Artificial Intelligence by Means of Deep Learning for Radar-Based Road-Surface Monitoring

Background
Knowledge about road surface condition is highly important for controlling vehicle dynamics in different weather conditions and to ensure safety of the driving. Recently, the development of Autonomous Driving (AD) makes the understanding the quality of road surface extremely critical, where driving scenarios such as maneuvering and breaking.

Thanks to the large bandwidth of 60GHz radars, it is now possible to measure distance and speed with high resolution in various applications. The goal of this project is to classify the road surface condition into a few classes such as dry, wet, ice and snow. This would be done by monitoring the time evolution of the radar signal and using features derived from polarimetry to identify changes in road surface condition. Safety can be considerably improved and slipping may be prevented by a timely recognition of such changes in road surface quality, where variations between left and right tires also are of importance.

In recent years, Deep Neural Networking (DNN) has enabled inference of models from data. In particular, Recurrent Neural Networks (RNN) can incorporate the time evolution figures into modeling a phenomenon. Here, the idea is to use RNNs to classify road surface condition based on 60 GHz radar reflections.

Project description
The project starts with a literature review that should lead to a basic and good understanding of polarimetric radar measurements as well as machine learning, where DNNs are of particular interest. Then, the radar-based measurement setup should be modeled, designed and constructed. Next, a measurement campaign should be planned and executed to collect relevant data, where some sort of reference measurement is also required to allow for supervised machine learning. The training, validation and test datasets are then used to train and assess a few different DNN-architectures. Finally, the project is documented in a MSc-thesis report, which includes a comparative analysis of the results.

As a master’s student for this project, you should have a background in communications, signal processing and radar, basic knowledge and interest in neural networks as well as programming skills in Matlab and Python. You are also required to have sufficient verbal and written communication skills in English. This project is suitable for two students who wish to do a 30hp MSc thesis project.

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