



UNIVERSITAS INDONESIA



UNIVERSITÉ D'ARTOIS

**PENGARUH PENEMPATAN SENSOR PADA JARINGAN
JALAN BEBAS HAMBATAN DALAM SIMULATOR AIMSUN
UNTUK KUALITAS KEBIJAKAN PENGUKURAN DURASI
WAKTU LAMPU HIJAU**

TESIS

DODDY MAULANA

0906579790

**FAKULTAS TEKNIK
PROGRAM PASCASARJANA
UNIVERSITAS INDONESIA
JULI 2011**



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TESIS

**Diajukan sebagai salah satu syarat untuk mendapatkan gelar Magister
Teknik**

DODDY MAULANA

0906579790

**FAKULTAS TEKNIK
PROGRAM PASCASARJANA
UNIVERSITAS INDONESIA
JULI 2011**

HALAMAN PERNYATAAN ORISINALITAS

Tesis ini adalah hasil karya saya sendiri,
Dan semua sumber baik yang dikutip maupun yang dirujuk
Telah saya nyatakan dengan benar.

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NPM : 0906579790

Tanda tangan : 

Tanggal : 05 Juli 2011

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Judul Tesis : Pengaruh Penempatan Sensor Pada Jaringan Jalan Bebas Hambatan Dalam Simulator AIMSUN Untuk Kualitas Kebijakan Pengukuran Durasi Waktu Lampu Hijau


Telah berhasil dipertahankan dihadapan dewan penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar Master-2 Université d'Artois (Perancis) dan Magister Teknik Program Studi Manajemen Infrastruktur, Fakultas Teknik, Universitas Indonesia

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Prof, Dr.Ir. Irwan Katili, DEA

UCAPAN TERIMA KASIH

Puji dan syukur saya panjatkan kehadiran Allah SWT, atas segala nikmat yang diberikan-Nya sehingga saya dapat menyelesaikan laporan ini.

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Depok, 05 Juli 2011

Doddy Maulana

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Depok, 05 July 2011

Doddy Maulana

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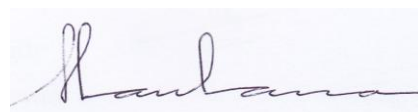
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(Doddy Maulana)

ABSTRAK

Nama : Doddy Maulana
Program Studi : Manajemen Infrastruktur
Judul : Pengaruh Penempatan Sensor Pada Jaringan Jalan Bebas Hambatan Dalam Simulator AIMSUN Untuk Kualitas Kebijakan Pengukuran Durasi Waktu Lampu Hijau

Kualitas strategi kebijakan lalu lintas jalan bebas hambatan tergantung pada ketersediaan informasi yang berkualitas pada jalan bebas hambatan tersebut setiap saat. Ini dapat diperoleh dengan cara mengukur aliran dan kecepatan kendaraan bermotor oleh sensor yang ditempatkan pada jaringan jalan raya tersebut. Akurasi Pengukuran tergantung pada penempatan sensor. Proyek ini mencoba untuk mengetahui pengaruh penempatan sensor pada jaringan jalan bebas hambatan dalam simulator AIMSUN untuk kualitas kebijakan pengukuran durasi waktu lampu hijau dengan menggunakan data riil dari jalan tol A6 di Paris, Prancis. Hasil terbaik dari simulasi ini adalah dengan menempatkan sensor di akhir on-jalan masuk ke jalan bebas hambatan dengan kebijakan pengaturan siklus lampu lalu lintas selama 40 detik, durasi lampu hijau selama 10 detik dan durasi lampu kuning selama 5 detik. Disarankan untuk menggunakan strategi ini dalam kondisi nyata di jalan raya, terutama di jalan bebas hambatan A6, Paris, Prancis

Kata Kunci: Simulasi, lalu lintas, peraturan, Sensor, metering, jalan bebas hambatan, di jalan

ABSTRACT

Name : Doddy Maulana
Interest Program : Civil Engineering
Title : The Influence of the placement of sensors on a network on the AIMSUN simulator for the quality of the Green-Time Metering Regulation

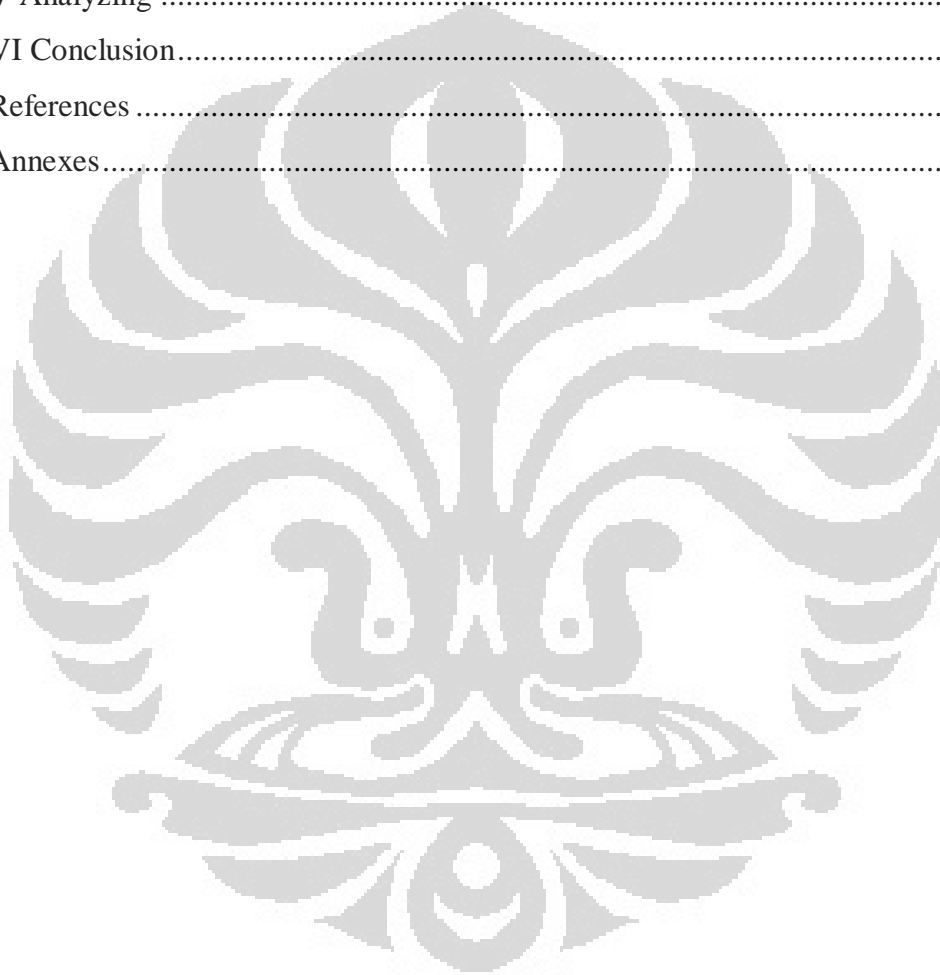
The quality of road traffic regulations strategies depend on the availability of qualified information on the network state at any time. This can be obtained by measuring the flow and velocity of the vehicle by a sensors which are placed on the network. The Measurement accuracy depends on the placement of the sensors. This project tries to find out the influence of the placement of sensors on a network on the AIMSUN simulator for the quality of The Green time metering regulation by using the real data from the A6 freeway on Paris, France. The best result from this simulation is to place the sensors in the end of on-ramp with the green time metering regulation is 40 seconds for the cycle, 10 seconds for green light duration and 5 seconds for yellow light duration. It is recommended for using that strategy in the real condition at the freeway, especially at A6 Freeway, Paris, France

