role of transportation networks in evacuation processes and disaster recovery. This research supports efforts to prioritize resiliency by (1) presenting two network-based measures for systematically characterizing the redundancy of transportation networks and (2) developing computational methods for evaluating the network-based redundancy measures.

the RESEARCH

This research presents travel alternative diversity and network spare capacity as two quantitative measures to capture the considerations of travelers and planners. These network-based measures are able to address the two fundamental questions in pre-disaster transport system evaluation and planning ("How many effective redundant alternatives are there for travelers in the event of a disruption?" and "How much redundant capacity does the network have?"). To implement these two network-based measures in practice, a formal methodology is provided to evaluate the transportation network redundancy. The node adjacent matrix operation method developed by Meng et al. is used to evaluate the travel alternative diversity dimension, and an optimization-based approach is used to evaluate the network spare capacity dimension. Lastly, a case study using the Winnipeg network in Manitoba, Canada, is conducted to demonstrate the applicability of the computational methods.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

Lead Investigator(s)

Dr. Anthony Chen
anthony.chen@usu.edu
Utah State University

Project Title

Development of Network-Based Measures and Computational Methods for Evaluating the Redundancy of Transportation Networks

Research Assistant(s)

Xiangdong Xu
Tongji University
Shanghai, China

Seungkyu Ryu
Utah State University

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China visiting student

USDOT, Research and Innovative Technology Administration

the **FINDINGS**

The application of the developed computation methods revealed that the two measures have different characterizations on network redundancy from different perspectives. Two sets of numerical examples were provided. The simple network example demonstrated the necessity of having the two dimensions together for systematically characterizing transportation network redundancy. The Winnipeg network demonstrated the applicability of the computational methods as well as the importance of considering the requirement of not-too-long routes in the travel alternative diversity measure.

the **IMPACT**

The two network-based measures and the computational methods developed in this study can help governments and communities evaluate the resiliency of transportation systems. The two measures (travel alternative diversity and network spare capacity) can complement each other by providing meaningful information to travelers and by helping planners enhance network redundancy in their infrastructure investment decisions. A well-designed future network with alternative travel modes could significantly increase the network spare capacity to accommodate a substantial demand increase.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=880

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.