Presentation to LAR

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What I'm going to say:

- Introduce myself;
- Some interesting facts;
- My past projects;
- The topic of my thesis.

Who I am?

I'm a master degree student from the **University of Padua** (Italy). I have a bachelor degree in **Information Engineering** and currently I'm studying **Automation Engineering.**

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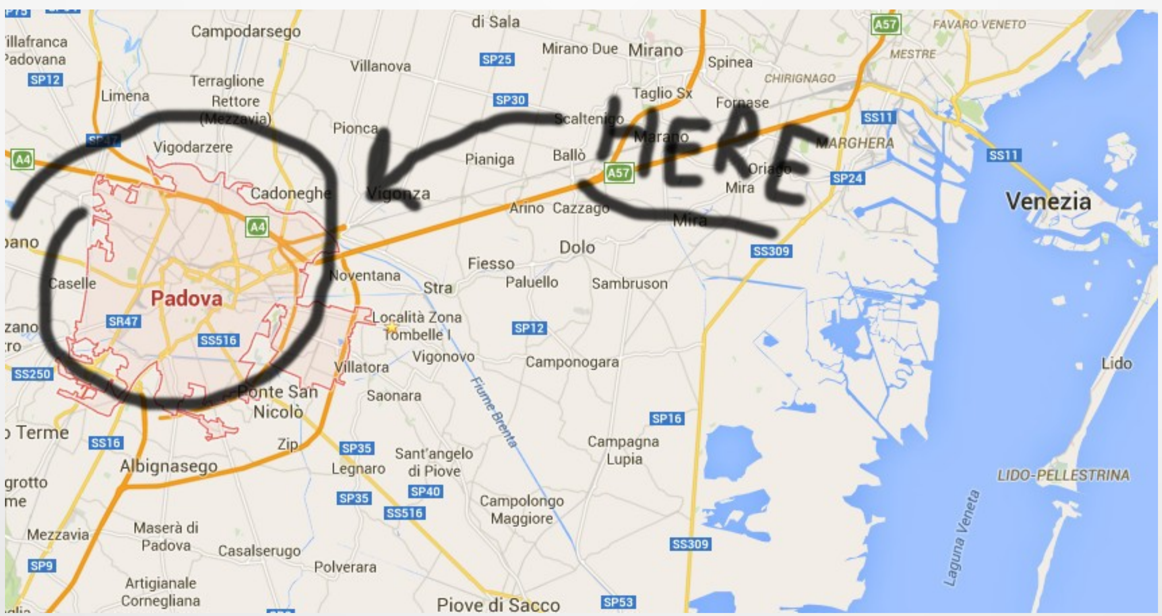
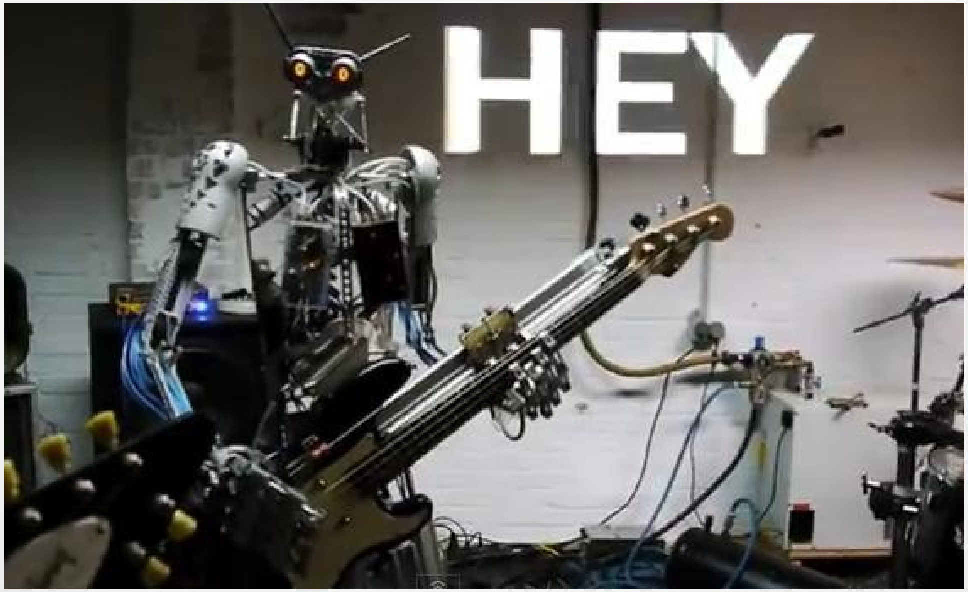


