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Distributed Intersection Management Algorithms for Autonomous Vehicles

CESAR GONZÁLEZ



UNIVERSITAT
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INTELLIGENCE (VRAIN)

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

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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.

Contents

I	Introduction	1
1	Introduction	3
1.1	Motivation	5
1.2	Goals	6
1.3	Thesis structure	8
1.4	Publication List	9
1.5	Research Projects	10
II	State of the Art	11
2	Autonomous Driving and Its Context	13
2.1	Automated Vehicles	14
2.1.1	ADAS and surroundings perception	17
2.1.2	Computing systems	18
2.1.3	Communications	20
2.2	Simulation for traffic management	21
2.2.1	Introduction to Traffic Simulation	22
2.2.2	Types of Traffic Simulators	22
2.2.3	Applications of Traffic Simulation	22
2.2.4	Traffic-Light Simulator	23
2.2.5	Simulation of Urban MObility-SUMO	24
2.3	Traffic Intersections: Strategies and Challenges	25
2.3.1	Centralized Control of Intersections	27
2.3.2	Distributed Control of Intersections	31

CONTENTS

2.3.3	Traffic Control Failures	34
2.3.4	Emergency Handling at Intersections	36
2.3.5	Intersections with Multiple Lanes	40
2.4	Conclusions	43
 III Development		45
3	Distributed Intersection Management Approach	47
3.1	Distributed Intersection Management (DIM)	48
3.1.1	Traffic flow	49
3.1.2	Autonomous vehicles	49
3.1.3	Communications	50
3.1.4	Behavioral roles	51
3.1.5	Negotiation between autonomous vehicles	53
3.2	Experiments	57
3.3	Conclusions	66
4	Extension of the DIM algorithm for implementing control failures	69
4.1	Model DIM Implementation in the Presence of Communication Failures	70
4.1.1	Communication failures	71
4.2	Experiments	72
4.2.1	Experiments on communication failures	73
4.3	Conclusions	75
5	Managing emergencies in DIM algorithm model	77
5.1	Emergency Vehicles Model	78
5.1.1	Emergency Vehicles	79
5.2	Experiments	81
5.2.1	Results with low complexity	82
5.2.2	Results with high complexity	86
5.3	Conslusions	98

CONTENTS

6	Implementation of DIM algorithm in high-complexity environments: Multi-lane cities.	101
6.1	Multi-lanes	102
6.2	DIM algorithm in multi-lanes	103
6.2.1	New behavioral role	104
6.2.2	Negotiation between autonomous vehicles (multi-lanes)	105
6.3	Experiments	111
6.3.1	Vehicle occurrence density distribution per lane.	111
6.3.2	Experiment applying the “Uniform” density distribution.	114
6.3.3	Experiment applying the “Biased” density distribution.	119
6.3.4	Experiment applying the “Random” density distribution.	124
6.4	Conclusions	129
IV	Conclusions and future work	131
7	Conclusions and future work	133
7.1	Conclusions	134
7.2	Future work	138
	Bibliography	141

List of Figures

2.1	Automated driving levels. Created by the author	16
2.2	Example of the “Traffic-Light” Simulator Developed by Zapotecatl (Adapted from [65])	24
3.1	Example of the perception radius and the communication radius.	50
3.2	Examples of the roles played by a vehicle	52
3.3	vehicle a_i playing role N_v sharing information with vehicle a_j play- ing role N_v in a conflict way intersecting their communication ra- dius ($C_r^{a_i}$ and $C_r^{a_j}$).	53
3.4	Reach priority to cross - low density.	54
3.5	a_i will avoid to cross on intersection k if $a_i + 1$ is in e	55
3.6	The queue of vehicles in lane 1 has priority to cross over vehicles in lane 2 according to the rule <i>Reach priority to cross in high densities</i> .	56
3.7	Experimental Results: City Simulation with 4 Intersections. . . .	59
3.8	WaitingTime vs Density. City Manhattan style of 4 intersections.	60
3.9	Experimental Results: City Simulation with 25 Intersections. . . .	61
3.10	WaitingTime vs Density. City Manhattan style of 25 intersections	62
3.11	Experimental Results: City Simulation with 100 Intersections. . .	63
3.12	WaitingTime vs Density. City Manhattan style of 100 intersections	64
3.13	Experimental Results: City Simulation with 225 Intersections. . .	65
3.14	WaitingTime vs Density. City Manhattan style of 225 intersections.	66
4.1	Semi-centralized model.	74
4.2	DIM model.	75
5.1	SUMO simulator showing an intersection with regular vehicles (yellow) and emergency vehicles (red).	83

