Piattaforma Low Cost per la simulazione Scale Electric Vehicle Intelligente

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http://cicei.ulpgc.es/aseimov

Context

- Energy Crisis
- Environmental Crisis
- Economic Crisis

Key elements

- Mobility
- Road Safety

Doble target: Sustainability and Efficiency

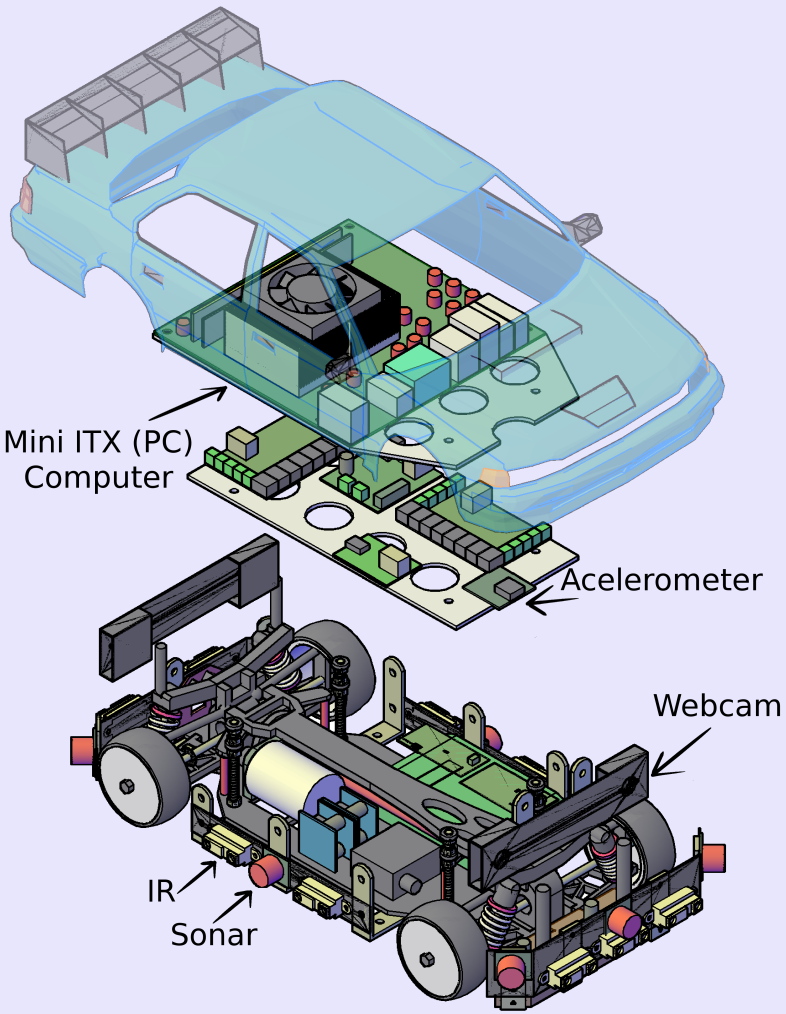
Optimization of Current Traffic Infrastructure

- More efficient Networks: The Maximum load on the network, the average time for trajectories, etc..
- Environmental Impact Reduction: Reducing Emission, Noise Pollution, ...
- Security Traffic Networks

Electric and Intelligent Mobility

- More Efficient and safer Vehicles (Energy Consumption, Emissions Reduction, Noise Pollution)
- More Efficient Use of Traffic Network (Platoon Driving, ...)
- Robotic platform for testing vehicle behaviours in the laboratory
- Intermediate stage between virtual simulation and real simulation

Autonomous Scaled Electric Intelligent MOnitored Vehicle

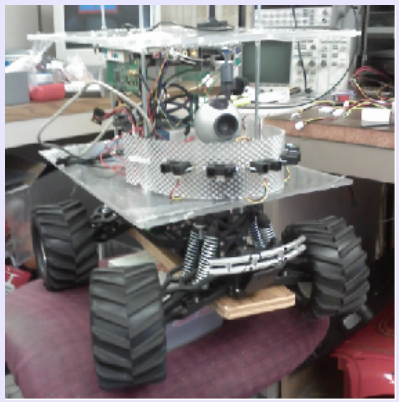


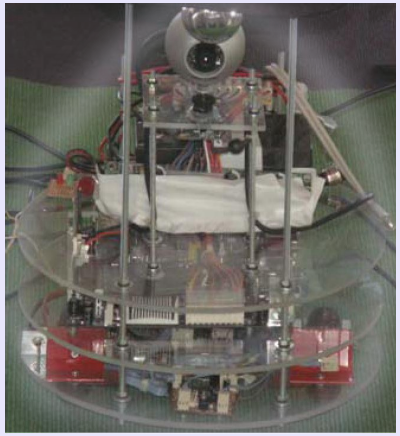
- ASEIMOV: RC car 1:10, Linux/PC and robotic devices.
- Low Cost. More researchers can join in this area.
- Free Software. GPL Licence. `http://cicei.ulpgc.es/aseimov/`
- OFF-THE-SHELF devices.
- An accurate scale model (Mass balance, Adaptative Control longitudinal and lateral) $\Rightarrow$ we would test smart vehicle solutions. Research in ITS.
- Future step: To implement the best solutions in real intelligent car

General Restrictions

- Space
  - Scale 1:10
  - Phisical size is limited
- Budget
  - Other research groups can build this model
  - Low Cost VS technological limitation – flexibility
- Autonomy
  - All devices should work at the same time.
  - low-power devices.