Some interesting facts

Usually, in Italy, the master degree in Automation Engineering has very **abstract** and **general** approach to the problems.

(...If we talk about metal or something similar, probably is the music genre.)



Some interesting facts

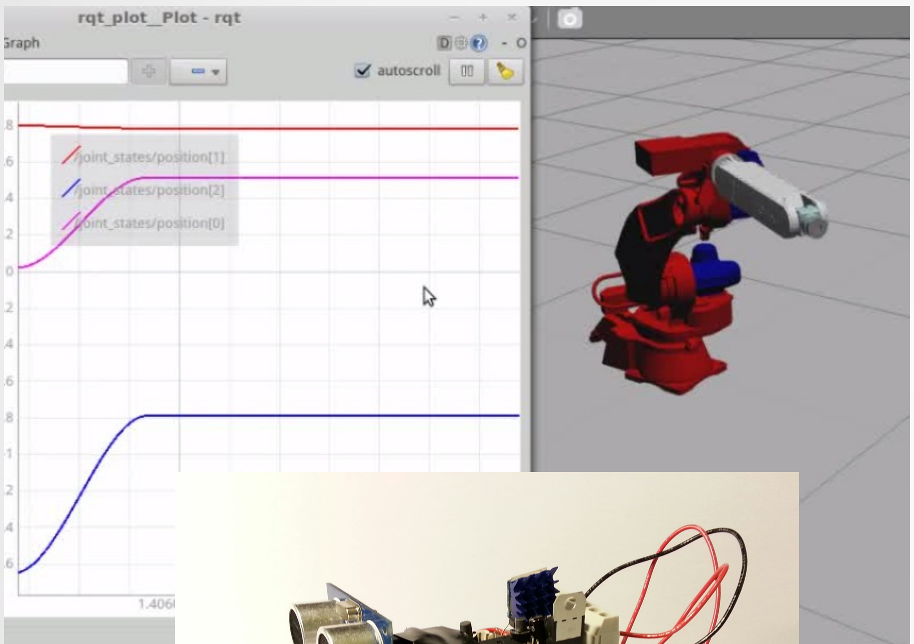
What we do is manipulate **information**.
To do that, we need a **mathematical model** (often in a state-space representation) of the system.

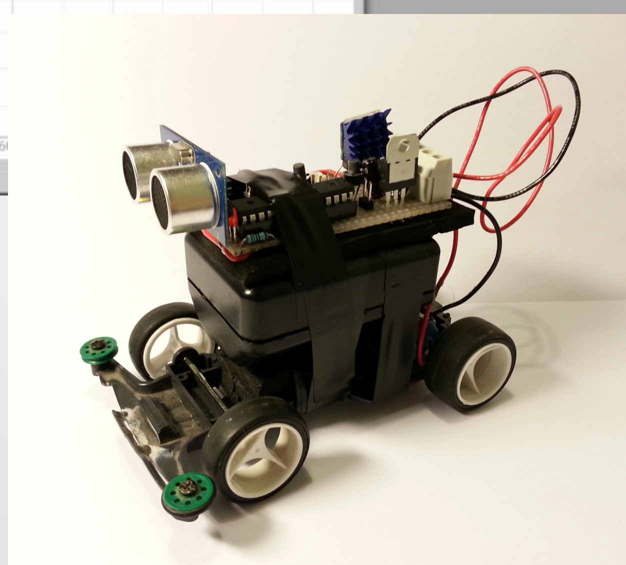
If the physical model of a system is too complex or unknown, we can create several abstract models by observing its behavior (for instance, we can choose an input and analyze the relative output).

