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CSBC2015

De 20 a 23 de julho de 2015.

XXXV CONGRESSO DA SOCIEDADE BRASILEIRA DE COMPUTAÇÃO

a internet de tudo, toda observada

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Simulação de Robôs Móveis e Articulados: Aplicações e Prática

Fernando Santos Osório
Rafael Alceste Berri

Simulação de Robôs Móveis e Articulados

Fernando Santos Osório
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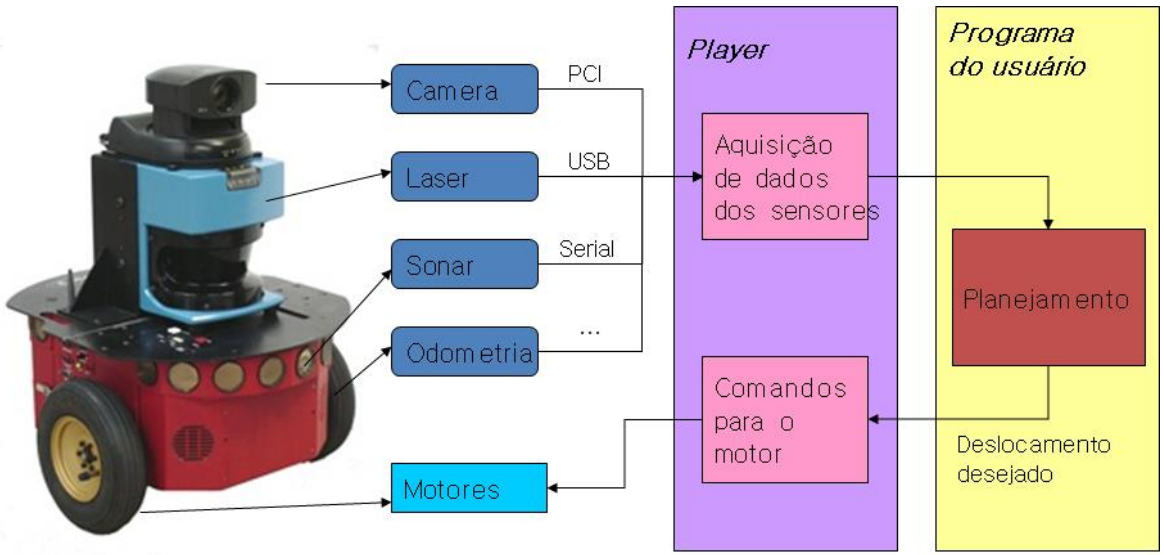
Ambientes de Software: Aplicações Robóticas

- Middleware: Acesso aos Dispositivos de Hardware

  Atuadores e Sensores => Ex. PLAYER/STAGE [2000-2010]



https://en.wikipedia.org/wiki/Player_Project

Player Software

2010

Player

Home
Wiki

Software
Player
Stage
Gazebo
Extensions

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Player

Cross-platform robot device interface & server

About Player

Player is a network server for robot control. Running on your robot, Player provides a clean and simple interface to the robot's sensors and actuators over the IP network. Your client program talks to Player over a TCP socket, reading data from sensors, writing commmands to actuators, and configuring devices on the fly.

Player supports a variety of robot hardware. The original Player platform is the ActivMedia Pioneer 2 family, but several other robots and many common sensors are supported. Player's modular architecture makes it easy to add support for new hardware, and an active user/developer community contributes new drivers.

Player runs on Linux (PC and embedded), Solaris and *BSD.