Keywords: Simulation, traffic, regulation, Sensor, metering, freeway, on-ramp

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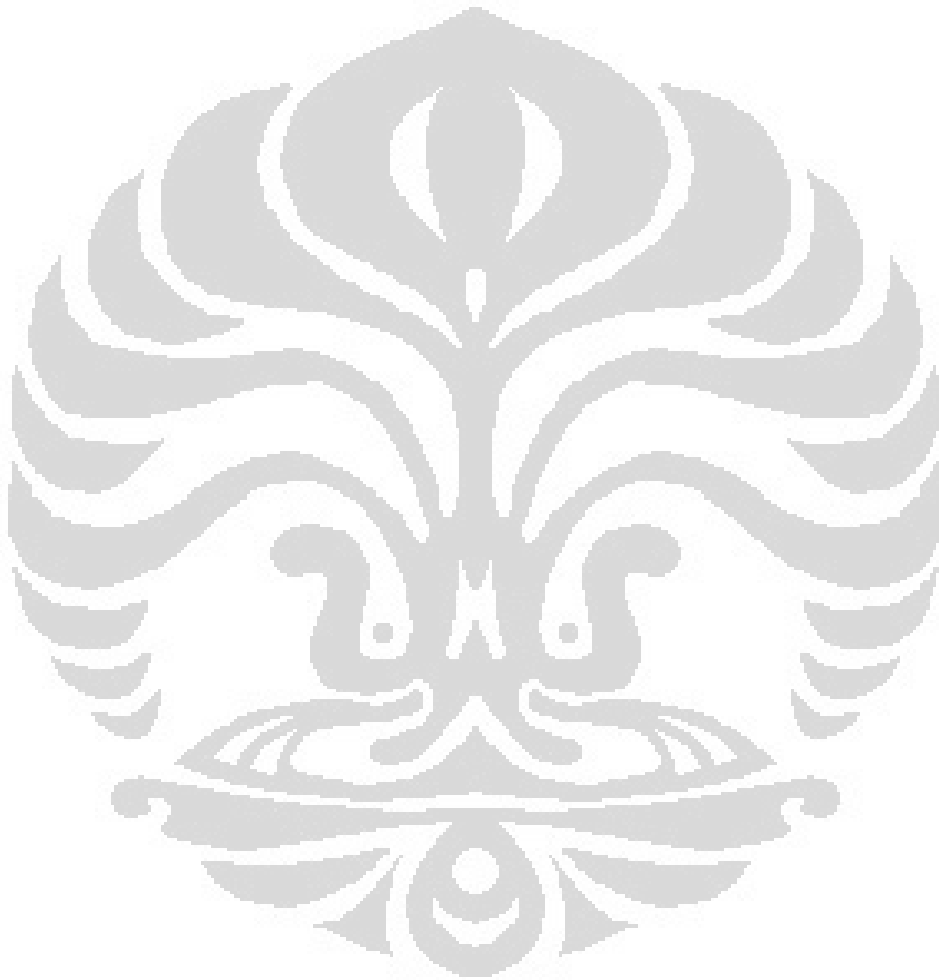
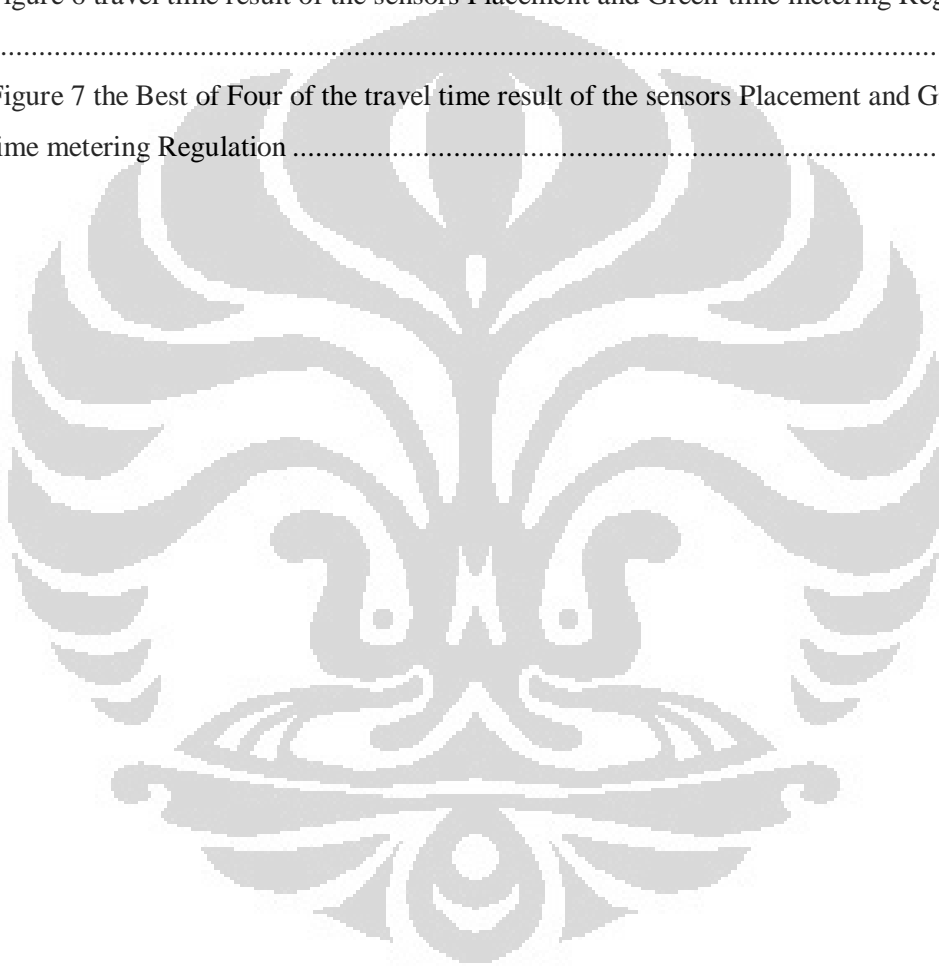


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I Introduction

1.1 Background

Transportation systems have become more complex and frequently congested. The approaches to traffic flow theory in Transportation System could be microscopic or macroscopic. The macroscopic approach is analogous to theories of fluid dynamics or continuum theories. The microscopic approach has resulted in car-following theories, which study the behavior of one vehicle following another. Microscopic simulation has gained recognition as an effective way for quantifying traffic operations. A variety of microscopic simulation models are currently available from academic and commercial sources, and new models are continually being developed.

One of the famous and widely used of traffic simulator is AIMSUN (Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks). It is an integrated transport modeling software, developed and marketed by [TSS - Transport Simulation Systems](#) based in [Barcelona, Spain](#).

On the other hand, the effectiveness of the regulation strategies on traffic flow depends on the availability of qualified information on the network state at any time. This is usually obtained by measuring the flow and velocity through sensors which are placed on the network. This measurement depends on the positioning of the sensors.

