Controller Designs of Homogeneous and Non-homogeneous Vehicle Platoon System

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Abstract

This project tackles the problems of road traffic and the factors affecting road accidents. It refers to many studies and research efforts that are related to the road traffic issues. The key objective of this research is to suggest a solution that can help reducing traffic accidents and thus improving road safety. Therefore, two main factors will be taken into account, which are road capacity and human behavior during driving.

Based on the above, one can propose two solutions; namely: 1) Instead of using the normal vehicles, intelligent automatic vehicles are considered to address improper acts done by humans and 2) vehicles are controlled to move in a platoon at the same speed. Here, inter-distance between vehicles in the platoon could be optimized in order to reduce traffic congestion.

In most vehicle platoon approaches found in the literature, the proposed systems are based on two main assumptions: 1) Vehicles are homogeneous (Assumed equal in length, deceleration capability, same delay in communication); and 2) wireless communication network is available. Based on this, the distances between vehicles are assumed to be constant. In this thesis, two platoon controllers were designed. The first platoon controller was designed based on the above mentioned assumptions. However, for more realistic situations, a second controller is designed considering that vehicles are non-homogeneous in both length and deceleration capabilities. Furthermore, platoon systems must be fault-tolerant to factors that may affect its performance. Such factors include vehicle characteristics and communicated information are updated during setting rate. For more specifics, if the system didn’t receive vehicle characteristics information (e.g. vehicle length, preceding vehicle length..) they used a default values, for a safety take a maximum vehicle length. If the information is not received during setting rate (e.g. 0.2 s) the system activate the communication lost mode and try to recover such failure.

The proposed designs were simulated and the obtained results indicate an improved performance during transient response, when compared to other platoon designs. Moreover, according to traffic capacity, the proposed design offers a higher traffic flow. Therefore, the proposed platoon controller maintains performance while reducing the inter-distance. This is done without compromising the safety aspects even in critical conditions.