Dreambot, nightmare, etc





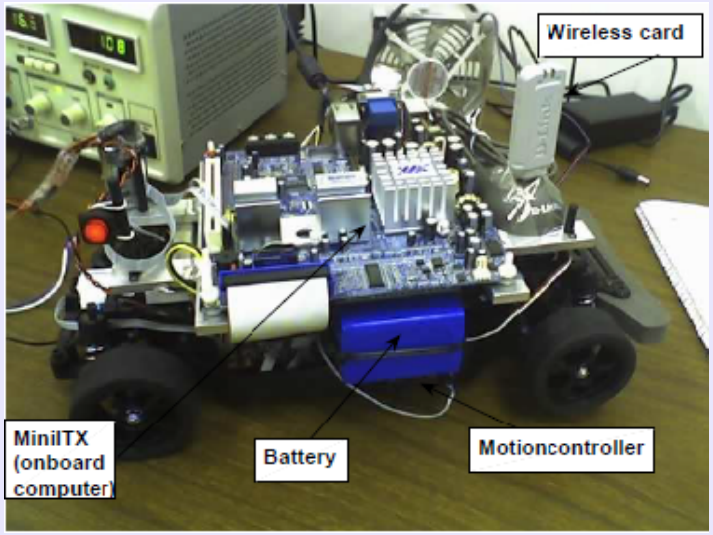
- Experimental Platform
- PC standar
- Software - Linux
- Scale 1:10
- Proximity sensors and cameras

Robocar Z

- Summer 2009 by Japanese Company
- Scaled Vehicle to test Intelligent Driver Solutions
- 8 IR, 3 accelerometers, 1 gyroscope, 1 laser, 2 VGA cameras (optional).
- Useful for research and modern technologies
- 5000€: no cameras or bodywork

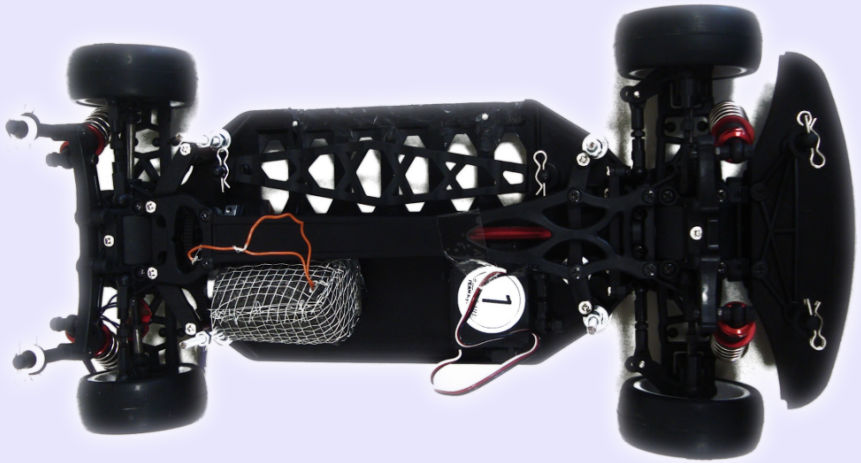
Model from University of Michigan

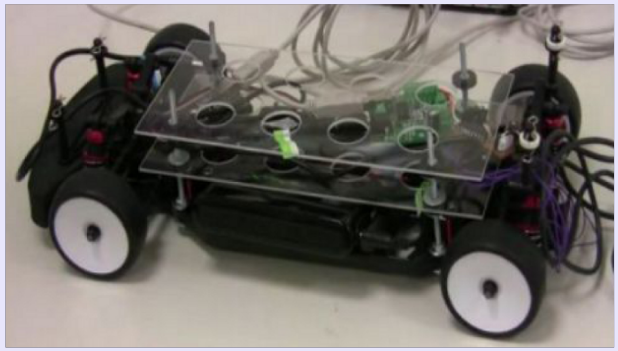
- Experimental Model
- PC standar
- Software Linux.
- Scaled 1:12
- sensors Off-the-shelf



Chassis

- Requirements
  - We need free space in order to add whatever we would like.

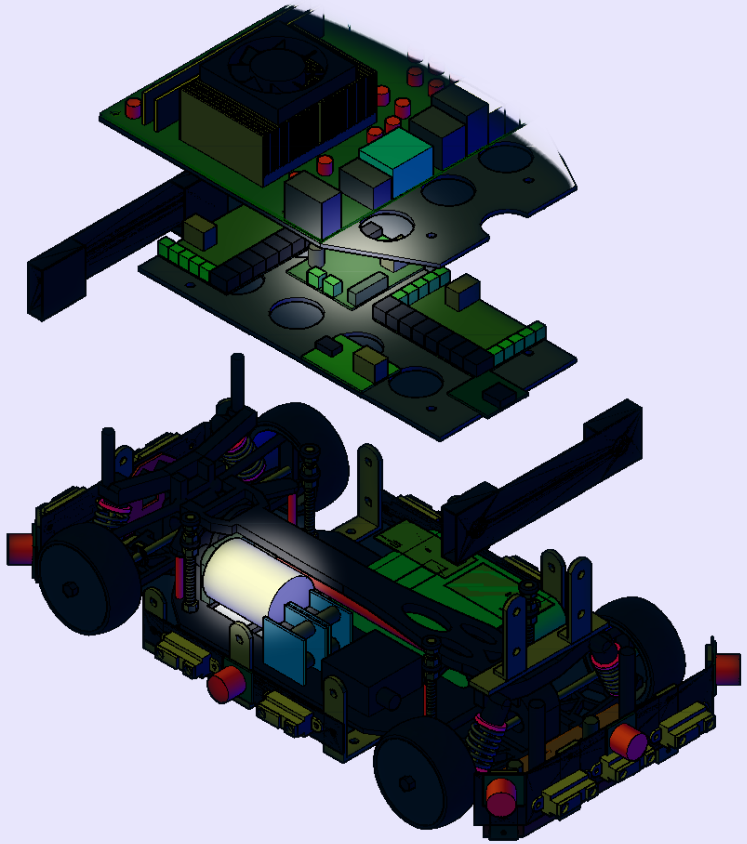




- Solution
  - We have installed 2 shelves. We have got 3 free levels.