This project purposed to study the Influence of the placement of sensors on a network on the AIMSUN simulator for the quality of the green light duration regulation

1.2 Problem

The problem of this project is in what way the placement of sensors on a network on the AIMSUN simulator can be influence the quality of the green light duration regulation

1.3 Objective

The objective of this project is to study the influence of the placement of sensors on a network on the AIMSUN simulator for the quality of the Green-time metering regulation

1.4 Task

The task of this project is:

- 1) Take over the basic functionality of Aimsun by modeling a simple road network as well as observers and control strategies.
- 2) To propose a plan of experiments to study the Influence of the position of sensors at road section on the simulator AIMSUN for the quality of the green light duration regulation.

1.5 Real Data Resource

We use real data for this project to calibrate the simulation and deal with a realistic situation. The data resource is from observation at the A6 Freeway, Paris, France

1.6 Organization of the Report

This report will be organized with the systematic bellow:

- Introduction
- Introduction to AIMSUN and Transport Simulation Systems (TSS)
- Training Session
- Modeling the simulator with real Data
- Analyzing
- Conclusion

1.7 Time Schedule

To make sure the project meet the deadline, it is important to make the project time schedule. The project time schedule of this project as shown as follow

Table 1 Project Time Schedule

	March		April				May				June				July	
Weeks	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Activities	Training AIMSUN						Implementation								Jury	

1.8 Activities Plan

To breakdown the project time schedule into the detail activities, we make the activities plan as shown as bellow

Table 2 Project Activities Plan

No	Month	Weeks	Activities	Details Activities	
1	March	3	Training AIMSUN	Introduction	
2		4		Editing Exercises	
3		1		Traffic Management Exercises	
4	April	2		Dynamic Modeling Exercises	
5		3		Micro simulation Output Exercises	
6		4		3D Exercises Macro-Meso-Micro Integration exercise	
7	May	1		Implementation	Modeling the Freeway
8		2			Inputting Real Data
9		3			Calibration and Validation
10		4			Ramp Metering Regulation
11	June	1	Analyzing & Conclusion		
12		2	Jury		Report making
13		3			Preparation Presentation
14		4			Soutenance
15	July	1			Jury
16		2	Jury		

II Introduction to AIMSUN and Transport Simulation Systems (TSS)

AIMSUN (Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks) is a microscopic simulator purposely designed and developed at the Laboratorio de Investigación Operativa y Simulación, a research group in the Department of Statistics and Operations Research of the Universitat Politècnica de Catalunya, bearing in mind the requirements of the ITS systems. AIMSUN is imbedded in GETRAM (Generic Environment for Traffic Analysis and Modeling), a simulation environment inspired by modern trends in the design of graphical user interfaces adapted to traffic modeling requirements. (J. Barcelo, 2005)

Aimsun is currently one of the market leaders in transport simulation software with nearly 2,000 licensed users in over 60 countries. Aimsun software is used by government agencies, municipalities, universities and consultants worldwide for [traffic engineering](#), [traffic simulation](#), [transportation planning](#) and [emergency evacuation](#) studies. It is used to improve road infrastructure, reduce emissions, cut congestion and design urban environments for vehicles and pedestrians (Wikipedia, 2010).

2.1 Product features

The Aimsun integrates a lot of types of transport models into one software application which is **Macroscopic static traffic assignment, Mesoscopic simulation, Microscopic simulation, Dynamic traffic assignment, Vehicle-pedestrian simulation**. This allows also for **the 2D and 3D visualization** of transport scenarios in major world cities at detailed and high levels.

The Other features on Aimsun include: Creation of vehicle actuated signals, Introduction public transport priority schemes, Definition of traffic management strategies using triggers and actions, Import, editing and manipulation of OD data, Management of scenarios, iterations and replications, Production of outputs as images videos, tables or raw data

2.2 Practical uses

The Aimsun most widely use is for:

- Impact analysis of infrastructure design
- [Environmental studies](#) and creation of green zones
- Toll, road pricing and [congestion charging](#)
- Control plan and signal optimization
- Urban and interurban traffic demand management
- Support system for public transport management
- Safety analysis and emergency evacuation planning



III Training Session

3.1 Editing exercises

In these exercises, the final goal is the creation of a complete network from zero with all the necessary data to finish with a microscopic simulation of the network. We will define, step by step, and based on a background image, all the graphical elements that compose a network, including sections, nodes, detectors, VMS, solid lines and bus stops. We will also define a control plan for traffic lights, bus lines and plans, reserved lanes for buses, a traffic state, centroids, O/D matrices, a traffic demand, and a scenario with an experiment which we will finally use for the simulation (AIMSUN, 2010).

3.2 Traffic management exercises

In these exercises, we will see how to create policies for rerouting vehicles. We will define elements including strategies, policies and VMSs. We will learn how to define rerouting depending on traffic conditions, and how the VMS message can be changed at specific times to reflect the policy applied (AIMSUN, 2010).

3.3 Dynamic Modeling exercises

In these exercises, the goal is to practice with some Transport Planning and Demand Analysis tools. We will start by assigning an O/D Matrix to the network, and we will see how the flow distribution and several results are obtained. Then we will adjust the O/D Matrix with detection data, demonstrating how to read detection data from a text file. We will also define a sub network for which we will obtain a traversal O/D Matrix. Finally, we will see an example of how to balance an O/D Matrix using the Furness method. (AIMSUN, 2010)

3.4 Micro simulation outputs exercises

In these exercises, we will take a glance at the different ways of obtaining immediate visual results in Aimsun. We will see how to view data from a single vehicle while doing a microscopic simulation. We will also practice with the Time Series Viewer to see Time Series data during a simulation. And finally, we will

learn about how to define Styles and Modes to present different results on the network, colorings by any criteria or using labels (AIMSUN, 2010).

3.5 3D exercises

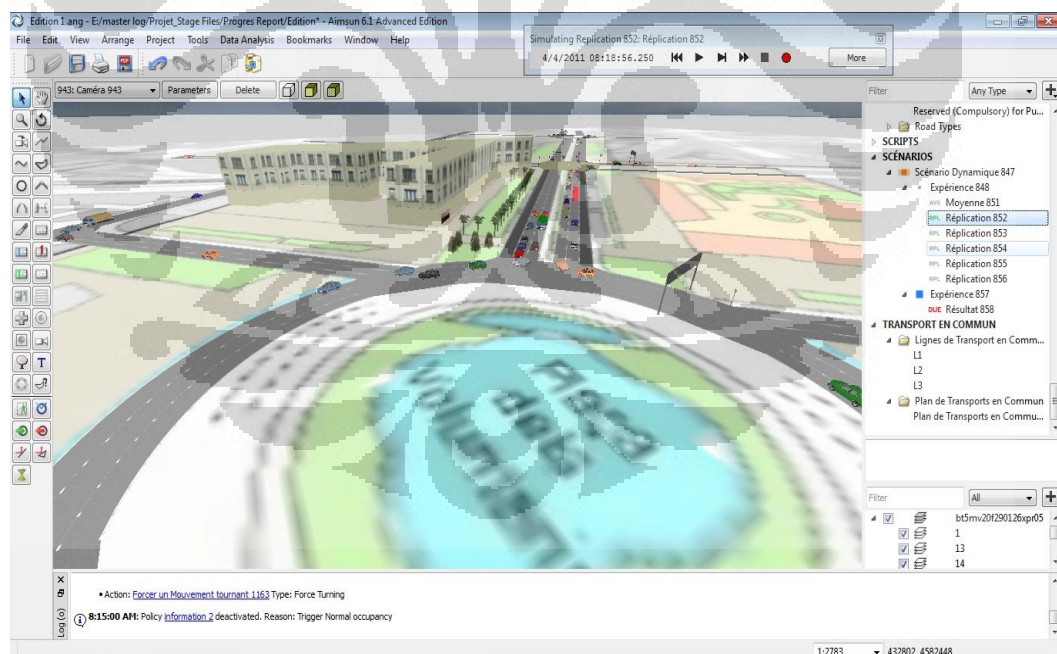
In these exercises, the final aim is to get used to moving around a 3D view, creating new cameras and also adding textures and shapes to the network. We will start from a 2D network, visualize it in 3D and make the proper changes so that it gets a realistic appearance (AIMSUN, 2010).

