

Contents

1	Introduction	1
1.1	Controlling traffic lights	1
1.2	Data acquisition methods	2
1.3	Airborne sensors	4
1.4	Self-Organizing Traffic Lights	4
1.5	Traffic optimization goals	5
1.6	Greenhouse gas	5
1.7	Vehicles' emissions	6
1.8	Hypothesis and the research questions	6
1.9	Organization of the thesis	7
2	Comparison of travel time estimations using intelligent infrastructure and floating car data	9
2.1	Introduction	9
2.2	State of the art	9
2.3	Simulation environment	10
2.4	Methods	12
2.5	Measurements	15
2.6	Results	18
2.7	Summary	20
3	Integration of cellular automata traffic simulation with carbon dioxide emission model	21
3.1	Traffic simulators	21
3.2	Greenhouse gases and carbon dioxide emission	21
3.3	CO ₂ emission model	22
3.4	Microscopic traffic simulator	26
3.5	Cellular automata traffic simulator	26
3.6	Integration of cellular automata traffic simulation with emission model	28
3.6.1	Data acquisition	28
3.6.2	Data preparation	29
3.6.3	Vehicles' acceleration rate	31

3.6.4	Data analysis	33
3.6.5	Distribution of the acceleration	38
3.6.6	Deceleration	45
3.6.7	Adaptation of Rule 184	49
3.7	Rule 184-based CO ₂ traffic emission model	60
3.7.1	Implementation note	63
3.8	NaSch-based CO ₂ traffic emission model	64
3.9	Critics, discussion and future work	69
4	The impact of dynamic route guidance system driven by travel time measurements on carbon dioxide emission	71
4.1	Introduction	71
4.2	Dynamic route guidance system architecture	72
4.2.1	Shortest Paths Algorithm	73
4.2.2	Cost function	75
4.2.3	Path with minimal cost	76
4.3	Methodology and measurements	76
4.4	Simulation	80
4.4.1	Virtual cities	81
4.5	Test scenarios and results	82
4.5.1	First scenario	82
4.5.2	Second scenario	87
4.5.3	Third scenario	87
4.5.4	Fourth scenario	93
4.5.5	Fifth scenario	97
4.5.6	Sixth scenario	97
4.5.7	Seventh scenario	104
4.5.8	Eighth scenario	104
4.6	Summary, critics and future work	109
5	Conclusions and future work	113
A	Naxos Traffic Simulator	115
A.1	Simulator description	115
A.2	Graphical user interface	117
A.2.1	Key shortcuts	117
A.3	Simulator configuration	120
A.4	Virtual cities	122
A.4.1	City generators	122
A.4.2	Importing city layouts from GIS	125
A.5	File formats	127
A.6	Distributed computing	133
A.7	Implementation	134

A.7.1	Logging	134
A.8	Source code	138
B	Practical issues related to tests in a real-world environment	139
B.1	Methodology	139
B.2	System architecture	141
B.3	Vehicle traveling times acquisition	142
B.3.1	Floating car data	142
B.3.2	Computer vision approach	142
B.3.3	Communication with traffic light controllers	147
B.4	Variable Message Signs	147
B.5	Central server and management console	151
B.6	Summary	151
	Bibliography	159
	Related work	169

Reduction of CO₂ Emissions from Road Transport in
Cities

Impact of Dynamic Route Guidance System on
Greenhouse Gas Emission

Markiewicz, M.

2017, XXVI, 169 p. 93 illus., 21 illus. in color., Softcover

ISBN: 978-3-658-16318-1