

TraCI4MAtlab: Re-engineering the Python implementation of the TraCI interface

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Outline

- Moycot
- Context
- TraCI4Matlab
 - Re-engineering approach
 - Reverse engineering sub-process
 - Forward engineering sub-process
- Results
- Conclusions

MOYCOT?

Urban Traffic Modelling and Control for Medellin city

Develop urban traffic models that describe the interaction between the different actors involved in the vehicular traffic (people, vehicles and articulated), which are useful for the development of strategies, and urban traffic control in a frame of reference multimodal (transport ways interacting each other).



Medellin

- Medellín - Colombia: An innovative and sustainability-oriented city.
- Host of the World Urban Forum 2014.



Medellin (cont..)

- Awards: Most Innovative City , Sustainable Transport , Urban Design.
- Integrated, multi-modal transportation system.



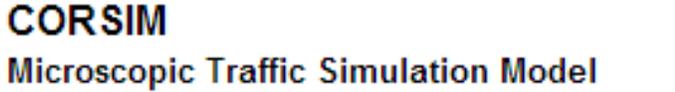
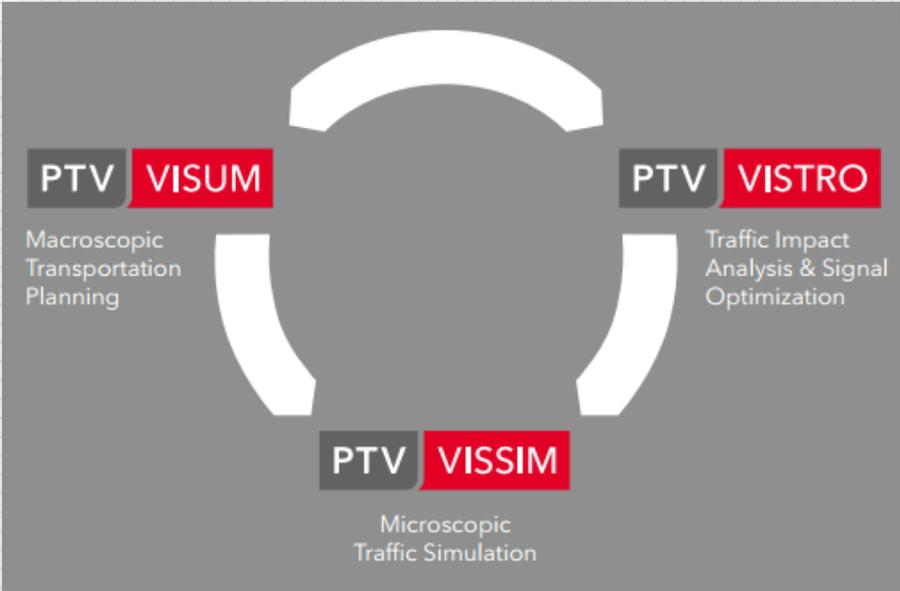
MOYCOT Project

- Modelling and control of urban traffic in the city of Medellín (MOYCOT) project:
 - *“To identify and propose strategies for coordination of traffic lights based on optimization that allow a better use of the road infrastructure and controlling urban traffic, considering the interaction among different available transportation modes”*
 - *“Develop a simulation tool of multimodal traffic from the proposed models, to validate the generated monitoring strategies and control in this project.”*

Why SUMO

- Benchmark study. The decision took in to account aspects as reliability, performance, source code, and extensibility.
- Chosen simulation platform: SUMO (Simulation of Urban Mobility)

Why SUMO



Software Traffic Simulator Benchmark

| Simulator | License | Extensibility | Agent Oriented | Parallelism/Distribution | IVC | Interactivity | Maturity Level |
|-------------|------------|------------------|------------------|--------------------------|-----------------|---------------|----------------|
| VISSIM | Commercial | Yes | No | Yes ³ | No | High | High |
| PARAMICS | Commercial | Yes | No | Yes ³⁴ | No | High | High |
| AIMSUN | Commercial | Yes | No | Yes ³ | No | High | High |
| MITSIM | Both | Yes ² | No ² | Yes ³ | No | Low | Low |
| SUMO | GPL | Yes ² | No ² | Yes ³ | No ⁵ | Medium | High |
| MAS-T2erLab | Free | Yes ¹ | Yes ¹ | Yes ³ | No | Medium | Low |