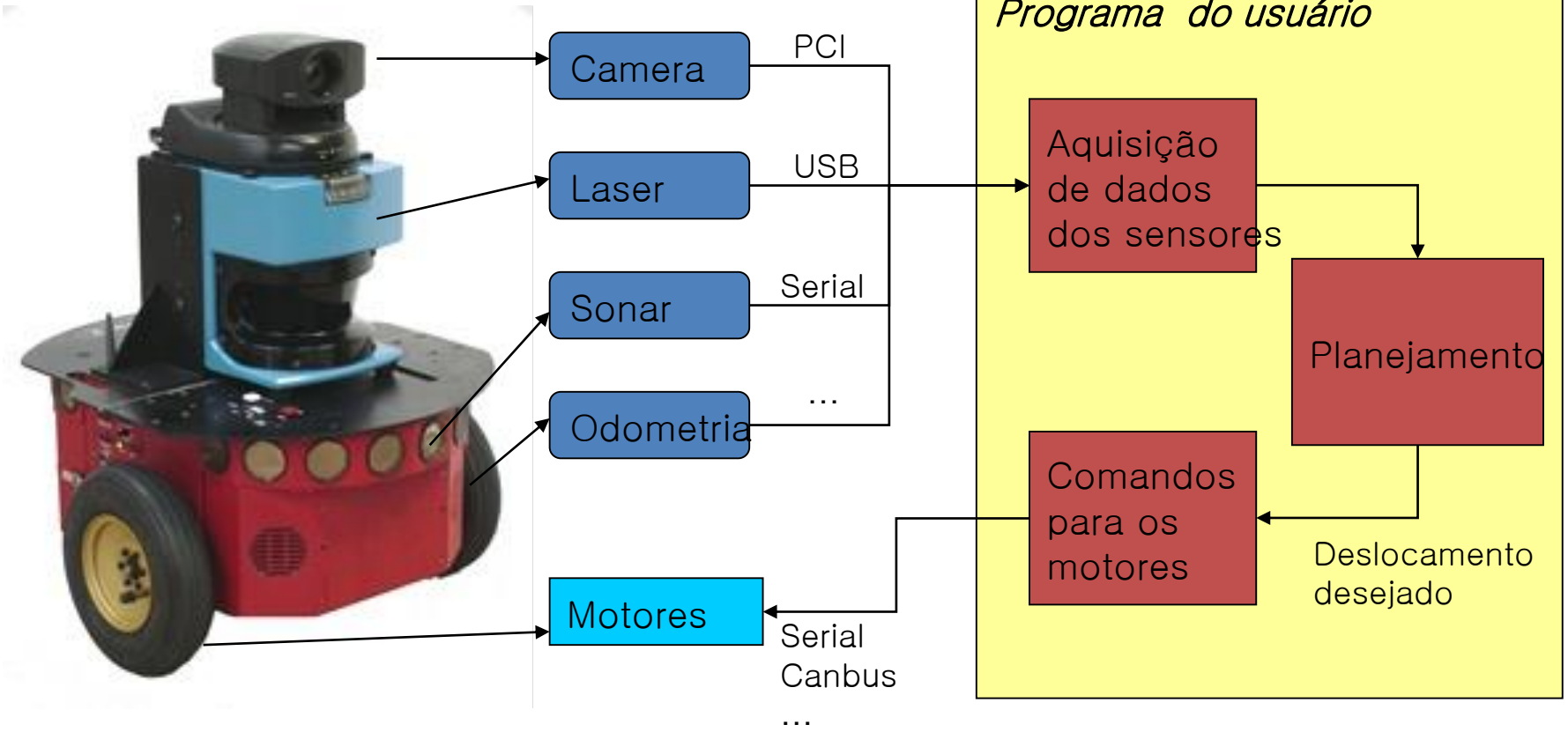
Features of Player

Player is designed to be language and platform independent. Your client program can run on any machine that has a network connection to your robot, and it can be written in any language that supports TCP sockets. We currently have client-side utilities available in C++, Tcl, Java, and Python. Further, Player makes no assumptions about how you might want to structure your robot control programs. In this way, it is much more "minimal" than other robot interfaces. If you want your client to be a highly concurrent multi-threaded program, write it like that. If you like a simple read-think-act loop, do that. If you like to control your robot interactively, try our Tcl client (or write your own client utilities in your favorite interactive language).

