Presentation 2.5

IMAGE-BASED AUTOMATED WINTER ROAD CONDITION MONITORING – A DEEP LEARNING APPROACH

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Real-time winter road surface condition (RSC) monitoring is of critical importance for both winter road maintenance operators and the travelling public. Accurate and timely RSC information during snow events can help maintenance operators to deliver better maintenance services such as plowing and salting for reduced costs and salt usage and improved level of service. With this information, the traveling public can make more informed decision on whether or not to travel, where to go, and which highways to drive. In this research, we proposed an RSC recognition solution that can automatically generate descriptive RSC information using video images from fixed traffic/weather cameras and in-vehicle devices. The core engine behind the solution is the widely successful machine learning technique called deep neural networks (DNN). In particular, we tested the idea of applying a set of pre-trained convolutional neural networks (CNN) instead of training a CNN from scratch. Four of the most successful CNN models currently available from the industry, namely, VGG16, ResNet50, Inception-V3 and Xception, are evaluated for their potential to address the particular challenges that we face in our application – RSC classification. The pre-trained models were first customized with additional fully-connected layers of neurons for learning the specific features of the RSC images. The extended models are then trained through a fine-tuning process using a set of RSC images with sufficient representations. Lastly, the models were tested using independent images from fixed traffic and weather cameras and vehicle dashboard cameras. A case study using data from a large training/testing data set from the province of Ontario, Canada was used to demonstrate the reliability of the proposed approach.