Abstract

Human drivers achieve a high level of performance in vehicle handling, especially race drivers in motorsport. Gaining insight into race drivers' handling process can therefore lead to further development in areas where handling at the limit of driving dynamics is a concern, for example in the field of autonomous driving. This cumulative thesis consists of five publications which cover the topic of data analysis at the limit of driving dynamics from data preparation to method development to applications. The first publication presents a deep learning framework for robust time series prediction and anomaly detection using a variational autoencoder for application in motorsport. By utilizing a machine learning classifier, the second publication points out that the driving styles of race drivers are distinct even though their overall performance is very similar. Subsequently, a method for race driver evaluation is developed in the third publication using a driving simulator. The driver's ability to exploit the grip potential of the tires serves as an evaluation criteria which is determined by optimizing a vehicle model and estimated using a machine learning model. This method is applied in the fourth publication to provide an objective evaluation of motion cueing algorithms, which control the motion system of driving simulators. To show the transferability of the discussed approaches, the fifth publication presents an extension of the grip potential exploitation analysis to the sport of bobsleigh, which is an area with different circumstances and partly different objectives compared to motorsport. A vehicle dynamics model for ice friction is developed for application in a bobsleigh driving simulator which also enables a novel method for bob driver evaluation.