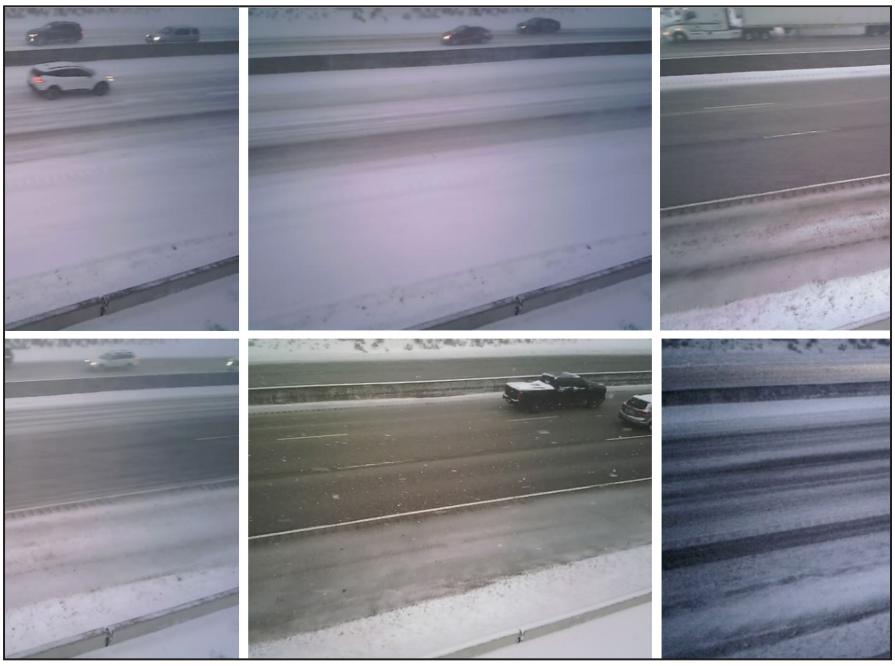
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-572 (project 698) | October 2024

Winter Safety Improvement with Computer Vision and Transfer Learning



the ISSUE

Snow and ice pose significant risks for drivers and create challenges for road agencies charged with snow and ice removal. According to the Federal Highway Administration, vehicle crashes resulting from snowy and icy road conditions result in an average of 1,300 deaths and 116,800 injuries annually. Enhanced Roadway slippery condition measurement is essential to improving winter roadway maintenance.

the RESEARCH

A research team from the University of Utah developed a convenient tool capable of multi-lane snow coverage estimation in winter seasons. The tool uses sensing technology to evaluate multi-lane roadway snow coverage and leverages non-contact dual-spectrum cameras, computer vision, and machine learning algorithms.

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

Lead Investigator(s)

Xuan Zhu
xuan.peter.zhu@utah.edu

Research Assistant(s)

Moein Ramezanpourkami
GRA, Ph.D.

Project Title

Connected Vehicle Winter Safety Improvement with Infrared Thermography Technology

Sponsors | Partners

Utah Department of Transportation

USDOT, Research and Innovative Technology Administration

the FINDINGS

The use of optical and infrared images for slippery roadway condition detection has the potential to operate in different illumination conditions. Computer vision algorithms were developed to perform image registration, segmentation, lane splitting, classification, and clustering. To account for the relatively limited data volume, the team also established a transfer learning framework, which greatly eliminated the need for training a large number of hyperparameters. The transfer learning algorithm achieved an impressive precision of 94% when using dual-spectrum images. The use of the transfer learning model proved to be particularly advantageous with a relatively small amount of labeled optical and infrared image data. The efficacy of the U-Net transfer learning model generally demonstrated similar or superior performance when compared with that of computer vision algorithms.

the IMPACT

The developed technology can potentially conduct multi-lane roadway ice/snow coverage estimation, which is superior to the state-of-the-art single-spot measurements. The technology promises to improve road safety and transportation in adverse weather conditions. The enhanced velocity and efficacy of this automated snow detection system will assist governing bodies in formulating well-informed judgments and executing prompt measures to alleviate perilous road conditions. There is potential for these systems to be integrated into existing intelligent transportation systems, thereby augmenting winter roadway safety in snowy regions.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1240

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.