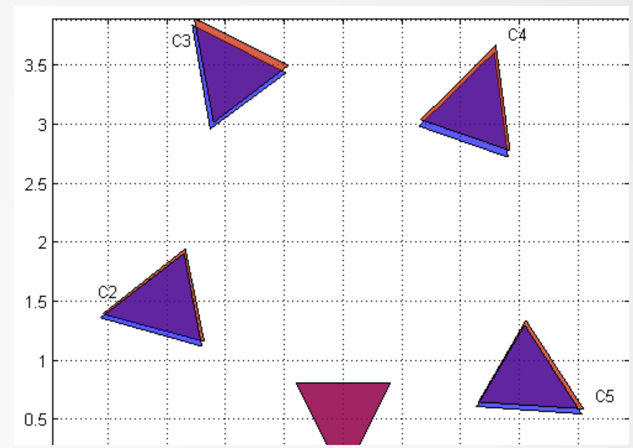
Once we got a model, we can do many things: the control, regulation, statistical estimation/filtering and so on.

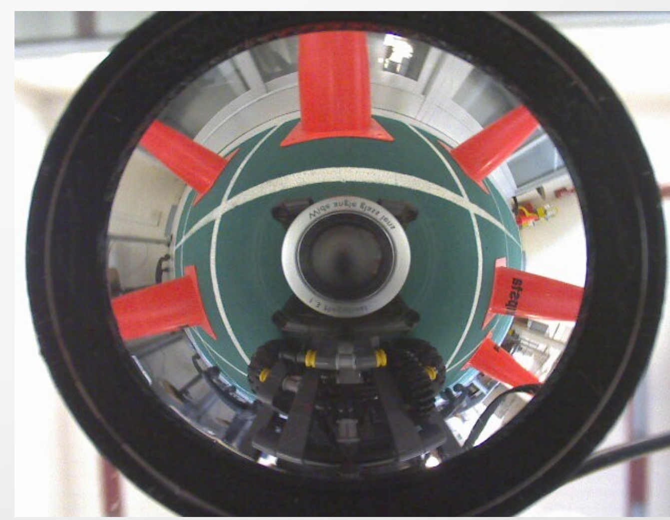
Some of my past projects

I'd like to show you some of my old projects.









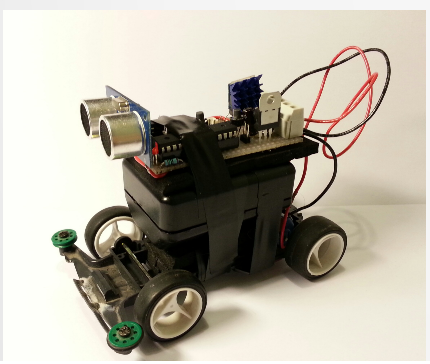
Bachelor's degree thesis

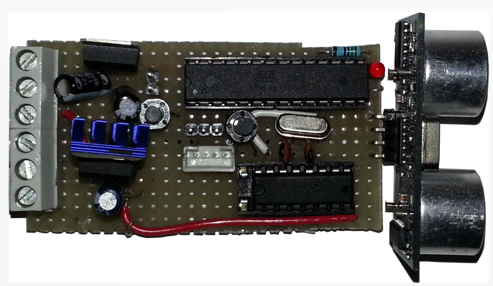
Identification and control of an electric vehicle

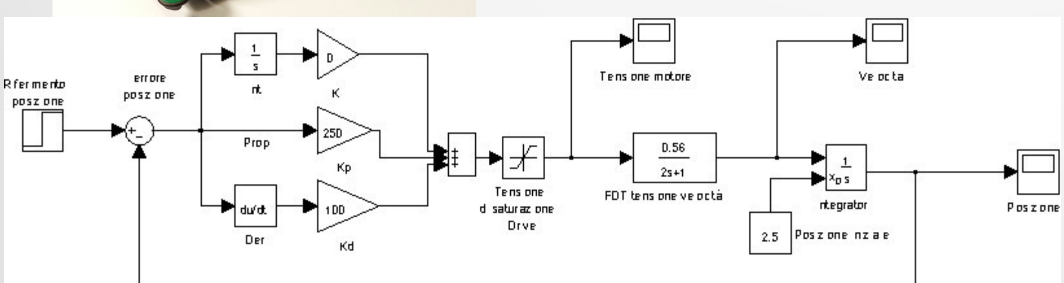
Goals:

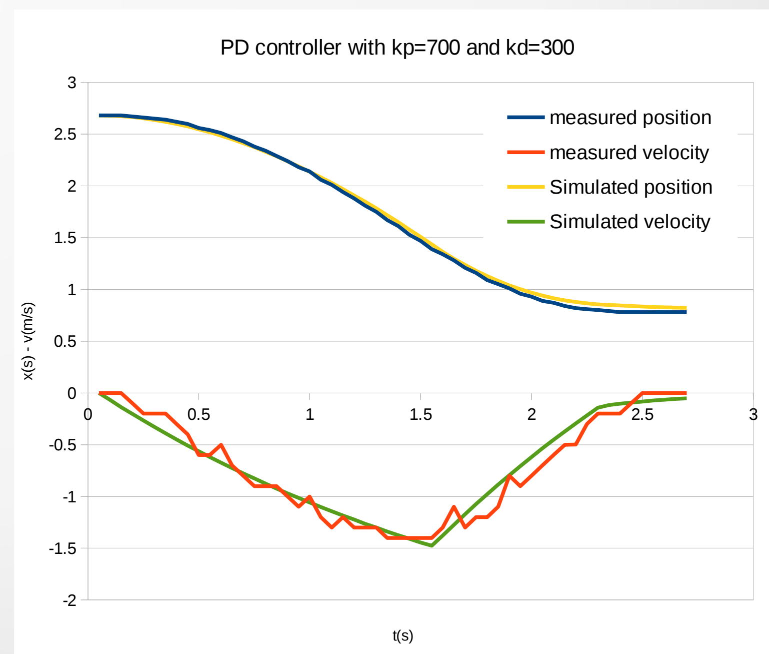
1. design an electronic board to control the vehicle;
2. identify the physical model;
3. validate the model with simulations and real tests;
4. perform the position control using a PID controller.

ARDUINO



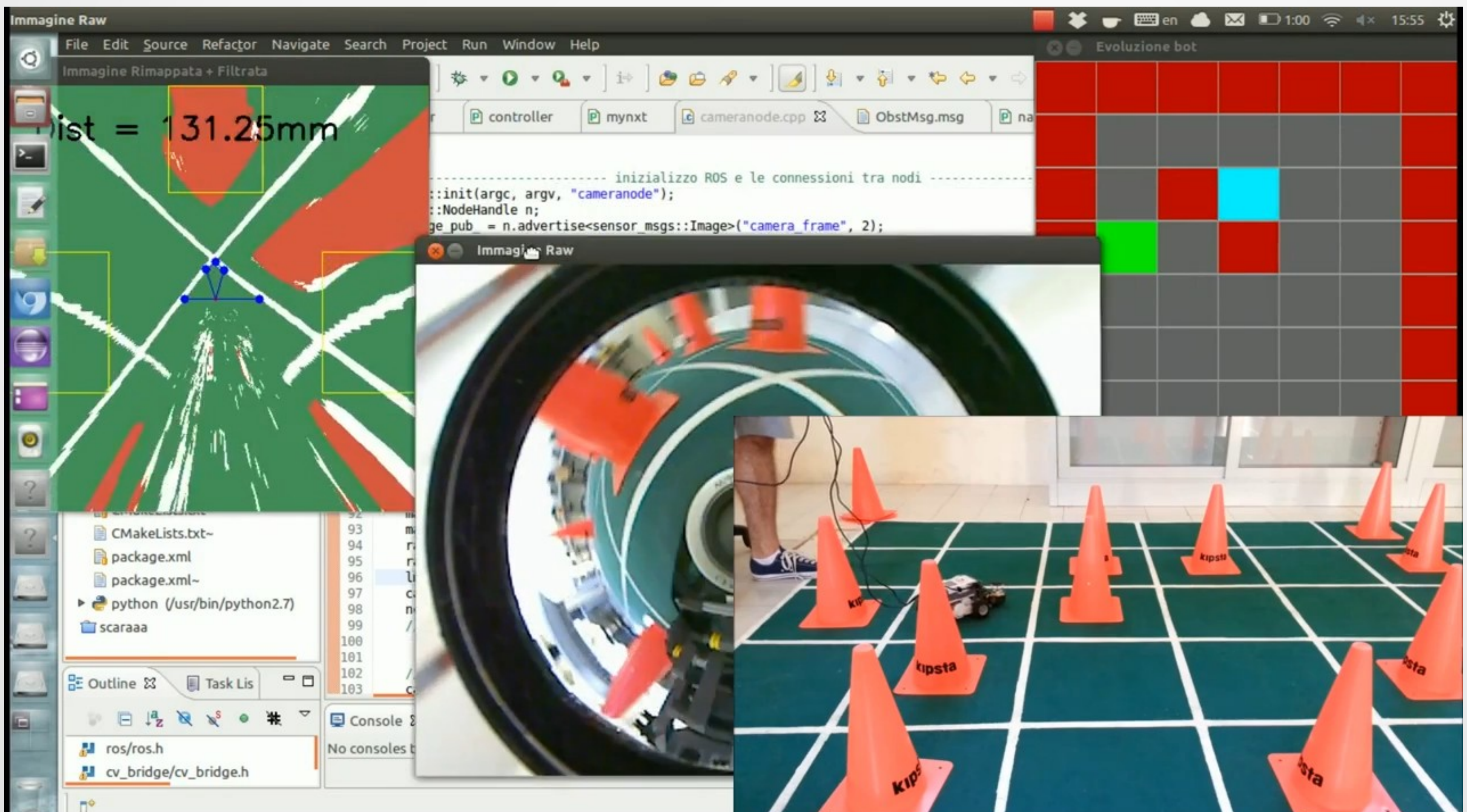






Autonomous navigation

This is a small project of autonomous navigation using an omni-directional camera.

