TU Clausthal

Kolloquium zur Masterarbeit

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„Predicting pedestrian motion using a physics-based neural network“

Autonomous robots and vehicles complementing and competing with existing road users will soon be a reality of our roads. Issues regarding their interaction with existing road users and adaptability to mixed traffic zones remain a key roadblock. Moreover, their ambiguous or nontransparent motion behavior raise questions about their viability and existing road user safety. Predicting pedestrian motion in mixed traffic situations is paramount for autonomous robot and vehicle motion planning in complicated situations. However, pedestrian motion includes intricate interactions with heterogeneous road users and the environment. To this end, in this thesis we present an explainable physics-based neural network based pedestrian motion prediction model considering pedestrian-to-obstacles (static), pedestrian-to-pedestrian (s) and pedestrian-to-group interactions.

Our model combines the feed forward neural network and a physics-based model, specifically, the social force model (SFM) with pedestrian groups. This combination helps avail main advantages of both approaches, ease of learning motion dynamics and explainability respectively. The neural network embeds SFM force equations into its architecture and estimates the corresponding force. Four individual modules separately predict the four different forces acting on the pedestrian with corresponding force equation based neural networks. A neural network combines these individual module predictions to finally estimate the total force.

We evaluate the model qualitatively and quantitatively using real world datasets. By performing case studies, we validate our model's ability to produce realistic and explainable trajectories. Initial results highlight that, the model predicts explainable trajectories and performs satisfactorily compared to existing models. We believe, this work is a substantial first step towards a complete and explainable pedestrian motion prediction model for autonomous robot and vehicle motion planning in mixed traffic.

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