LIST OF FIGURES

5.2	Models comparison without emergency vehicles	84
5.3	Models comparison with emergency vehicles	85
5.4	Flow vs Density on city with 4 intersections. Models without emergency vehicles.	88
5.5	Velocity vs Density on city with 4 intersections. Models without emergency vehicles.	88
5.6	WaitingTime vs Density on city with 4 intersections. Models without emergency vehicles.	89
5.7	Flow vs Density on city with 25 intersections. Models without emergency vehicles.	90
5.8	Velocity vs Density on city with 25 intersections. Models without emergency vehicles.	90
5.9	WaitingTime vs Density on city with 4 intersections. Models without emergency vehicles.	91
5.10	Models comparison in flow, with emergency vehicles at 1% and 9% on two different cities.	92
5.11	Models comparison in velocity, with emergency vehicles at 1% and 9% on two different cities.	93
5.12	WaitingTime vs Density on city with 4 intersections and 1% Emergencies	94
5.13	WaitingTime vs Density on city with 25 intersections and 1% Emergencies.	95
5.14	WaitingTime vs Density on city with 4 intersections and 9% Emergencies.	95
5.15	WaitingTime vs Density on city with 25 intersections and 9% Emergencies.	96
6.1	A multi-lane street in the SUMO simulator.	103
6.2	a_i is a vehicle in role SN_v	104
6.3	“Uniform” density distribution at 30% per street	111
6.4	“Biased” density distribution at 30% per street	112
6.5	“Random” density distribution at 30% per street.	113
6.6	Flow results with “Uniform” density distribution: city with 4 intersections	114

LIST OF FIGURES

6.7	Flow results with “Uniform” density distribution: city with 16 intersections	115
6.8	Velocity results with “Uniform” density distribution: city with 4 intersections	116
6.9	Velocity results with “Uniform” density distribution: city with 16 intersections	117
6.10	Waiting-Time results with “Uniform” density distribution: city with 4 intersections	118
6.11	Waiting-Time results with “Uniform” density distribution: city with 16 intersections	118
6.12	Flow results with “Biased” density distribution: city with 4 intersections	120
6.13	Flow results with “Biased” density distribution: city with 16 intersections	120
6.14	Velocity results with “Biased” density distribution: city with 4 intersections	121
6.15	Velocity results with “Biased” density distribution: city with 16 intersections	122
6.16	Waiting-Time results with “Biased” density distribution: city with 4 intersections	123
6.17	Waiting-Time results with “Biased” density distribution: city with 16 intersections	124
6.18	Flow results with “Random” density distribution: city with 4 intersections	125
6.19	Flow results with “Random” density distribution: city with 16 intersections	125
6.20	Velocity results with “Random” density distribution: city with 4 intersections	126
6.21	Velocity results with “Random” density distribution: city with 16 intersections	127
6.22	Results with “Random” density distribution. City with 4 intersections	128
6.23	Results with “Random” density distribution. Cities with 16 intersections	128

List of Tables

5.1	Queue lengths and halted vehicles in cities with 200 meters between intersections.	97
5.2	Queue lengths and halted vehicles in cities with 500 meters between intersections.	97
5.3	Queue lengths and halted vehicles in cities with 700 meters between intersections.	97