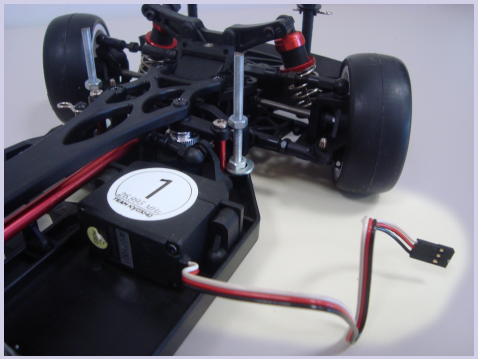
locomotion

- DC Motor
  - Torque and speed
  - Size motor adaptable to chassis size
- Controller board
  - It limits the power to the motor.
  - Speed, acceleration and direction control.

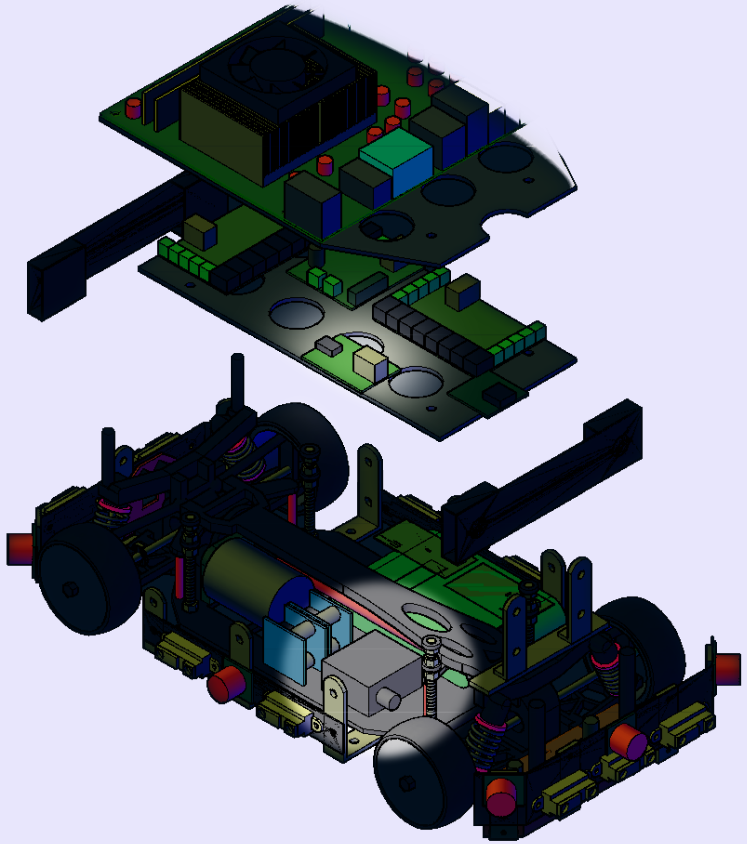


locomotion

- Servomotor
  - Steering of the front wheels



- Controller board



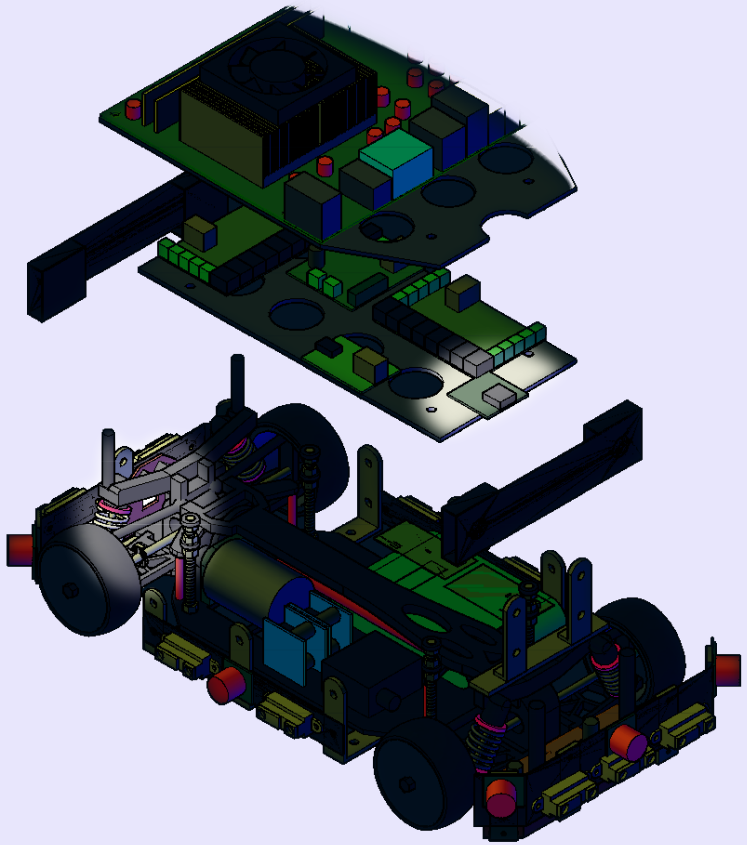
Odometry (positioning)

Accelerometer, Gyroscope, Compass

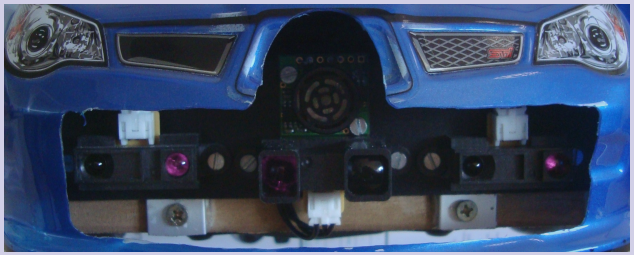
- Acceleration, gyro and compass data in the three orthogonal axes
- Integrated acceleration: speed and position