Software Traffic Simulator Benchmark

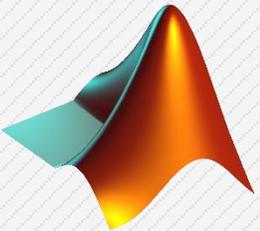
J. L. Pereira and R. J. Rossetti, "An integrated architecture for autonomous vehicles simulation," In Proceedings of the 27th Annual ACM Symposium on Applied Computing, 2012, pp. 286–292..

Optimization and Simulation



SUMO is the right tool for urban traffic simulation.

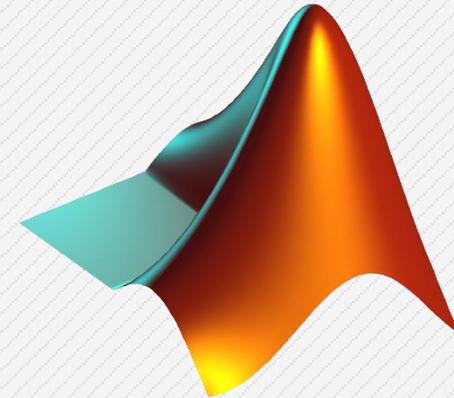
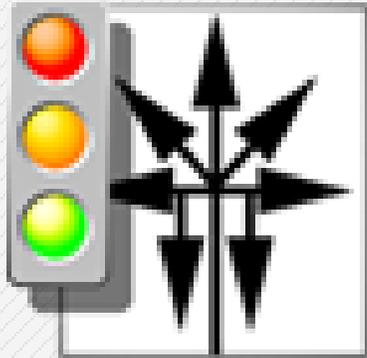
- Open Source
- Extensibility
- Integration capabilities
- Microscopic Simulator
- Allow large Scale Simulations
- Performance



Matlab is used vastly in engineering scientific research[1]

- High Level Language
- Highly Graphical capabilities
- Integrate Mathematical Functions
- Rapid Prototyping
- Plenty of toolboxes
- IDE
- Highly Integrable
- Parallel Processing

Problem ☹



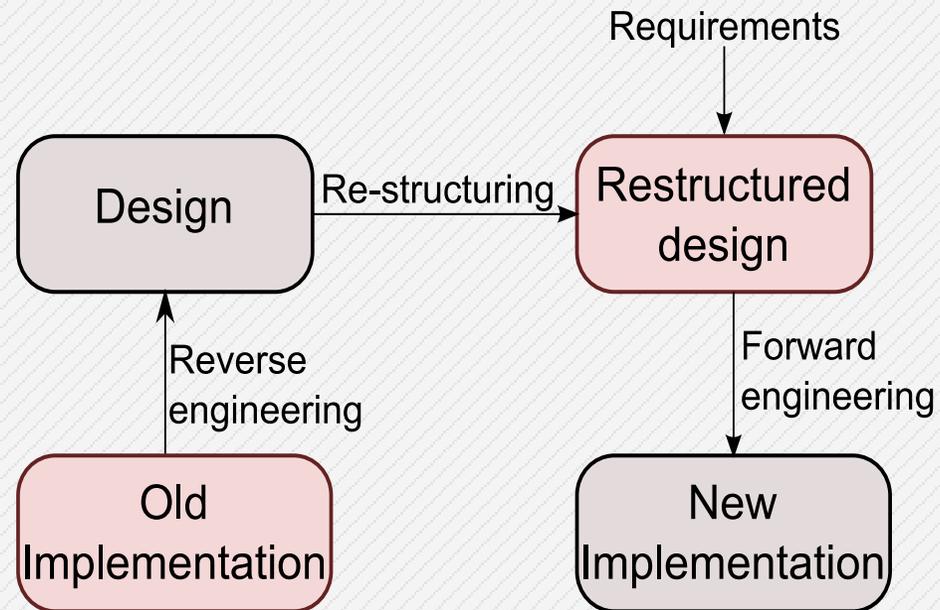
They didn't talk to each other

TraCI4Matlab

- Implementation of the TraCI protocol for Matlab based on the Python implementation.
- Approaches
 - Translate the subject implementation
 - Use an automated tool
 - Re-engineering

