Road Vehicle Recognition and Classification Using Magnetic Field Measurement

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Certificate of Original Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

This dissertation presents a road vehicle detection approach for intelligent transportation systems. This approach uses a roadside-installed, low-cost magnetic sensor and associated data collection system. The system measures magnetic field changes to count, detect, and classify passing vehicles into a number of vehicle types. We compare each vehicle using dynamic time warping (DTW), then extend Mel-Frequency Cepstral Coefficients to analyse the vehicles' magnetic signals and extract them as vehicle features using the representations of cepstrum, frame energy, and gap cepstrum of magnetic signals. There are three directions (X-axis, Y-axis, and Z-axis directions) in the earth's magnetic field. We design one- (X-axis direction) and three-dimensional (i.e. X-axis, Y-axis, and Z-axis direction) map algorithms using Vector Quantisation to classify the vehicle magnetic features according to four typical vehicle types for the Australian suburbs: sedan, van, truck, and bus. We also compared experimental results between these two methods. Results show that our approach achieves a high level of accuracy for vehicle detection and classification. In the end, we found that filtering raw magnetic measurement signals can significantly influence vehicle recognition accuracy. Compared with the one-dimensional map, we reached the highest accuracy of vehicle classification in our test data using the three-dimensional map.

Keywords: signal processing, vehicle classification, road traffic model, intelligence vehicle, magnetic sensing