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Master's Thesis

Platoon Formation using Swarm Intelligence

The ongoing growth of passenger transport leads to increased road traffic and pollution. Researchers and car manufacturers are trying to improve driving using Inter-Vehicle Communication (IVC), resulting in trends like Intelligent Transportation Systems (ITSs) or cooperative driving. One application there is Cooperative Adaptive Cruise Control (CACC) or *platooning*, which promises to improve today's driving a lot by increasing traffic, reducing fuel consumption, and improving safety. Before profiting from all of these improvements, vehicles have to get into a platoon. Thus, *platoon formation* is an important challenge in this field.

We studied platoon formation strategies from the perspective of individual cars by optimizing platoon assignments regarding individual capabilities and properties [1]. Simulations using simple heuristics already indicate that these, and the willingness to compromise, have a huge impact on the resulting assignments.

A different approach for forming platoons might be using swarm intelligence [2], which lets multiple agents perform simple actions to achieve a greater goal. Concepts like distributed opinion building [3] could be applicable for coming up with car-to-platoon assignments. Therefore, the feasibility of swarm intelligence concepts for platoon formation needs to be investigated.

This thesis is in cooperation with Prof. Dr.-Ing. Heiko Hamann[1] from University of Lübeck.

Goals

In this thesis, the feasibility of platoon formation using swarm intelligence should be investigated. As an example, the concept of distributed opinion building [3] should be used. In order to achieve the goal of this thesis, you have to (a) design a formation algorithm which uses swarm intelligence and considers the properties of the individual cars to build platoons and (b) evaluate its performance within a simulation study by comparing it to traditional formation approaches.

Requirements

You should have a basic understanding of *Vehicular Networking*, *Network Simulation*, and *C++*.

[1] J. Heinovski and F. Dressler, "Platoon Formation: Optimized Car to Platoon Assignment Strategies and Protocols," in *10th IEEE Vehicular Networking Conference (VNC 2018)*, O. Altintas, H.-M. Tsai, L. Kate, B. Mate, C.-Y. Wang, and T. Sahin, Eds., Taipei, Taiwan: IEEE, Dec. 2018. DOI: 10.1109/VNC.2018.8628396.

[2] L. Li, R. Hao, W. Ma, X. Qi, and C. Diao, "Swarm Intelligence Based Algorithm for Management of Autonomous Vehicles on Arterials," SAE International, SAE Technical Paper 2018-01-1646, Aug. 2018. DOI: 10.4271/2018-01-1646.

[3] S. Motsch and E. Tadmor, "Heterophilious Dynamics Enhances Consensus," *SIAM Review*, vol. 56, no. 4, pp. 577–621, Nov. 2014. DOI: 10.1137/120901866.

[1] https://www.iti.uni-luebeck.de/en/staff/hamann.html

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