3.6 Macro-Meso-Micro Integration exercise

In these exercises, the goal is to practice with the microscopic and mesoscopic simulators and with the macroscopic modeling in Aimsun and demonstrate the interaction between them (AIMSUN, 2010).

The final result of the training session with 3D visualize is as shown as figure 1 bellow

Figure 1 Final Result of the Training Session



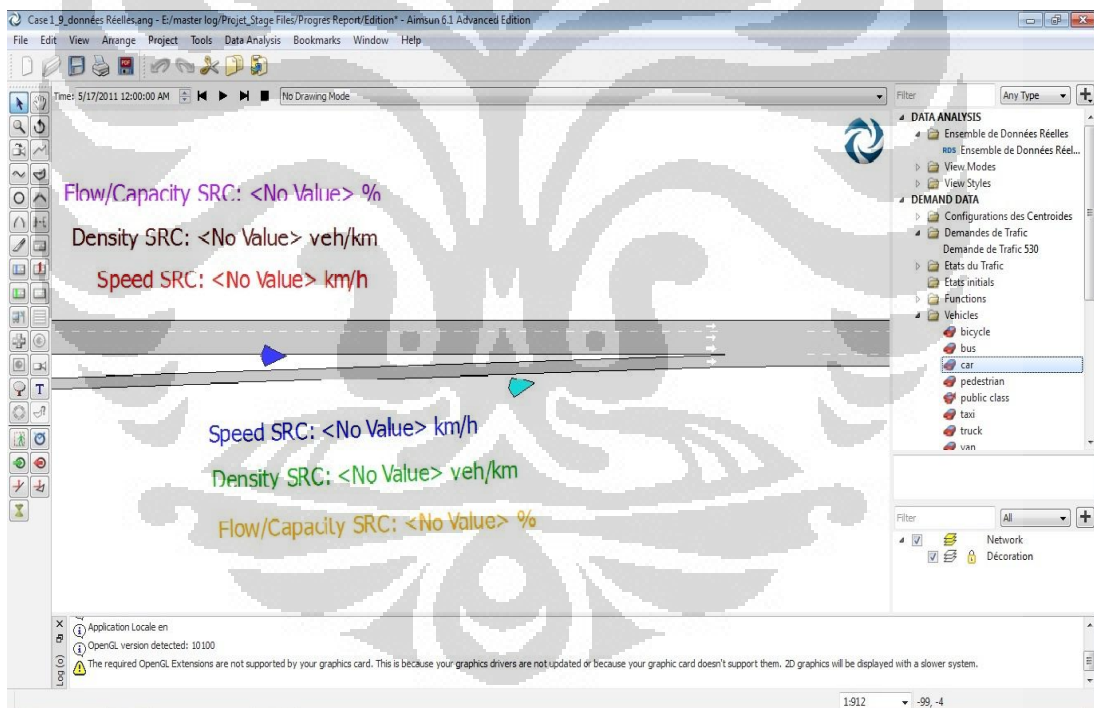
IV Modeling the simulator with real Data

After passing a training session, the next activities are modeling the simulator with the real data. The data resource came from an observation in a real freeway, namely L'outoroute A6, in Paris, France. The parameters are Flow and Speed of the vehicle which passing on a freeway in duration of 24 hours

4.1 Modeling the Freeway

The first step is making a simple model of a freeway as close as a real condition at L'autoroute A6. For this model, the distances of the freeway before join nodes is created in 999,994 m and after join nodes is 1721,12 m long. For the distance of on ramp is 1000.17 m. The design of a freeway as shown below

Figure 2 the Design of a Freeway



4.2 Inputting Real Data

The next step is inputting a real data of flow and speed of a vehicle that we have in the traffic state feature on simulator. In this case, entry data processing is using a Traffic State feature on AIMSUN.

4.3 Calibration

For making the condition on the simulator as close as a real one, we have to calibrate the parameters. J Hourdakis said on his journal:

“The effectiveness of a traffic simulator in evaluating traffic management strategies lies in its ability to accurately replicate actual traffic conditions; this requires proper calibration of its parameters rather than using default values” (J Hourdakis, 2002).

“Calibration is the process in which the model parameters of the simulator are optimized to the extent possible for obtaining a close match between the simulated and the actual traffic measurements, which primarily include volume, speed and occupancy. Generally, calibration is an iterative process in which the engineer adjusts the simulation model parameters until the results produced by the simulator match field measurements; the comparison part is often referred to as validation” (J Hourdakis, 2002).

To calibrate the simulator, we have to make changes some parameters in a simulator. The changing can do by trial and error. We can change the freeway parameters and/or the vehicle parameters. In this project, there are more than 50 trial and error processes to obtain a result as close as the real condition. The parameter changes that has been done is presented as shown at table 3 below

Table 3 Parameter of calibration

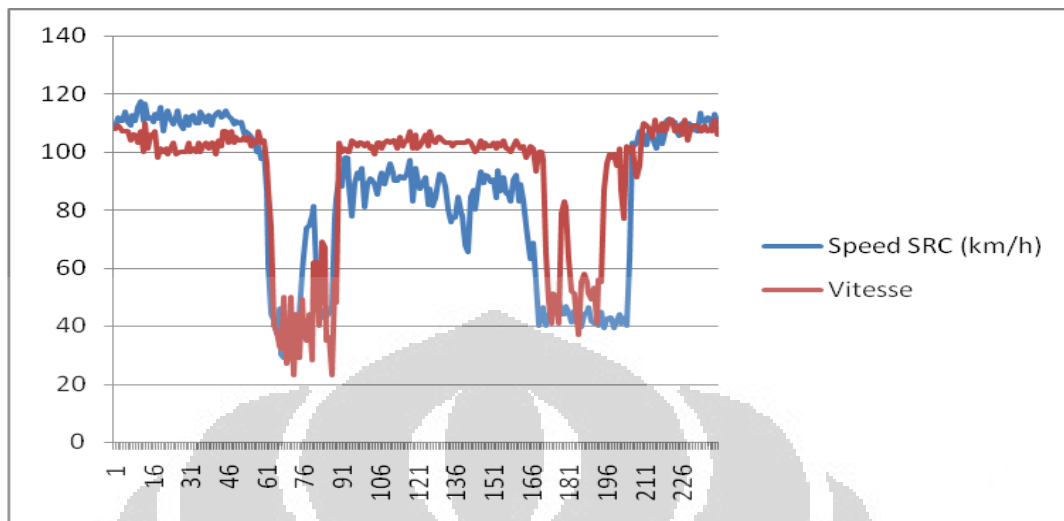
Variable			
Route			
	Freeway		
		Max Vitesse	110
	On/Off Ramp		
		Max Vitesse	120
Vehicle			
	Vitesse		
		Moyenne	130
		Deviation	27
		Min	7
		Max	140

