

Deep learning for abnormal driving behaviour detection, prediction and prevention



Problem description

Abnormal driving behaviours which bring great uncertainty to the traffic, may lead to accidents causing serious danger to both the driver and the public. To ensure traffic safety, accurate identification and detection of abnormal driving is vital which can also help to evaluate the drivers' driving style and alert surrounding vehicles. Furthermore, detecting and removing abnormal driving behaviours from naturalistic driving data would be the prerequisite step for imitate training of a human-like driving model. Existing abnormal driving detectors are mainly based upon shallow supervised learning, which require large amount of labelled data. Abnormal driving behaviours are always rare cases. Usually, there is a large amount of normal driving data, while collecting data involving abnormal driving is difficult and even dangerous. So, how to make use of the available normal data to train a model able to detect potential abnormal samples would be a meaningful and yet challenging task. Auto-Encoder Neural Networks and Extreme Learning Machine are possible models for exploration to handle this research problem. The aim of this research is to explore possible deep learning architecture, e.g., Transformer, multi-layer stacked denoising sparse Auto-Encoders (**SdsAEs**) with Extreme Learning Machine, Auxiliary Classifier Generative Adversarial Network (GAN), to identify potential abnormal driving behaviours. In practice, the SdsAEs could be firstly pre-trained on normal labeled data for feature extraction, and then new coming data will be fed into the neural network to calculate the reconstruction loss, which is utilized for abnormal detection with a threshold. The threshold of reconstruction loss could be obtained in a semi-supervised way, by training with available labeled anomaly data. Also, to obtain better results, the model could be fine-tuned in a top-down way by employing Error Propagation algorithm in a supervised manner.

Assignments

- Review state-of-the-art DL methods to do abnormal detection, methods could be from other fields e.g., CV, NLP;
- Based upon literature review, fine define the abnormal driving behaviour you would like to tackle, open-source data and references are available;
- Screen out DL methods suitable for identifying abnormal behaviour in selected driving tasks (e.g., ELM-SdsAEs)
- Implement, validate, and compare the selected abnormal detection methods with baseline models, using open-source datasets (e.g., SPMD, SHRP2, highD);
- High quality publication is possible and highly encouraged!

Requirements: Experienced in Python and TensorFlow/Pytorch; Expertise in DL/ML/CV; Prior knowledge and experience of abnormal detection, and/or DNNs, e.g., ELM, Auto-Encoders, GAN, LSTM, would be a high priority.

Research group

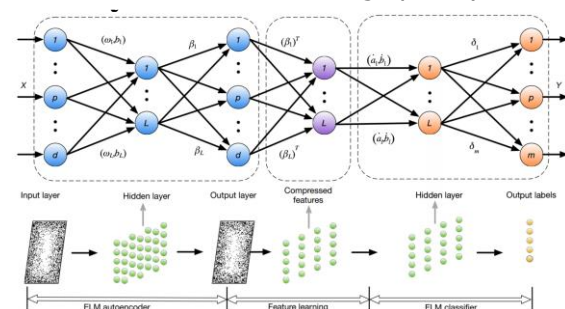
Automated Mobility in Mixed Traffic; Transpiration AI; ISAC

Thesis supervisors: Yongqi Dong (<https://yongqidong.github.io/>)

External supervisor: possibility with industry partners

Information

For further information on this Master topic, please contact: yongqi.dong@rwth-aachen.de



Extreme Learning Machine-based Auto-Encoder