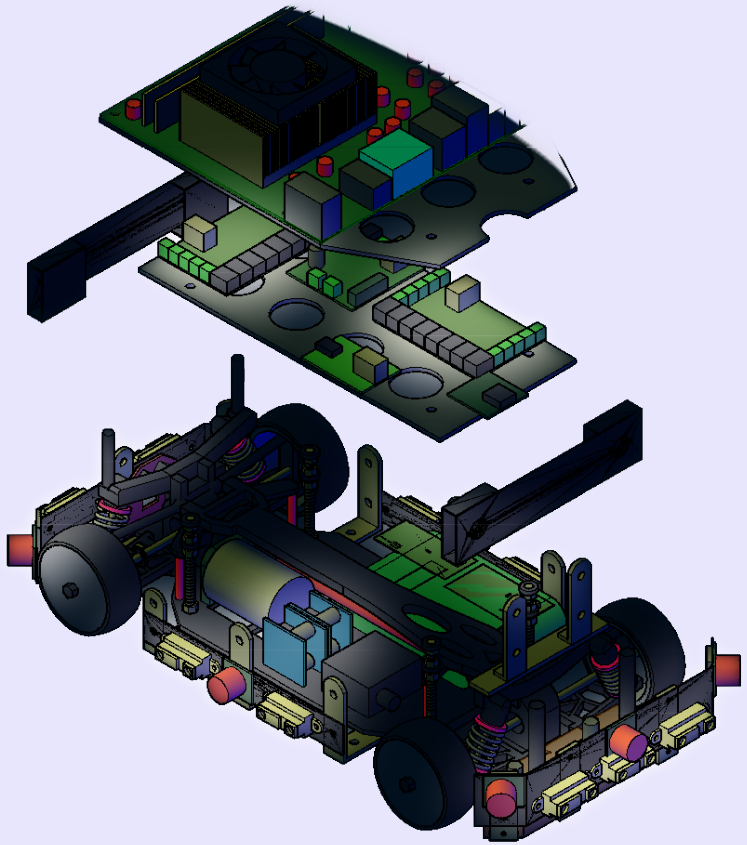
Speed encoder

- Low Cost: we have taken advantage of an old ball mouse
- It has been installed in rear axle



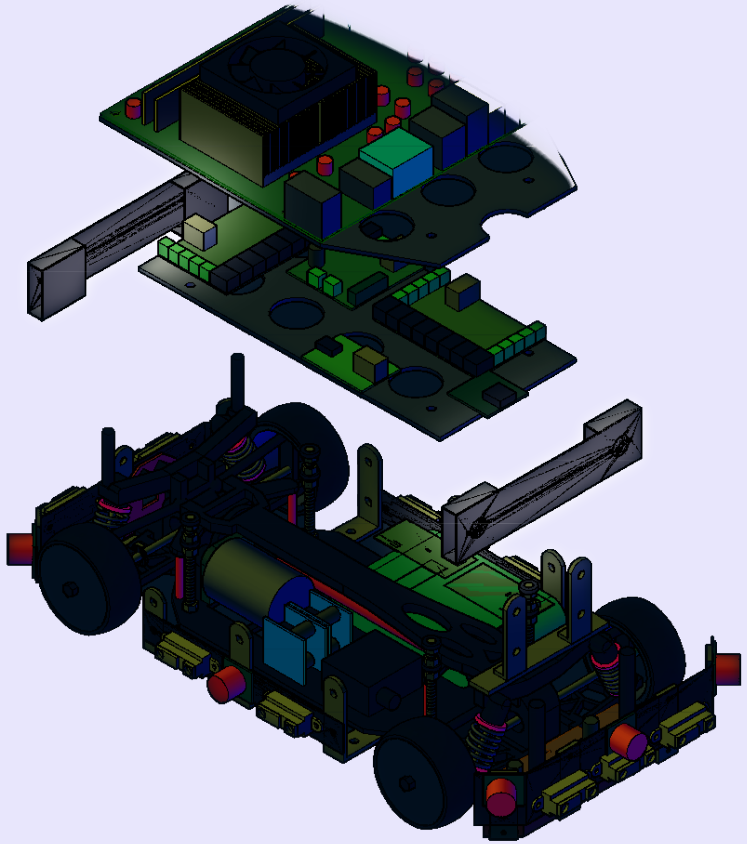
- 7 sonars sensor, 9 IR sensor and 2 data acquisition boards
- Introduce the concept of safety bubble