	Acceptation de Guidage		
		Moyenne	75
		Deviation	15
		Min	70
		Max	90
	Acceptation de Vitesse		
		Moyenne	1.1
		Deviation	0.25
		Min	1
		Max	1.4
	Min Distance Vehicule		
		Moyenne	6
		Deviation	0.3
		Min	3.5
		Max	35
	Give Way Time		
		Moyenne	0
		Deviation	0
		Min	0
		Max	0
	Minimum Headaway		
		Moyenne	1
		Deviation	0.1
		Min	0.5
		Max	5

4.4 Validation

If we see the figure 3 below, it is shows the graph from a real speed (vitesse) and the result from the simulator (speed SRC). The graph shows that the result from the simulator is nearly meet the real speed.

Figure 3 the graphic of real speed (vitesse) and the result from simulator (speed SRC)



It is nearly as close as the other measurement that expose on Mr **J. Barceló** journal as shown as follow.

Figure 4 the other AIMSUN Measured and Simulated Speed

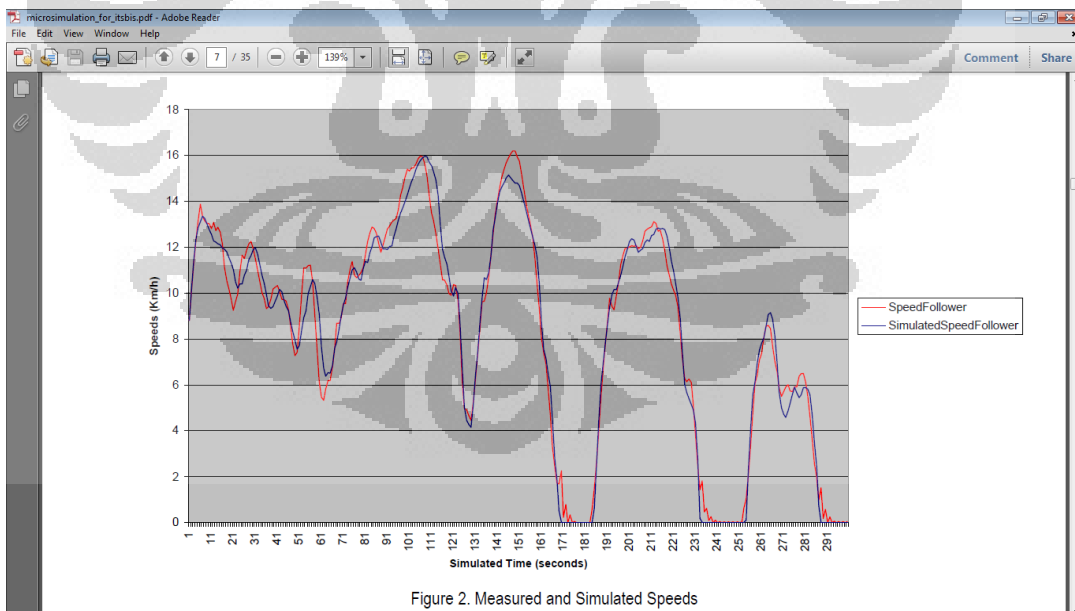


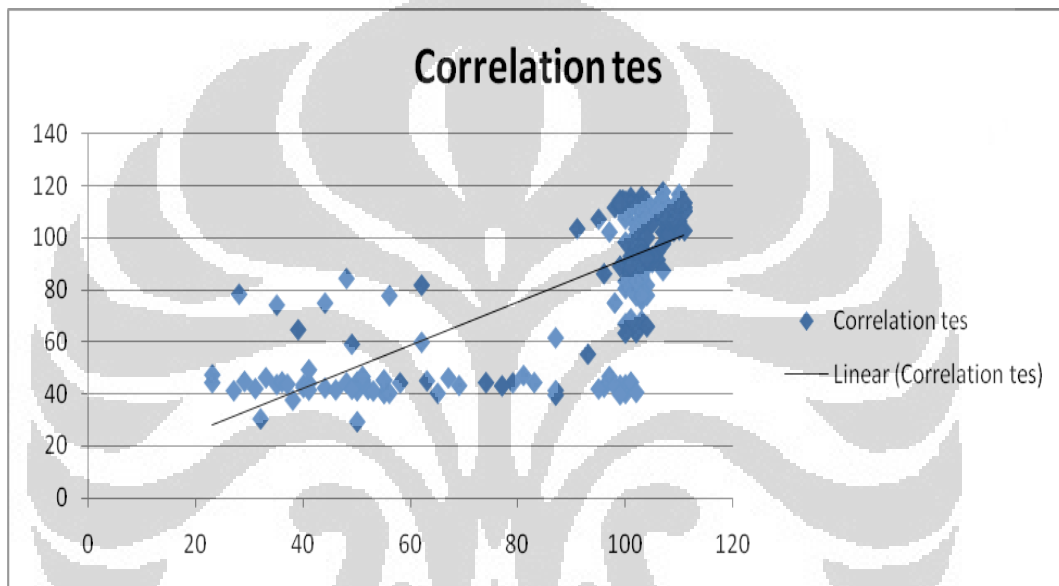
Figure 2. Measured and Simulated Speeds

(source : J. Barceló, MICROSCOPIC TRAFFIC SIMULATION: A TOOL FOR THE ANALYSIS AND ASSESSMENT OF ITS SYSTEMS, p 7, TSS, 2005)

To measure the result, we have to validate the result. In this project, we use a correlation test in Microsoft Excel to validate a calibration processes result in simulator. The result of the correlation test is **0.742175**. It is mean that most of the modeling has a condition as closed as the real one.

If we see on the graphic of XY correlation test below, its shows that there is a lot of data from modeling in AIMSUN are meets with the real one.

Figure 5 the XY graphic of correlation test



That result proves that AIMSUN can meet the real condition by calibrate the parameter of the simulator. It has been explain by J. Barceló on his journal :
“The numerical value for the error metric for the AIMSUN2 model was 3.4726. These results show that the AIMSUN2 car-following model is able of a fairly good reproduction of the observed values.” (J. Barceló, 2005)

4.5 Ramp Metering Regulation

After creating a model on the simulation and have a result of the speed and flow of the vehicles, now we try to make a placement of the ramp metering and make some regulation and look the differences of the result.

First of all, we should to know what about the Ramp metering. It is a tool that takes place on entrance ramps to a freeway in order to limit the flow of

vehicles entering, so it can make sure that entrance demand never surpasses the capacity of the main road. Ramp Metering can be positioned anywhere along the section; all lanes are affected. There are four variety implementation of Ramp metering control which is: Green-time metering, Delay metering, Flow metering, Flow-ALINEA metering.

