

HYCON2 MEETING REPORT

INRIA GRENOBLE

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At the moment, after developing different controllers for the different groups involving traffic control as well as modeling of traffic system, a suitable and functional interface to taste these controllers in a real world situation was needed. In order to develop this, a meeting, to gather people working on the same project from different universities, was organized.

The group was composed by Luca Capisani, Post doctoral researcher at University of Pavia, Jose Ramon Dominguez PHD student At University of Seville, Luis Leon PHD student At University of Grenoble, Guillaume Gay and Pierre Gault interns from University of Grenoble.

As said above, the aiming was to develop a functional interface between the micro-simulator that models a real highway and the program to compute the control. The micro-simulator chose was the program Aimsun, widely used given its functionalities, to name a few, the possibility to evaluate in greater detail the situation in one or more roads, its friendly working environments and the possibility of acquisition of statistical data from the simulation, among others. This software was used to model Grenoble South Ring (Rocade Sud) Highway. And in order to compute the control, the environments Matlab/Simulink were chosen.

The junction between these programs and the interface needed is shown in figure 1.

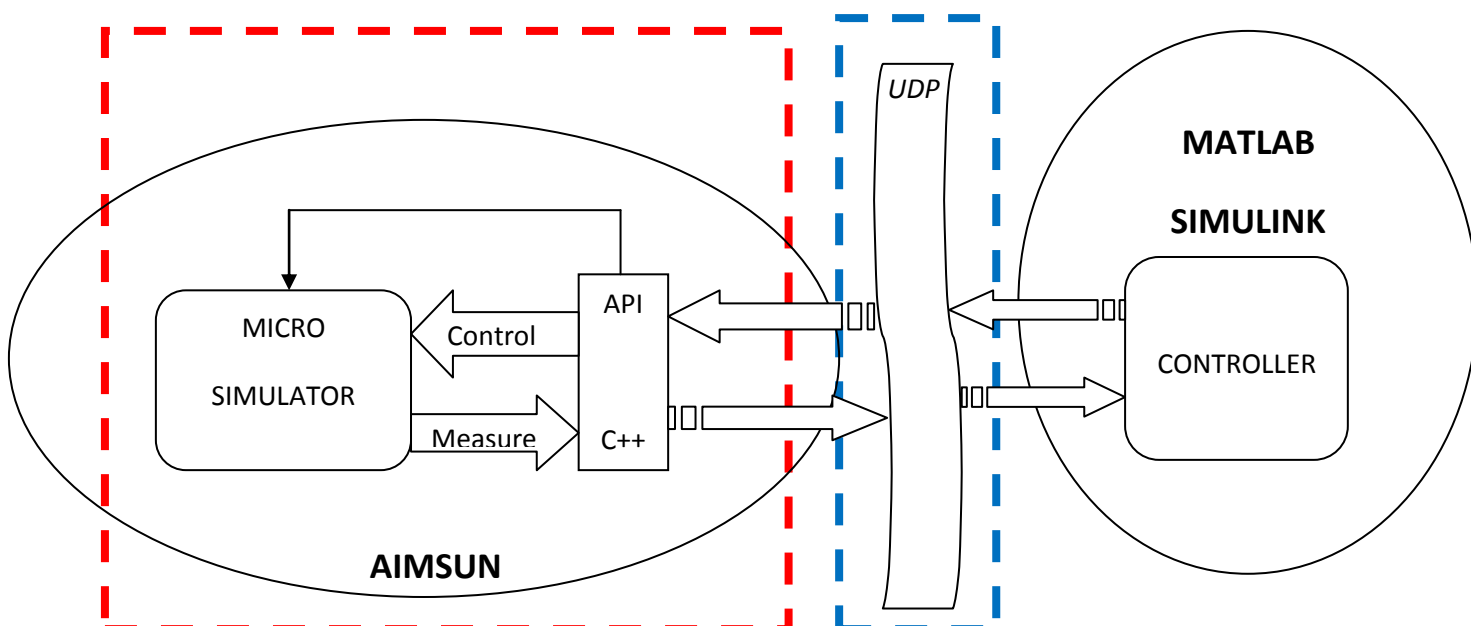


Figure 1. Scheme of the Interface between AIMSUN and MATLAB/SIMULINK

Modifying the AIMSUN extension API in C++, the group managed to be able to recollect the data (numbers of cars and mean velocity) from the micro-simulator in real time, with a sample time of 60 seconds, which can be changed, according to each group needs. For doing so, sensors that store this information were set at the beginning and at the end of the different segments that make up the model of the highway.

In addition to this, the behavior of the actuators of Ramp Metering and Variable Speed Limits were also changed due to introduction of C++ functions in the API.

As a result, at this point the group has already accomplished the first part of the objective (red dotted lines square in figure 1), the recollection of the data and the controlled change of the values of the actuators in AIMSUN through C++ code.

The other part of the goal and not yet developed, is to be able to go from AIMSUN to Matlab/Simulink and vice versa through UDP communication. With this code, already largely implemented in both ways, the cycle of recollecting real time information of Grenoble South Ring, bringing it to Matlab/Simulink, computing the control and returning the values of the actuators is complete.

Although we have succeeded to elaborate a raw version of the program that overcomes the first part of the problem, in order to get this code completely developed and to have a suitable micro model of the highway, we still have some work ahead us to be done. Such as;

1. **Sensors placements** (individual proposal, according to the state variables of the model used).
2. **Generalization of the code** for the n sensors and m actuators placed along the highway.
3. **Possible optimization** of the C++ code.
4. **Variable Speed Limits actuators (VSL) placement.** As seen in AIMSUN, when we tried to control the signs of the VSL, as in real world, the function that would enable us to do so, was not found. Instead we achieved to change through API the velocity of the whole segment in the simulation, as if there was a VSL sign in the beginning of each one. Which brings us to one of these cases:
 - 4.1. Real positioning of the VSL in AIMSUN. Solving the incognita of whether or not having to change the highway micro-model in order to fit the signs in the intersection of the segments.
 - 4.2. Controlling the VSL actuators from API. I.e. Finding a C++ function that enables us to do so.
5. **Ramp metering placement.** Study the situation of each on-ramp in order to know if its flow is important enough to be controlled.

The meeting held by the members of the different groups was rather productive. As it was possible to initiate a common work, that allows each party to taste the controller designed in a real life situation as well as study how their model adapts to it.

As a future work is proposed to develop a macroscopic model to characterize the on-ramps of the highway. Describing as accurate as possible the behavior of the ramp metering, i.e. $\alpha=f(N)$, where α is the period of time when the traffic light is green and N is the number of cars allowed to get into the main road.