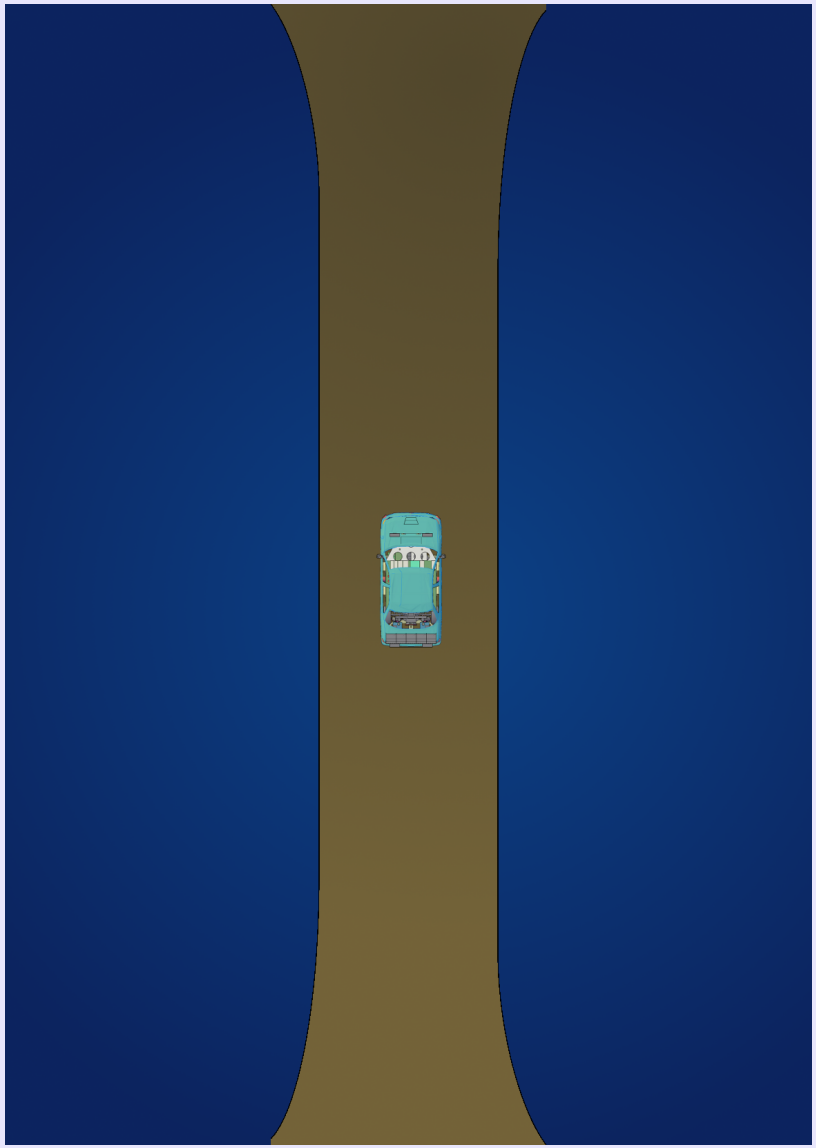


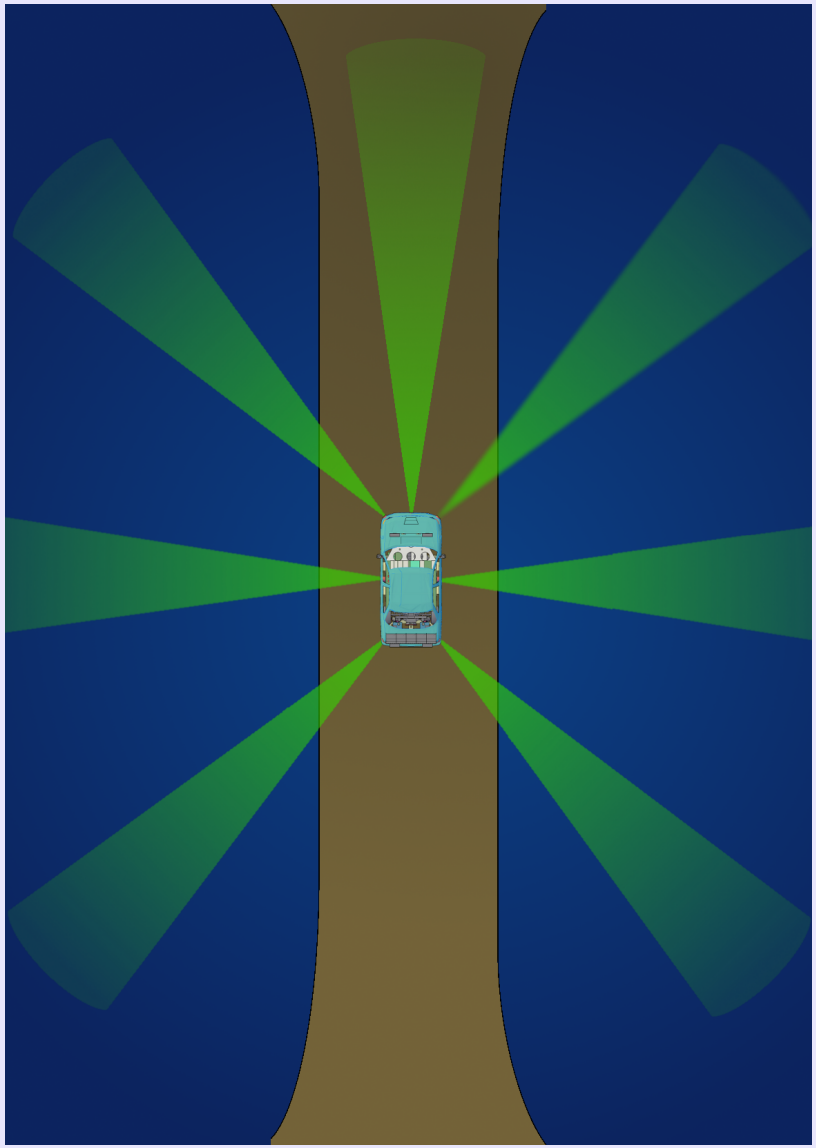


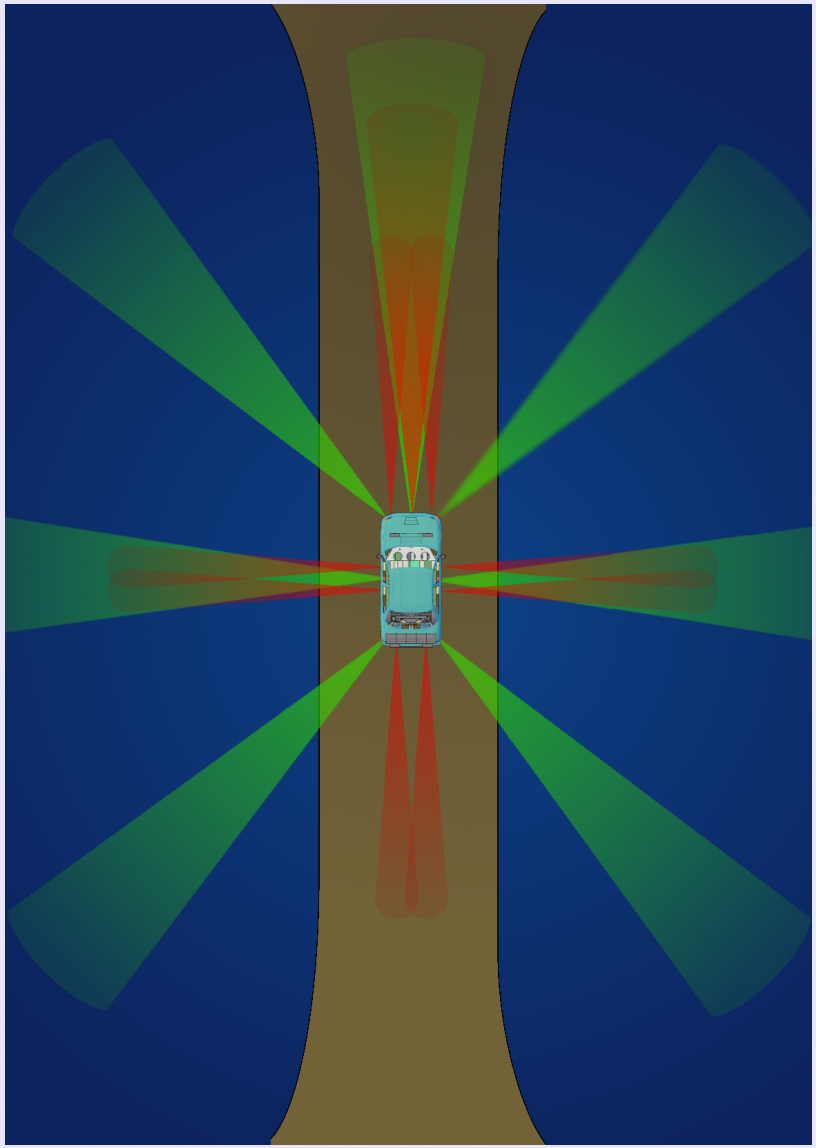
- 4 webcams: two in the front and two in the rear of the car.

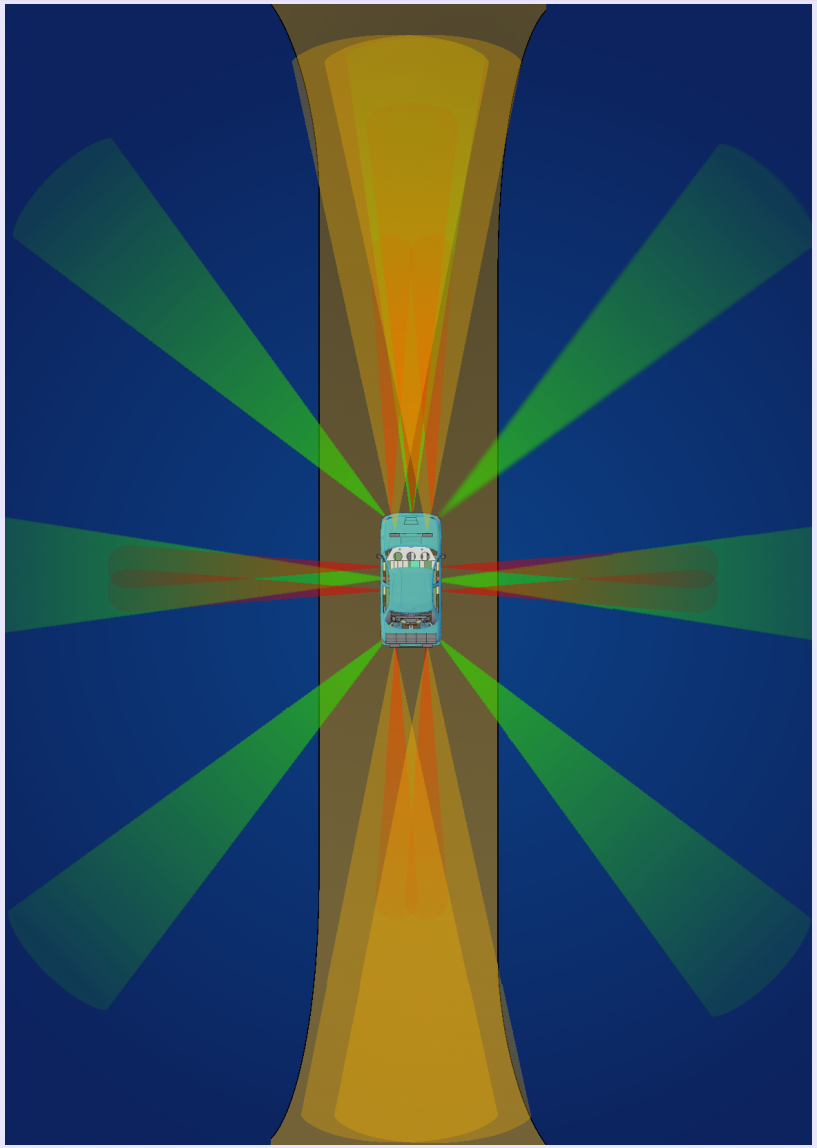
- 352 x 288 px. 6-7 FPS
- Target: to get stereoscopic vision for future applications



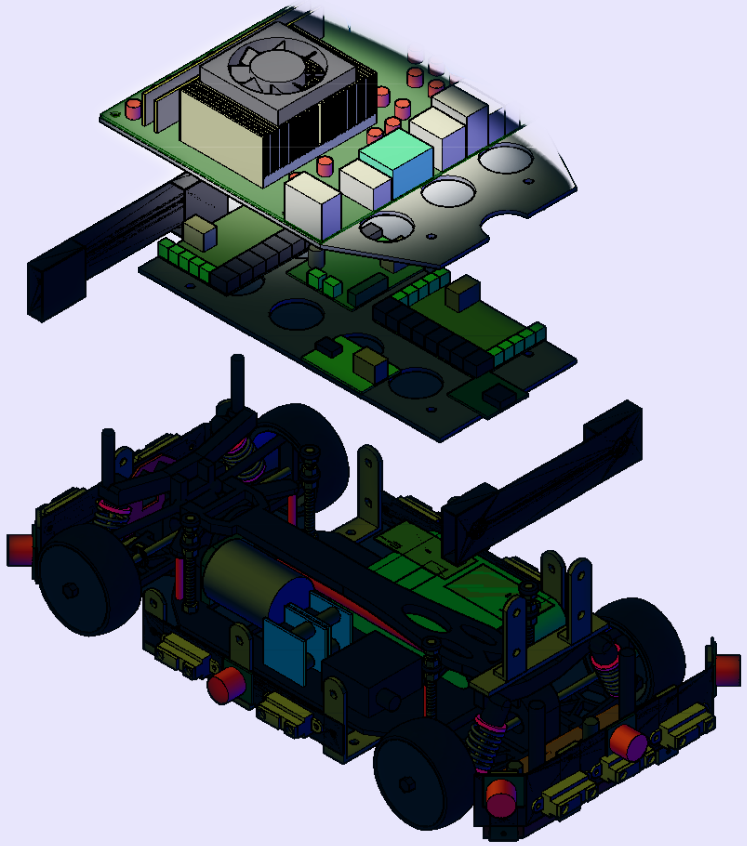








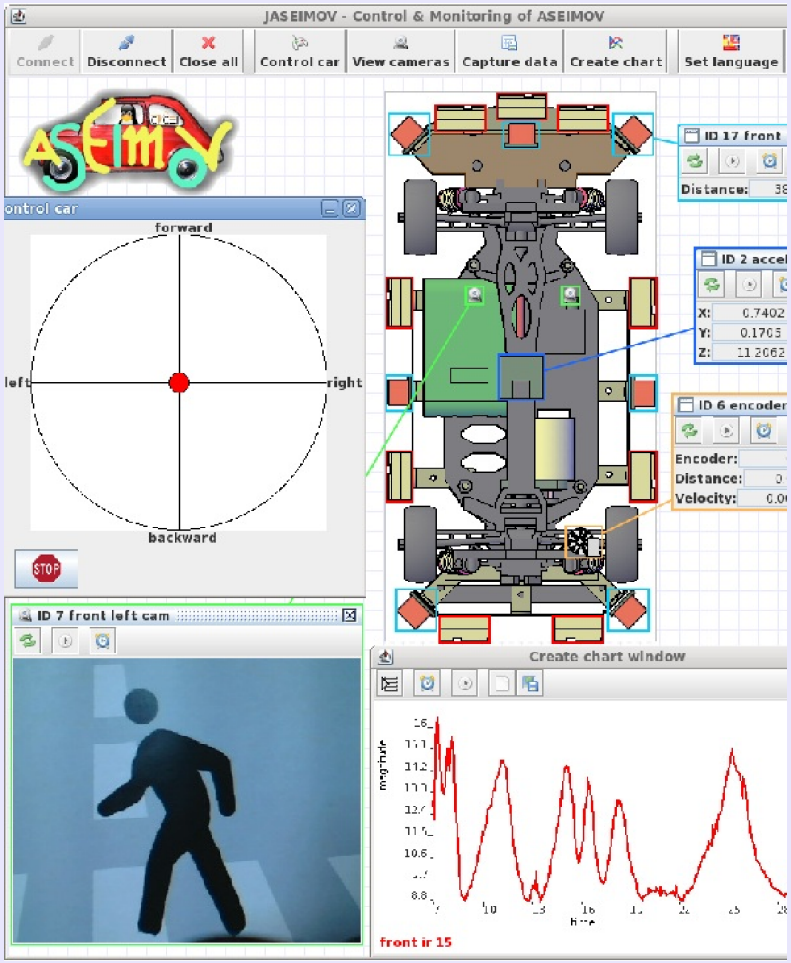
- We have designed a Free Software with GPL licence in order to control and monitor the vehicle, Java application.
- Distribution: Linux – Debian.



Autonomy

$50\ min \pm 5\ min$

Demonstration and Automatic detection



Acceleration and Deceleration Reference Curves

Figure: Reference Longitudinal Curve from Real Electric Car

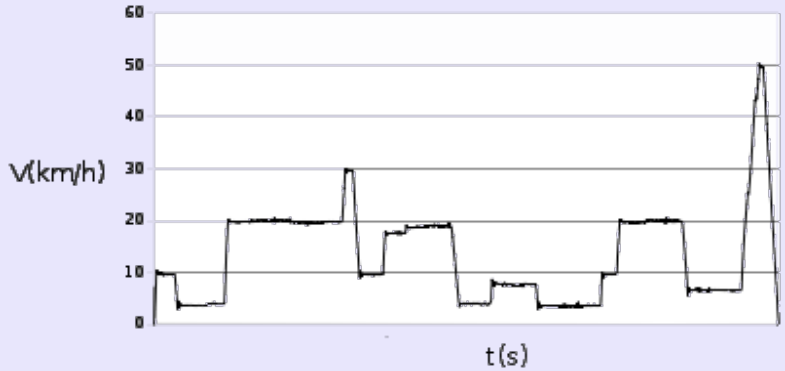
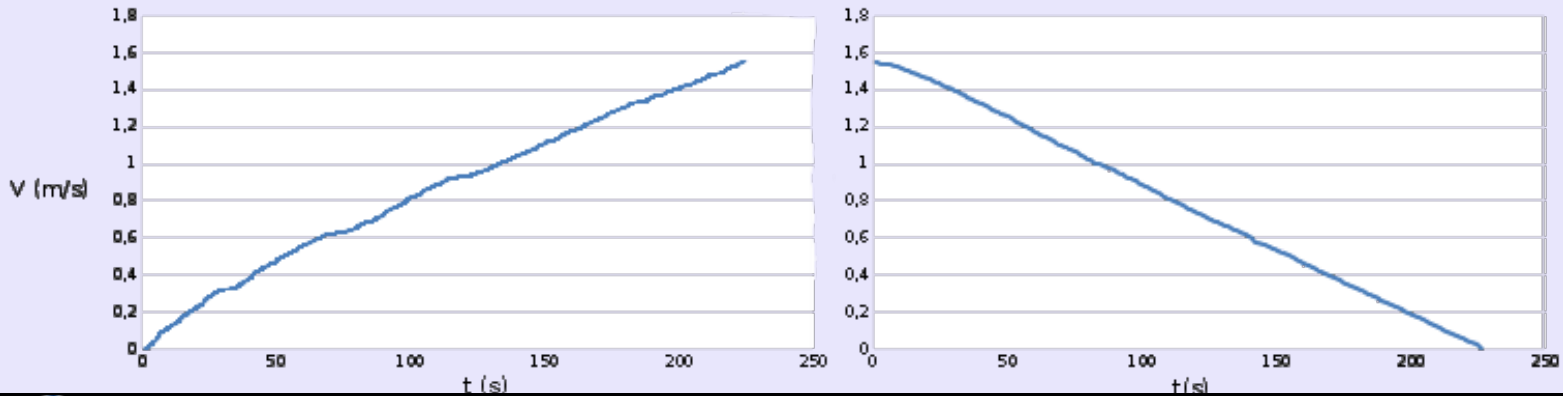
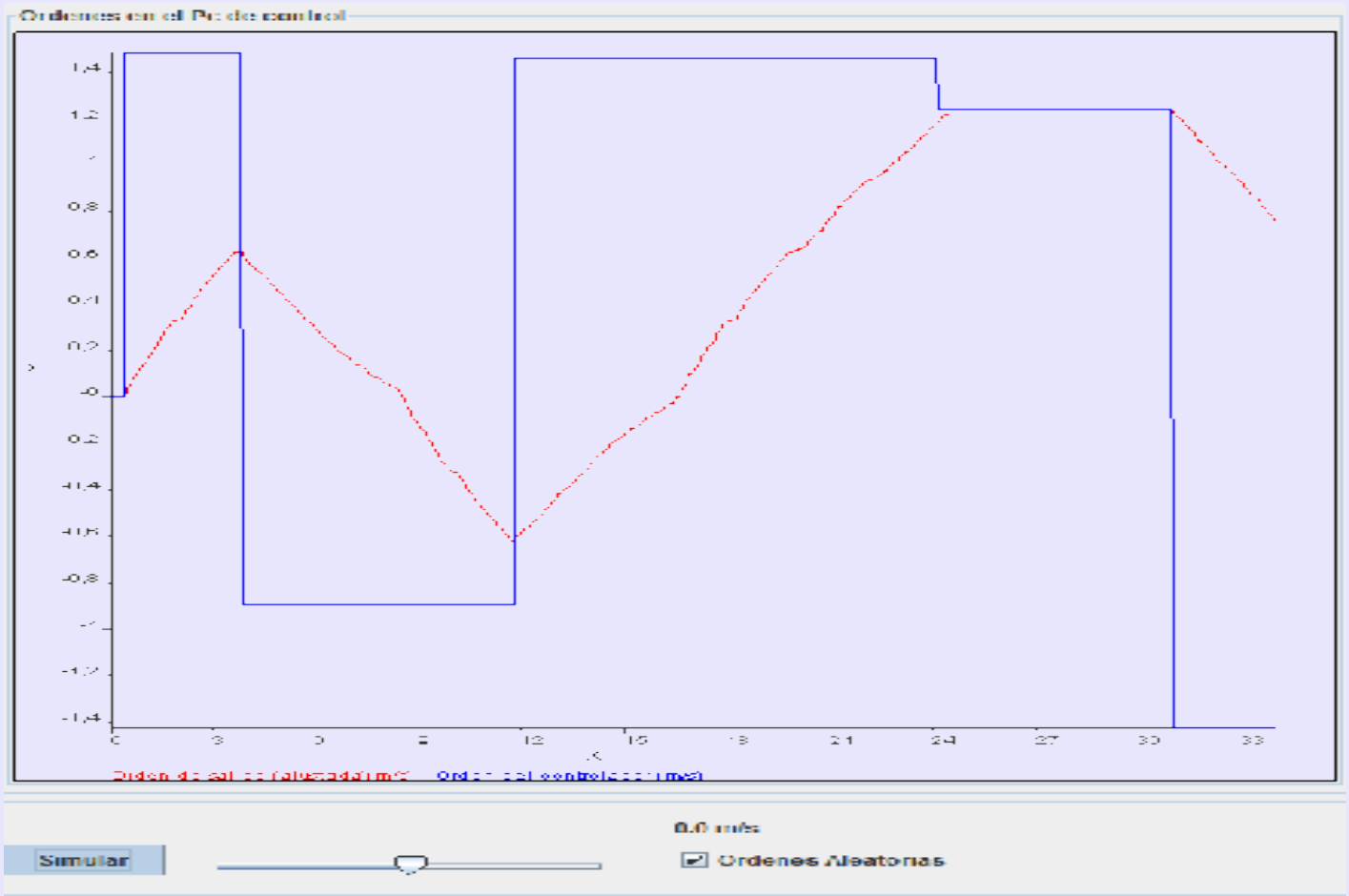


Figure: Acceleration and Deceleration Reference Curves



Result from Adaptative longitudinal Control



Adaptative longitudinal Control

Conclusions

- New model of experimentation platform on Intelligent Vehicles: ASEIMOV
- We could test ITS solutions without high cost and risk.
- To test the best solutions in real intelligent cars.
- Low cost model, easily reproduce without huge budgets.
- Flexible model controlled by Linux. Other devices can be installed.

Future Plans

- There is much work to do.
- Define the safety bubble we can use.
- Study the vehicle positioning by combination of speed encoder and the accelerometer.
- Explore intelligent vehicle applications, i.e. a cluster of ASEIMOV units.

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The End

Grazie Mille

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