1. Green time metering. Parameters are green time and cycle time. This is modeled as a traffic signal.
2. Flow metering. Parameters are platoon length and flow (veh/h). The meter is automatically regulated in order to permit the entrance of a certain maximum number of vehicles per hour. The platoon length is the maximum number of vehicles allowed through each time.
3. Delay metering. Parameters are the mean delay time and the standard deviation. It is used to model vehicles stopping due to some control facility, such as a toll or customs barrier.
4. Flow-ALINEA metering. Special type of flow metering that implements the ALINEA ramp metering strategy.

(microsimulator and mesosimulator Aimsun 6.1 users manual, 2010)

In this project we are only use the green-time metering implementation. It's decided to simplify the problem. By The Green-time metering, the ramp meter is controlled by a traffic signal that turns red and green on a cyclical basis

4.6 Simulating the placement of the ramp metering and changing of parameter the Green-time metering

We start to simulate the placement of the ramp metering on entire ramp entry and changing The Green-time metering regulation to find out the effectiveness of the regulation. We measure this simulating with duration of **travelling time**. The more effective of the simulation is the most short of the traveling time of the vehicle on a freeway.

The ramp metering placement simulating start from the end of the on-ramp and moving backward each fifty meters until 200 meters from the end of on-ramp, meanwhile the cycle of green-time metering is fixing at 90 second. The choosing

of 90 second for the cycle of green-time metering it is caused that cycle is the standard cycle that given from the AIMSUN Simulator.

After simulating the placement of the ramp metering, the experiment continues to make some regulation of green-time metering in the fixing place of ramp metering, which is at the end of on-ram. The cycle of green-time metering simulating is start at 90 second and then at 40 second for comparison.

The chosen the cycle at 40 second is Based on the other research that has been published by Hassane Abouaïssa (2011), *“Lors de nos simulations, la durée du cycle est égale à $C = 40$ secondes, avec une durée de feux vert et d’orange de 35 secondes au maximum. La durée minimum du rouge est donc de 5 secondes, en fonctionnement normal. Ces durées, utilisées par les exploitants, semblent appropriées puisqu’elles minimisent les arrêts sur les rampes. Les usagers avancent constamment dans la file d’attente jusqu’au feu”*

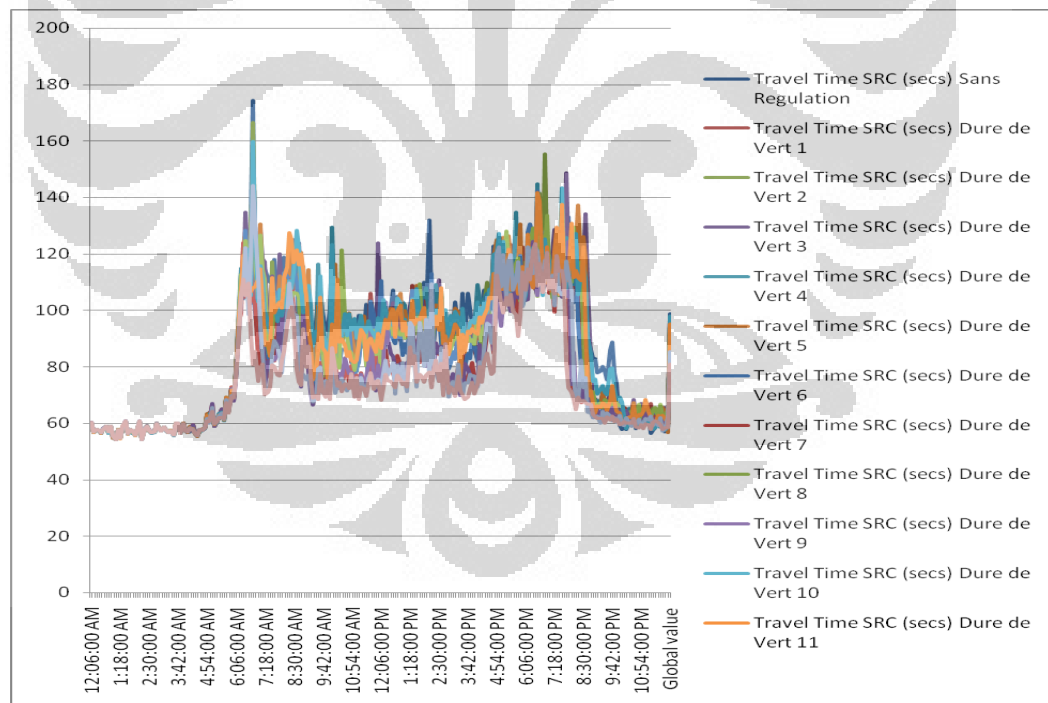
(For detail of the regulation see annexes)

V Analyzing

If we look the results shown on table 4 and figure 6, we can see that the best placement of the ramp metering is in the end of the on ramp, because it give a significant influence of minimizing the travelling time comparing with the others placement. The regulation “dure de vert 1”, “dure de vert 6” and “dure de vert 7” are the regulation of ramp metering that place the metering in the end of the on-ramp. They give the greater ratio of decreasing global value traveling time than the other placement did.

On the other hand, the changing of the parameter of the Green-time metering, can give more significant affectivity of traveling time of the vehicle on a freeway (see annexes for the detail). It is shows on the graph below

Figure 6 travel time result of the sensors Placement and Green-time metering Regulation



We could see from the graphic of figure 7 below, there are four regulations which give the best decreasing of travelling time. These are “Dure de Vert 7”, “Dure de Vert 9”, “Dure de Vert 12” and “Dure de Vert 13”.

If we look from the ratio of Decreasing Global Value Traveling Time that shown at table 4, “Dure de Vert 7”, “Dure de Vert 9”, “Dure de Vert 12” and “Dure de Vert 13” give the maximum ratio of decreasing global value traveling time.

Table 4 Global Value Traveling Time Ratio

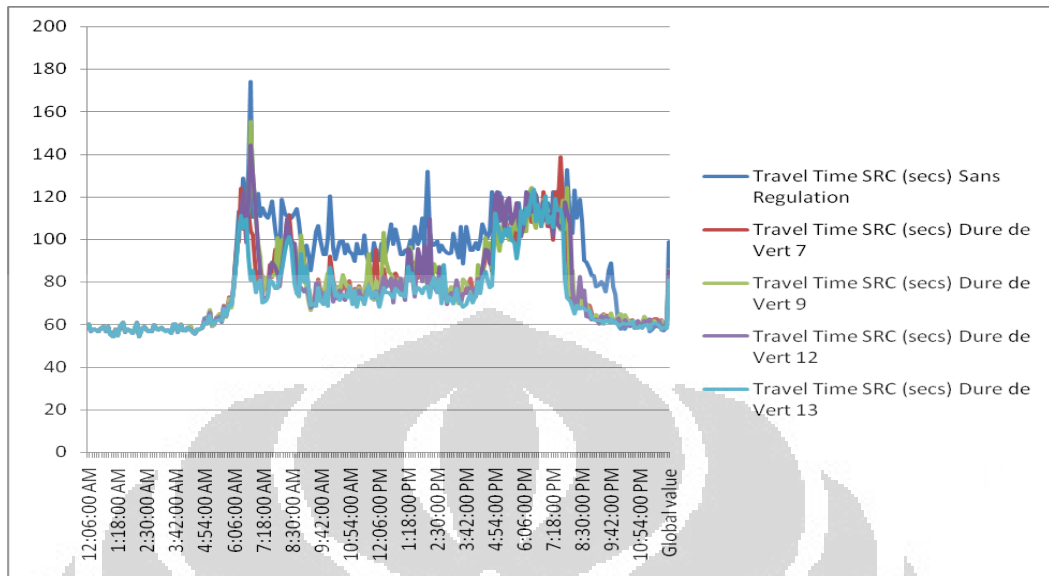
Regulation	Global Value Travel Time SRC (secs)		Ratio
	Avec regulation	Sans Regulation	
Dure de Vert 1	93.37	98.77	-5.467%
Dure de Vert 2	95.89	98.77	-2.916%
Dure de Vert 3	97.5	98.77	-1.286%
Dure de Vert 4	96.22	98.77	-2.582%
Dure de Vert 5	97.27	98.77	-1.519%
Dure de Vert 6	92.06	98.77	-6.794%
Dure de Vert 7	84.89	98.77	-14.053%
Dure de Vert 8	93.92	98.77	-4.910%
Dure de Vert 9	85.8	98.77	-13.132%
Dure de Vert 10	97.84	98.77	-0.942%
Dure de Vert 11	95.01	98.77	-3.807%
Dure de Vert 12	85.4	98.77	-13.536%
Dure de Vert 13	81.03	98.77	-17.961%

