Traffic jam reduction based on vehicle platoons and intelligent crossroads interactions

Traffic congestion is one of the major problems of this century. However, there is no straightforward solution to relieve the traffic. Only a combination of several solutions will enable us to respond to our increasing demand of transportation. Today, infrastructure managers as well as public authorities support the huge effort to alleviate the traffic. Tomorrow, personal vehicles will contribute to improve the way of sharing the infrastructure. Indeed, the automotive industry has promised the autonomous vehicle for very soon (in 2017). Moreover, vehicles will be able to know accurately their position and to communicate with their surrounding environment (up to IEEE 802.11p). Vehicles will negotiate together the access to conflicting spaces (in 2020). According to the real observed situation, they smartly decide together which vehicle will cross the intersection first, which will be the next and so on. Such a “sequence formation” contributes, without doubt, to prevent traffic deadlock (gridlock) and consequently to increase the capacity of our road network. Furthermore, the vehicles will accordingly synchronize their speeds together to avoid useless stops.

One of the main objectives of the work is to consider the platoon function, which allows vehicles to follow each other automatically forming a train without any material coupling, in a network of intersections. Over the last two decades, many projects, such as PATH, CRISTAL, SARTRE, SafePlatoon have dealt with platoon issue in order to increase the traffic safety and efficiency on urban area and highways. Another possible approach consists in developing smart crossroads aimed at improving the efficiency of the classical traffic light of stop sign intersection. Many approaches dealing with this issue can be found in literature. Among them, one can cite the methods based on the headway time for extending the right of way.

However, in a network of intersections the platoon strategy can lead to a deadlock (gridlock). Hence, the train size will strongly depend in both road and parking capacities. The subject of this PhD has to take into consideration several levels of the problem from the local point of view, dealing with the perception and communication issues between vehicles (V2V) and with the infrastructure (V2I), to the system point of view where one want to optimize the travel time of vehicles by reorienting vehicles according to the current road occupancy. For each level, the candidate will have to define measurements so as to evaluate with pertinence his proposals by using adequate formalism such as hyper-graph model, Petri Net.

The candidate will benefit from the experience of IRTES-SeT laboratory researchers on platoon systems (European FP7 CATS Project, FCE/FUI National CRISTAL Project, ANR SafePlatoon French National Project, PV PAC regional project). This work will be made both in simulation using the tools developed in IRTES-SeT laboratory such as VIVUS (http://www.vivus-simulator.org), and with IRTES-SeT mobile vehicles (http://www.multiagent.fr/IntelligentVehicle_Platform), in collaboration with Dr. Gechter (http://www.multiagent.fr/People:Gechter_franck)

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References:

