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Que/that Don/Mr. César Leonardo González Pinzón

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born on 26 April 1979 in Bogotá, Colombia, of Colombian nationality, has passed the studies leading to the ***official university degree of DOCTOR FROM THE UNIVERSITAT POLITÈCNICA DE VALÈNCIA****, obtaining the grade of* ***Excellent*** *and the* ***Cum Laude award*** *in defence of his doctoral thesis, presented on 12 April 2024, in the "****Doctoral Programme in Computer Science****" organized by the Universitat Politècnica de València and which is registered in the National Register of Degrees under the number:* ***2024082520****.*

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Distributed Intersection Management Algorithms for Autonomous Vehicles

Cesar González

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Valencian Research Institute for Artificial Intelligence (VRAIN)

Thesis submitted to obtain the degree of Doctor of Philosophy in Computer Science.

Advisors:
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March 2024

Abstract

Since a couple of decades, the technological driving aids have gone growing at a dizzying pace with the intention of making these systems more efficient and safe. These driving aids have been covering failures that the researchers name “erratic driving” or “unsafe driving behaviors” and are arbitrary decisions taken by a human driver which endanger all road users.

These bad decisions in addition to the increasing number of driving commutes in a city nowadays (post pandemic), show the need to continue doing technological proposals focused on where there are more complex interactions between vehicles when density increases; for instance, an intersection in rush hour.

The developments in driving aids have been orientated in two topics: the first driving automation (Advanced Driver Assistance Systems - ADAS and Automated Vehicles - AV) and the second road traffic management (centralized or distributed algorithms to traffic control). Although there are currently several automotive companies and research centers working in the two topics, and in special in some cases removing the equation the human behavior, there are still lacks in the configurations for an vehicle autonomous be able to make optimal decisions front to all possible conditions available in a road traffic.

Now, and take into account the two topics aforementioned about driving aids developments, researchers broadly envisage that in order to reach autonomous driving levels higher (first topic) in the next decade, is necessary to study how to do autonomous vehicle interactions (second topic) more efficient. Therefore, road intersections are an instance where it is possible to analyse cases of highly complexity interactions between vehicles, because it is a part of road infrastructure where the vehicles sharing lanes, paths, crossings or lane changes at will and it could generate collisions on conflict points and time delay in the commutes if there is not an appropriate cooperation.

Hence, this thesis proposes a series of distributed algorithms to traffic control on intersections, based on interchange of communications between autonomous vehicles (local interactions) near to the intersections that show emergent behaviors to crossing cooperative, safe way and efficiency with high densities the traffic system on intersections. This research is developed us-

ing simulators with Manhattan-style streets; first implementing scenarios less complex with one-lane city streets and then increase the complexity with multiple-lanes.

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