The four regulations are talking about the changing of the Green-time metering parameter (Ramp control strategy).

This result is nearly the same as told as J. Barceló on his journal:

“The results of this testing simply confirmed that the ramp control strategy, improved the operating conditions on the freeway significantly on the overall system, especially with heavy congestion. This of course, was not unexpected.” (J. Barceló, 2005)

Figure 7 the Best of Four of the travel time result of the sensors Placement and Green-time metering Regulation



If we see from figure 7 The regulation “Dure de Vert 13” is the best result to minimize the traveling time on a freeway, compared with the traveling time without regulation. The detail parameter of the regulation is as seen as follow :

Table 5 the Detail Parameter of the Green Time metering/Ramp Control Strategy

Name of simulation	Dure de Vert 13	
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	40	Sec
Green Duration	10	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	80	%

So, it is recommended for using that strategy in the real condition at the freeway, especially at A6 Freeway, Paris, France

VI Conclusion

After doing of all the work on this project, we can conclude that:

- The AIMSUN can be used to simulated the real condition of the traffic by changing the parameter of the freeway and the vehicle
- The best placement of the ramp metering is in the end of the on ramp, because it is give a significant influence of minimizing the travelling time comparing with the others placement.
- The changing of the Green-time metering parameter can decrease significantly the vehicle traveling time on a freeway.
- According to this project, the graph "Travel Time SRC (secs) Dure de Vert 13" (40 seconds for the cycle, 10 seconds for green light duration and 5 seconds for yellow light duration) is the best result of the regulation to decrease significantly the vehicle traveling time on a freeway.
- It is recommended for using that strategy in the real condition at the freeway, especially at A6 Freeway, Paris, France

References

J. Barceló, **MICROSCOPIC TRAFFIC SIMULATION: A TOOL FOR THE ANALYSIS AND ASSESSMENT OF ITS SYSTEMS**, TSS, 2005

J Hourdakís, P G Michalopoulos, J Kottommannil, **A PRACTICAL PROCEDURE FOR CALIBRATING MICROSCOPIC TRAFFIC SIMULATION MODELS**, TRB Annual Meeting, 2003

Hassane Abouaïssa, M Fliess, V Iordanova, C Join, **Prolégomènes`a une régulation sans modèle du trafic autoroutier, First steps towards a model-free control of a freeway traffic flow**, MISC, 2011

Microsimulator and Mesosimulator Aimsun 6.1 users manual, 2010

AIMSUN, exercises : Editing, 2010

AIMSUN, exercises : Traffic management, 2010

AIMSUN, exercises : Dynamic Modeling, 2010

AIMSUN, exercises : Micro simulation outputs, 2010

AIMSUN, exercises : 3D, 2010

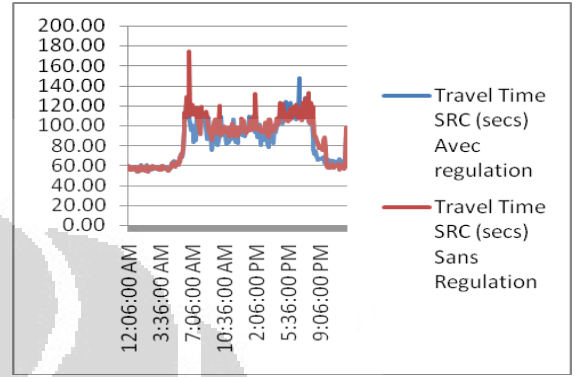
AIMSUN, exercises : Macro-Meso-Micro Integration, 2010

Wikipedia, AIMSUN, 2010

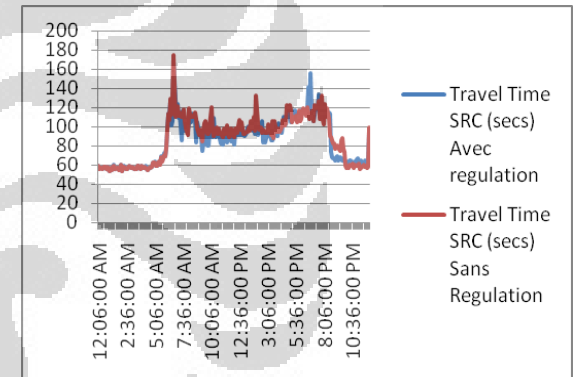
Annexes

Changing of Placement of the ramp metering and Regulation of Green light duration

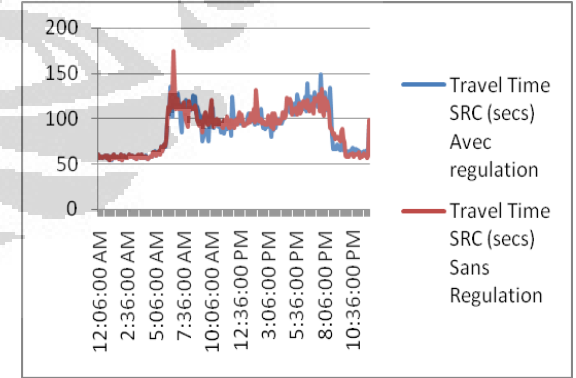
Dure de Vert 1		
Length	2	m
Distance from Entrance	997.7	m
Distance to Exit	0.5	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



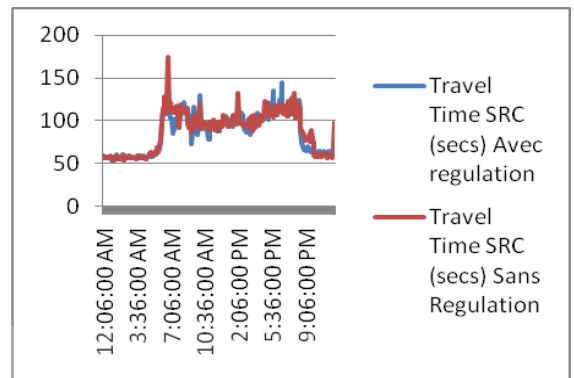
Dure de Vert 2		
Length	2	m
Distance from Entrance	948.1	m
Distance to Exit	50.1	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



