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Traffic Prediction and Management via RBF Neural Nets and Semantic Control

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Abstract: *The objective of this work has been to develop layers of control and optimization modules for the purpose of urban traffic management. We utilize the semantic control paradigm to model both the macrolevel (traffic control) and the microlevel (vehicle path planning and steering control). A semantic controller consists of three modules for identification, goal selection, and adaptation, respectively. This hierarchical structure has been used successfully at the Center for Optimization and Semantic Control to solve complex, nonlinear, and time-varying problems. In our previous work we have used a judicious combination of artificial intelligence, optimization, and control systems.*

The focus of this paper is the identifier module, which performs "system identification," i.e., determines the road network congestion level. Traffic flow can be characterized as a nonlinear stochastic process where linear prediction models such as linear regression are not suitable. However, neural network techniques may provide an effective tool for data-based modeling and system identification. The radial basis function neural network (RBFNN) is an attractive tool for nonlinear time-series modeling and traffic-flow prediction. The goal selector module that finds the shortest path is also discussed in some detail.

A model of the highway system, based on historical data provided by Missouri Highway and Transportation Department (MoHTD), has been developed. The prediction and planning system is evaluated using the traffic-flow data from nine sensors located on the highway in the St. Louis metropolitan area.

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1 INTRODUCTION

The emergence of the various thrusts of Intelligent Transportation Systems (ITS)[1,15] presents numerous new theoretical and practical challenges; many of these deal with the modeling, prediction, cause-and-effect relationships, analysis, optimization, and control of an overall transportation system. In view of these, an advanced traffic management system (ATMS) will require a dynamic traffic model that can