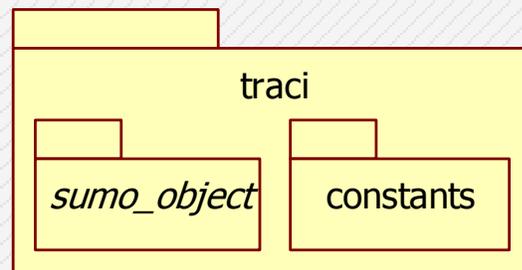
TraCI4Matlab

- Re-engineering

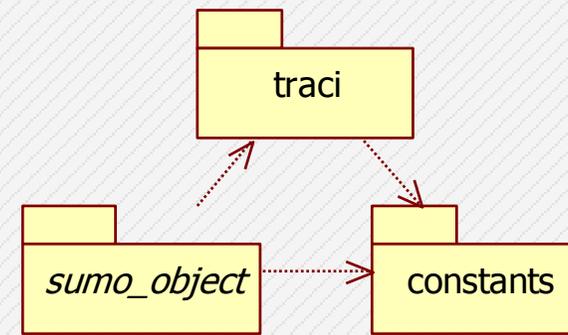


TraCI4Matlab

- Reverse engineering sub-process
 - Packages and namespaces



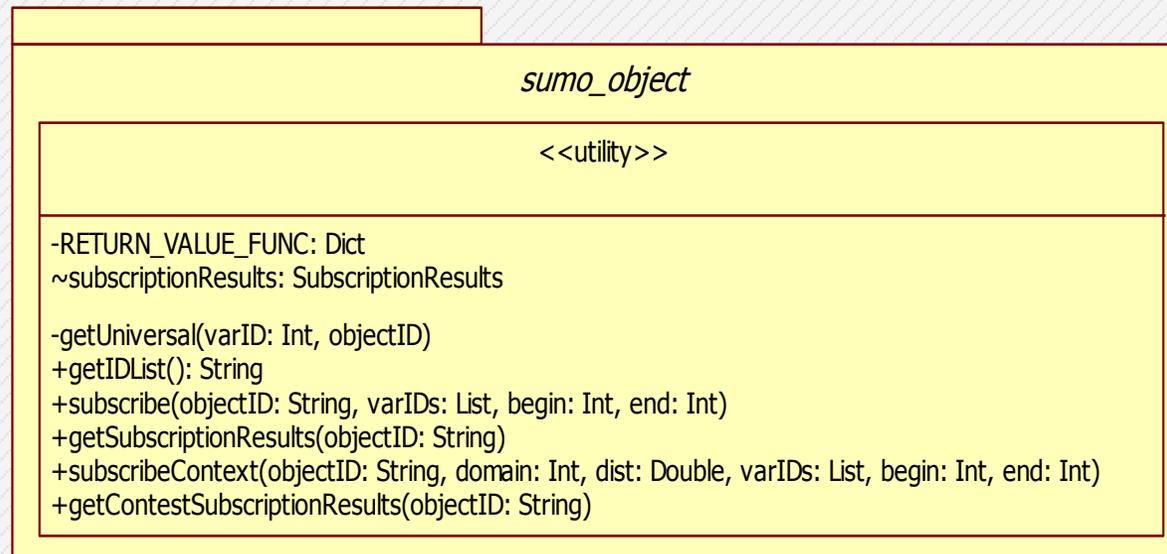
Deployment



Dependency

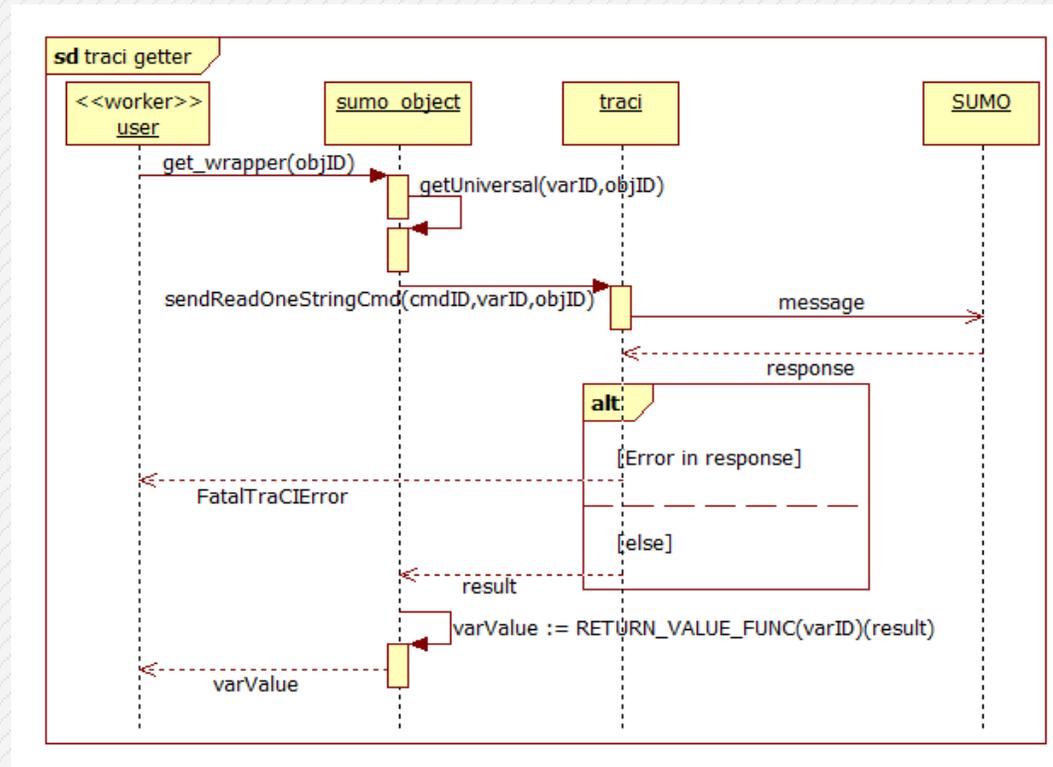
TraCI4Matlab

- Reverse engineering sub-process
 - Modules' attributes and methods



TraCI4Matlab

- Reverse engineering sub-process
 - Dynamic behavior



TraCI4Matlab

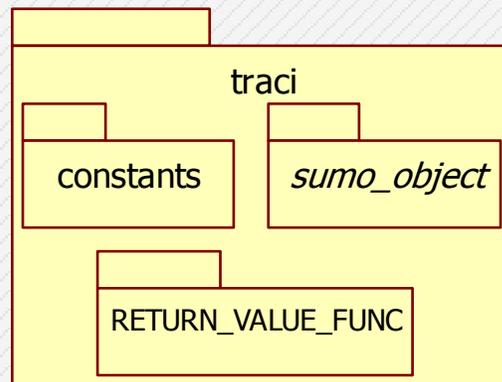
- Forward engineering sub-process
 - Problem: Differences between Python and Matlab

| Python | Matlab |
|--|--|
| Packages and modules create namespaces | Only packages create namespaces |
| Classes, functions and variables can be associated to namespaces | Only classes and functions can be associated to namespaces |