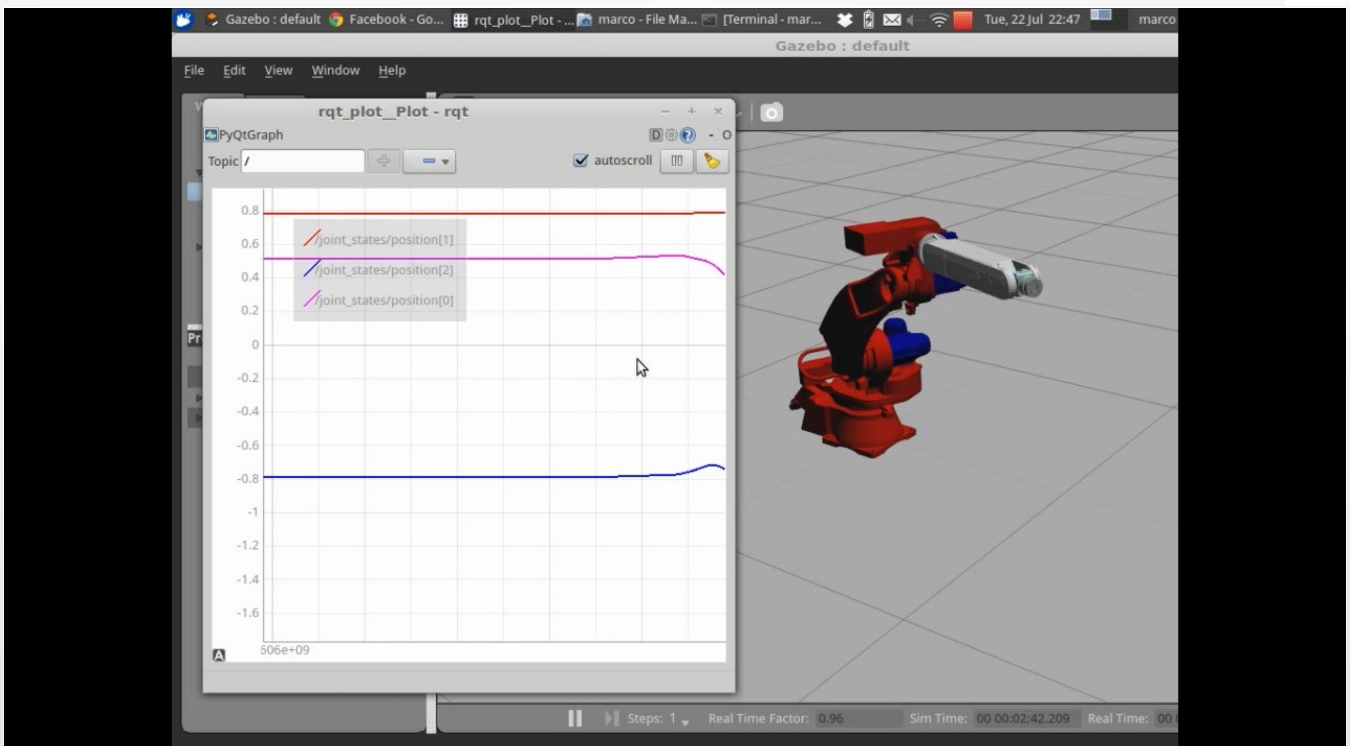


OpenCV

ROS

Control of a Comau Smart5 Six under ROS

I developed a low-level interface between **ROS** and the **C4G controller** with an ad-hoc motion controller based on cubic polynomials. The interface works in Real Time (**RTAI**) and the motion controller allows to replan the trajectory on-the-fly when the target joint positions are changed.