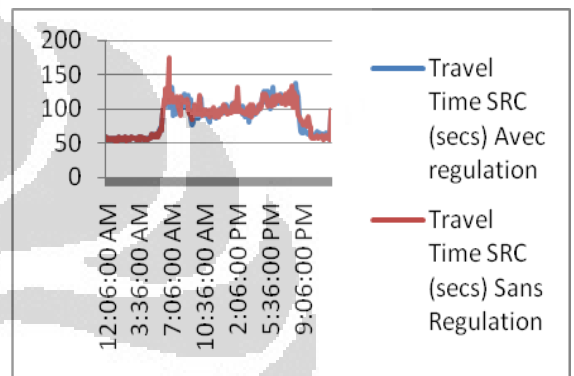
Dure de Vert 3		
Length	2	m
Distance from Entrance	898.2	m
Distance to Exit	100	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



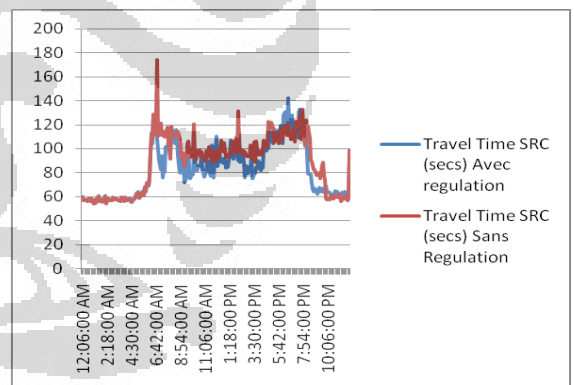
Dure de Vert 4		
Length	2	m
Distance from Entrance	848.1	m
Distance to Exit	150.1	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



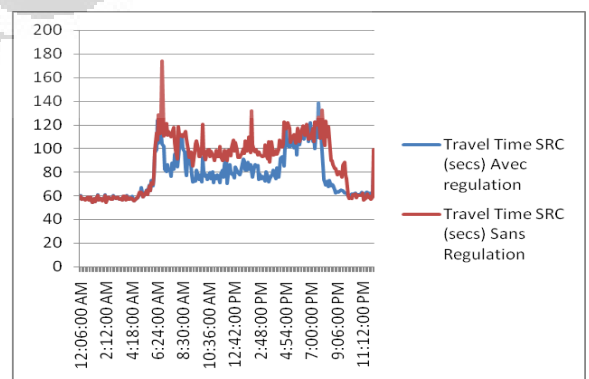
Dure de Vert 5		
Length	2	m
Distance from Entrance	798	m
Distance to Exit	200.2	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



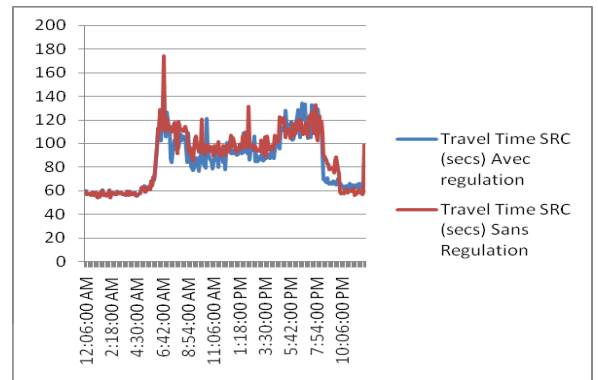
Dure de Vert 6		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	90	Sec
Green Duration	35	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



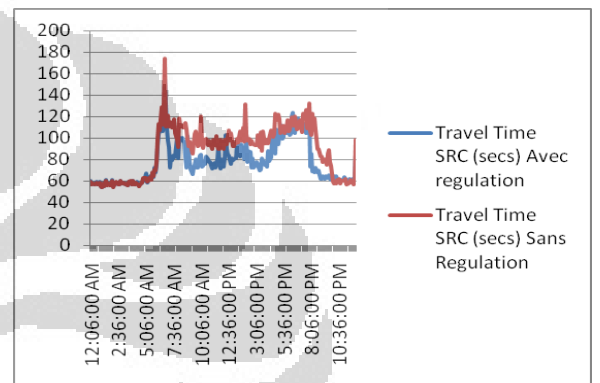
Dure de Vert 7		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	90	Sec
Green Duration	25	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



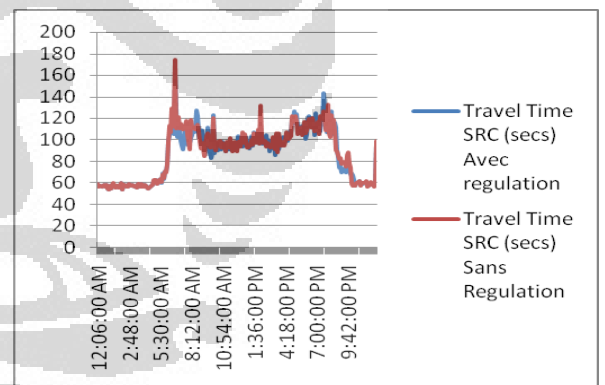
Dure de Vert 8		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	90	Sec
Green Duration	45	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	80	%



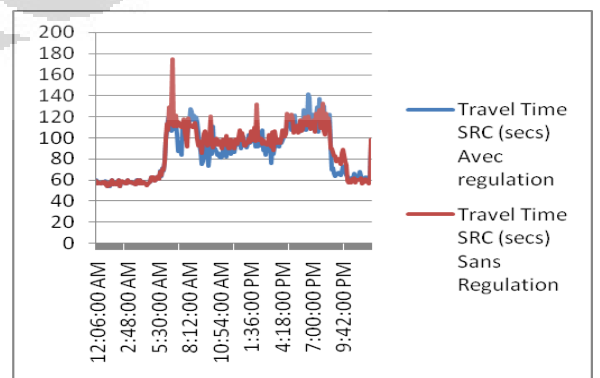
Dure de Vert 9		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	90	Sec
Green Duration	25	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	80	%



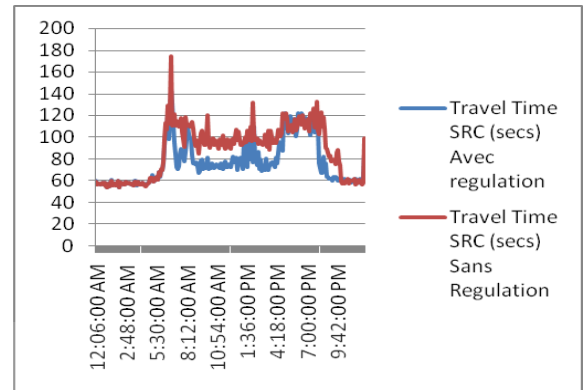
Dure de Vert 10		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	40	Sec
Green Duration	30	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



Dure de Vert 11		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	40	Sec
Green Duration	20	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



Dure de Vert 12		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	40	Sec
Green Duration	10	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	50	%



Dure de Vert 13		
Length	2	m
Distance from Entrance	998	m
Distance to Exit	0.1	m
Cycle	40	Sec
Green Duration	10	Sec
Offset	0	Sec
Yellow Time	5	Sec
Red Percentage	80	%