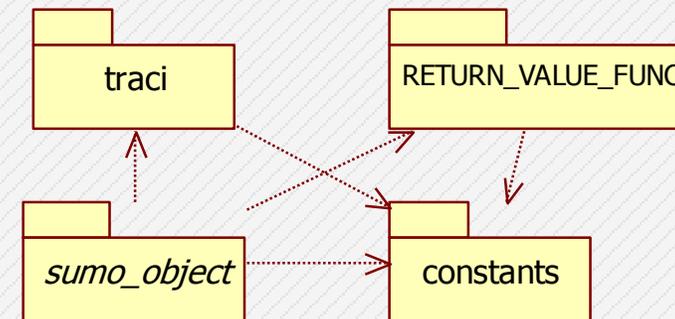
- Solution: Use global variables and a new class with constant attributes

TraCI4Matlab

- Forward engineering sub-process
 - Packages and namespaces



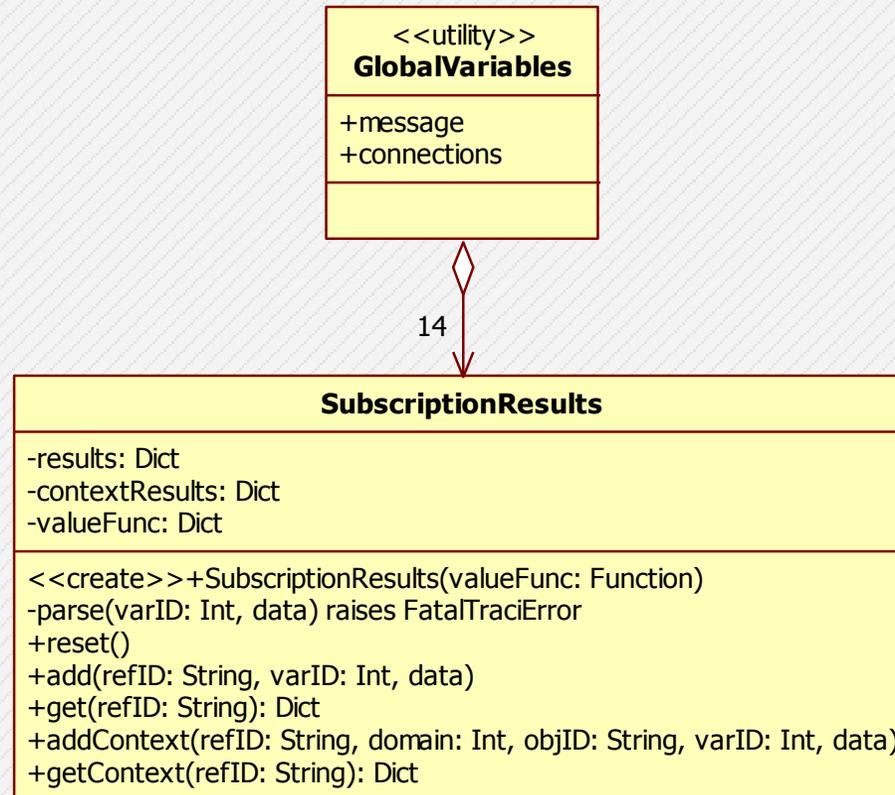
Deployment



Dependency

TraCI4Matlab

- Forward engineering sub-process
 - Global variables



Results

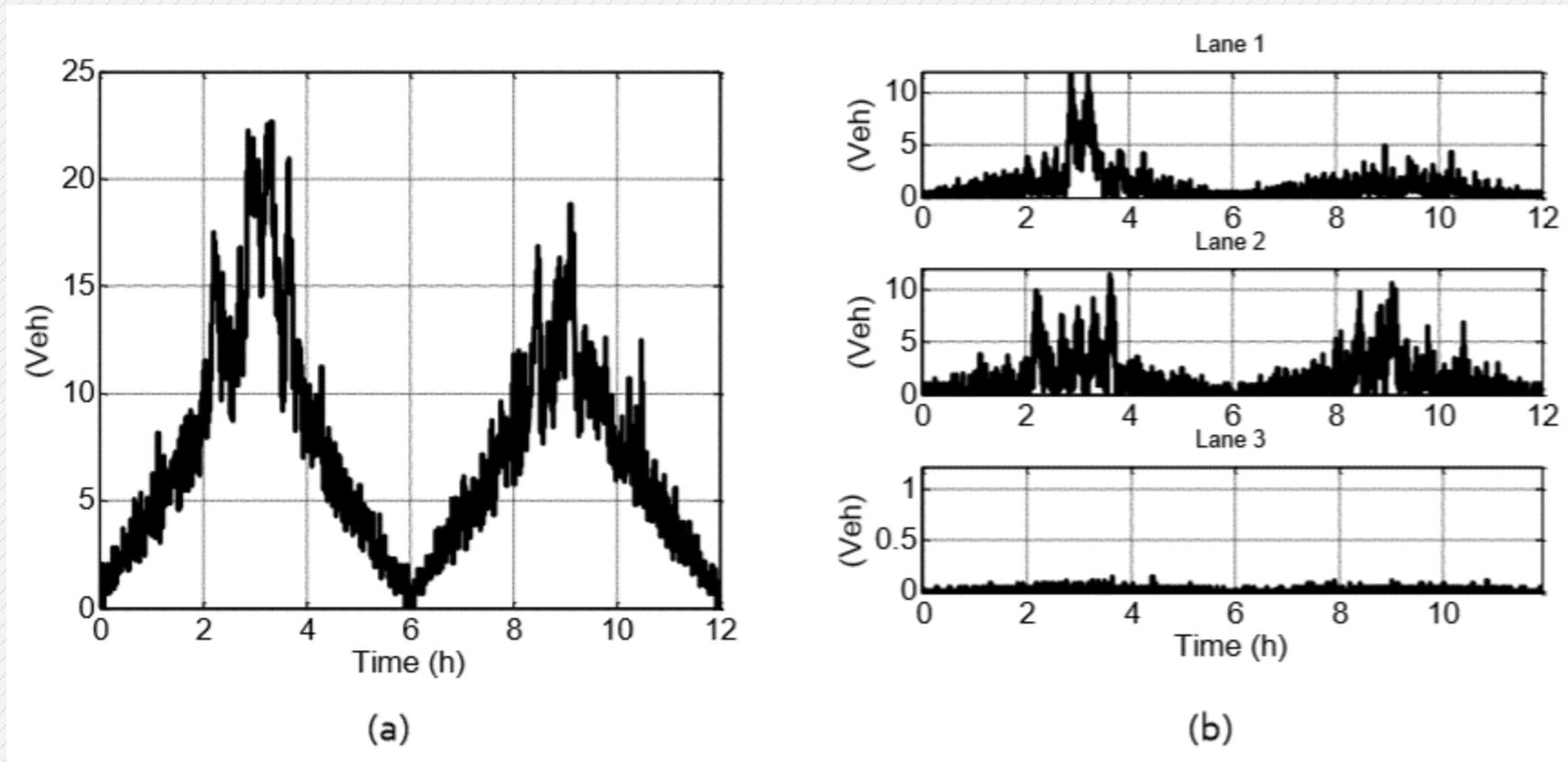
- DEMO
- TraCI4Matlab was released on 24th December of 2013 under the BSD license. It is free software and is available for the community at Matlab Central[14], or as part of the SUMO contributed tools since SUMO 0.20.0.

Results



The single intersection scenario used in the MOYCOT project to obtain parameters needed for MPC traffic lights controller.

Results



Data obtained in the north-south edge using TraCI4Matlab:

(a) Number of vehicles entering the edge, (b) Length of the queue on each lane in vehicles.

Conclusions

- We could integrate SUMO and Matlab, and perform simulations in a transparent way.
- During this process static and dynamic models related to the architectural and component design were obtained that can be used to implement TraCI in any object-oriented programming language.
- There are some performance Issues that could be study to improve time simulations evaluations.
- There were found some issues related to the socket implementation of Matlab.
- Issues related to package visibility on Matlab.

Acknowledgement

- This work was supported by Proyecto Colciencias 111856934640 contrato 941-2012: Modelamiento y Control de tráfico urbano en la ciudad de Medellín. Convocatoria 569.





© Man Bouncing Question Mark Towards Doctor - Artist: [Art Glazer](#)