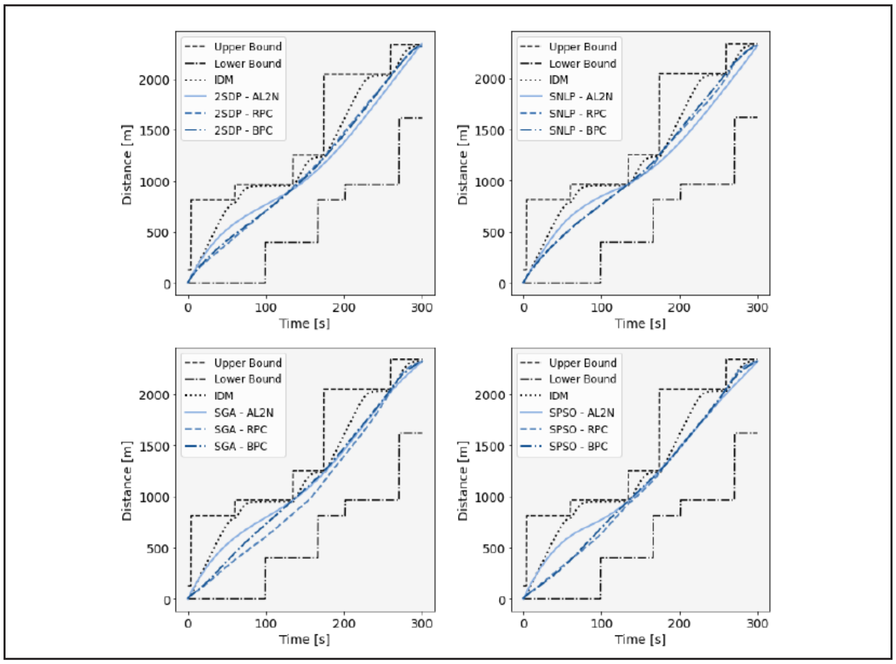
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-558 (project 570) | September 2024

Real-Time Implementation Comparison of Urban Eco-Driving Controls



the ISSUE

Eco-driving is a strategy designed to reduce fuel consumption by minimizing accelerations and unnecessary braking events. Vehicular autonomy and connected autonomous vehicle (CAV) technology provide an opportunity for the widespread application of eco-driving strategies because they circumvent driver acceptance/training issues. A great variety of solutions for autonomous eco-driving control have been introduced in the literature. This diversity is due to the complicated nature of the problem and the many dimensional design spaces that result from it. However, no comprehensive research has been done to compare the various solutions.

the RESEARCH

The study focuses on eco-driving strategies, particularly the effectiveness of autonomous eco-driving, which can be implemented more easily and at scale compared with manual strategies, thereby circumventing driver training issues. A key part of this research is a comprehensive comparative study that addresses the lack of such analysis in the existing literature. This study summarizes eco-driving control strategies, sets up a framework for comparing solver methods, and evaluates these methods using real-world data. The literature review categorizes methods into rule-based and optimal, with optimal further divided into globally and locally optimal methods. It discusses the advantages of autonomous eco-driving over manual strategies, including precision, scalability, and driver acceptance.

The researchers provide a detailed review of the literature, system definition, and analysis of eco-driving subsystems, including perception, planning, and the plant subsystem. It explains the computational models used for simulations and compares various control methods such as rule-based eco-driving, discretized control optimization, and polynomial trajectory optimization.

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

Experiments and Modeling for Infrastructure Data-Derived Fuel Economy and Safety Improvements

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the FINDINGS

The results section details the effectiveness of each method in terms of energy economy improvement and computational load, highlighting that, while globally optimal solutions (like those from dynamic programming) offer the highest potential for energy economy improvement, they are computationally expensive. Genetic algorithms emerge as a promising real-time method that strikes a balance between energy economy improvement and computational feasibility.

the IMPACT

The researchers found that autonomous eco-driving controls can significantly enhance vehicle energy economy with an 11% national impact on energy savings if widely adopted. It recommends the use of a genetic algorithm method with a road power cost function as the best trade-off for generating optimal eco-driving traces for urban battery electric vehicles.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1203

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.