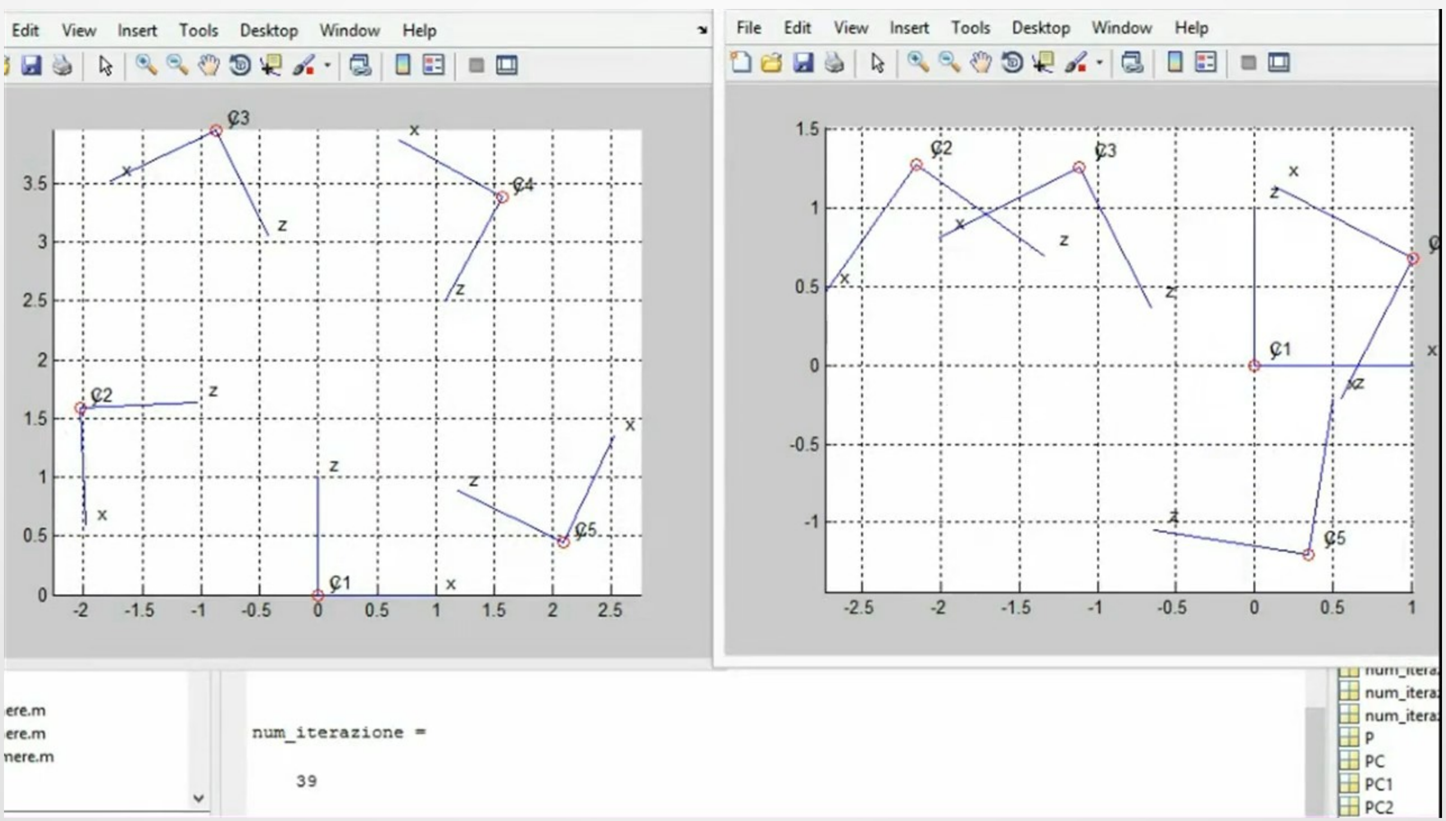


Control of a Comau Smart5 Six under ROS

With the real robot:

Distributed camera network localization

I developed an algorithm to obtain a distributed camera network **localization** in a 2D space using a ***consensus*** approach. Many communication protocols was tested (symmetric, broadcast, gossip).



The topic of my thesis

I'm going to design an **autonomous indoor navigation system** which will use visual information and **simple passive markers** to estimate the position.

I will focus the attention on the industrial environment.
In order to allow the position estimation of **AGVs** (Automatically Guided Vehicles) we can find various solutions:

- laser and special reflectors to allow triangulation;
- strict paths marked by “wires”;
- **vision-based solutions**.

Context of the problem

It is not always possible to predispose the environment to be fully robot-friendly.

But we can have some a priori information of the environment (**map**, the position of some **passive markers**, ...).

We can use **vision** with one or more cameras to detect these markers. This approach is **cheap** and becomes appealing, despite the expected higher complexity of algorithms, and it can be very **reliable**.

Proposed solution

The idea is to use simple passive markers (like **datamatrix** codes) placed in the environment as beacons.

The markers must be easy to **place** and to **detect** in images.

Develop algorithms to perform robot **localization** based on the **visual information** and estimation techniques for enhanced robustness (such as **Kalman Filters**).

The estimation can also takes advantages of the presence of an **inertial sensor**.

Implement some appropriate **path planning** techniques to go from one point to another.

Perform robot **motion control** along the planned path.

Phases and objectives (1/2)

- Create the state of the art for this problem and associated techniques, and get acquainted with the existing setup and previous related works;
- prepare the ATLAS-MV robot to act as a AGV in a indoor environment;
- test the algorithm used to detect datamatrix codes, and improve it to determine not only the angles used in the triangulation process but also other geometric information to improve the accuracy of the estimation;
- study the possibility of integrating a simple obstacle detection system;

Phases and objectives (2/2)

- include the physical model of the robot motion (and possibily perception) in a Kalman filter in order to reduce the effect of the noise in the localization procedure;
- integrate a proper path planner to permit the execution of the task;
- implement an application with a proper GUI to generate interactively the datamatrix beacons;
- write the thesis and other documentation.

Thank you for your attention.