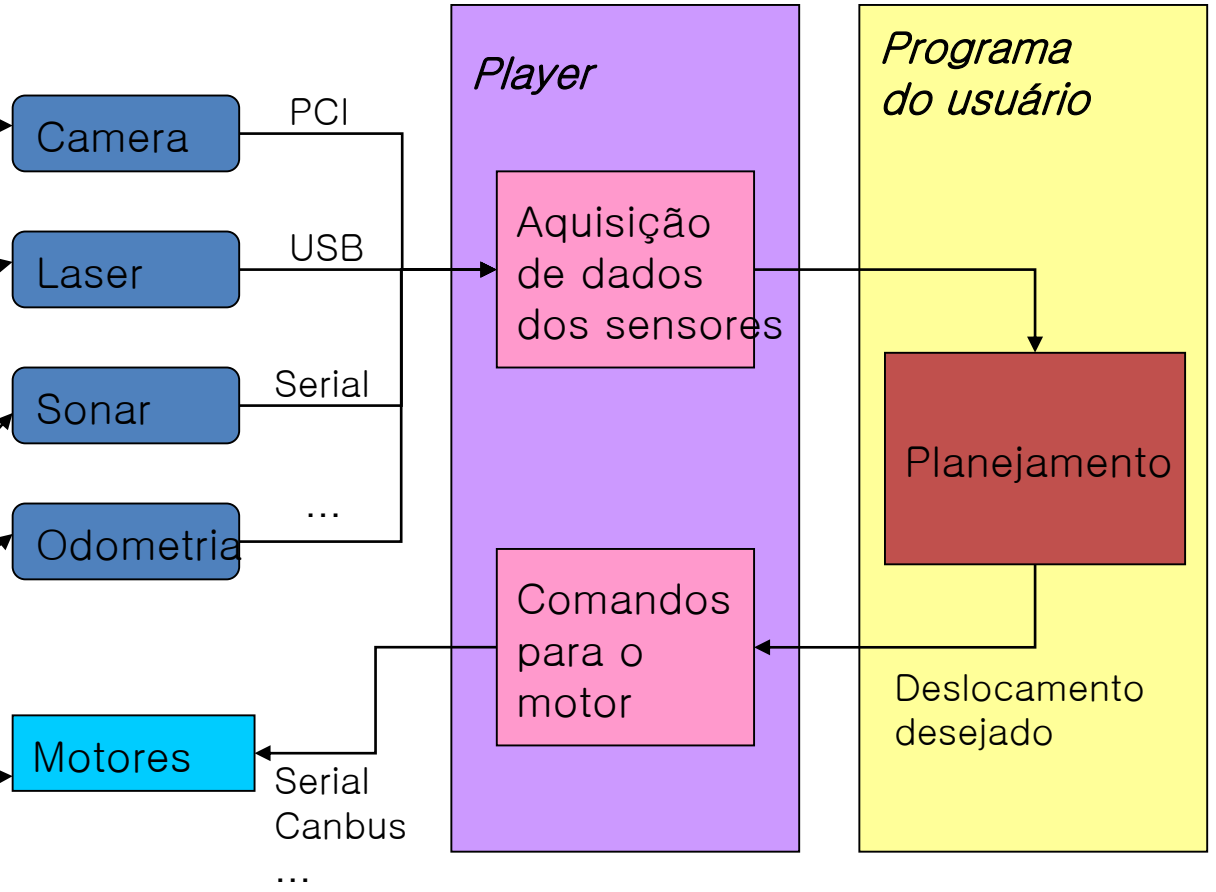
Player allows multiple devices to present the same interface. For example the Pioneer 2 and RWI drivers both use Player's 'position' interface to allow control of the robot's movement. Thus the same control code could drive both kinds of robot. This feature is very useful when combined with the Stage simulator; control programs written for Stage's simulated robots will often work unchanged on real hardware.

Player is also designed to support virtually any number of clients. Have you ever wanted your robots to "see" through each others' eyes? Now they can. Any client can connect to and read sensor data from (and even write motor commands to) any instance of Player on any robot. Aside from distributed sensing for control, you can also use Player for monitoring of experiments. For example, while your C++ client controls a robot, you can run a graphical visualization tool elsewhere that shows you current sensor data and a logger program to save data for later analysis. On-the-fly device requests allow your clients to gain access to differenct sensors and actuators as needed for the task at hand.

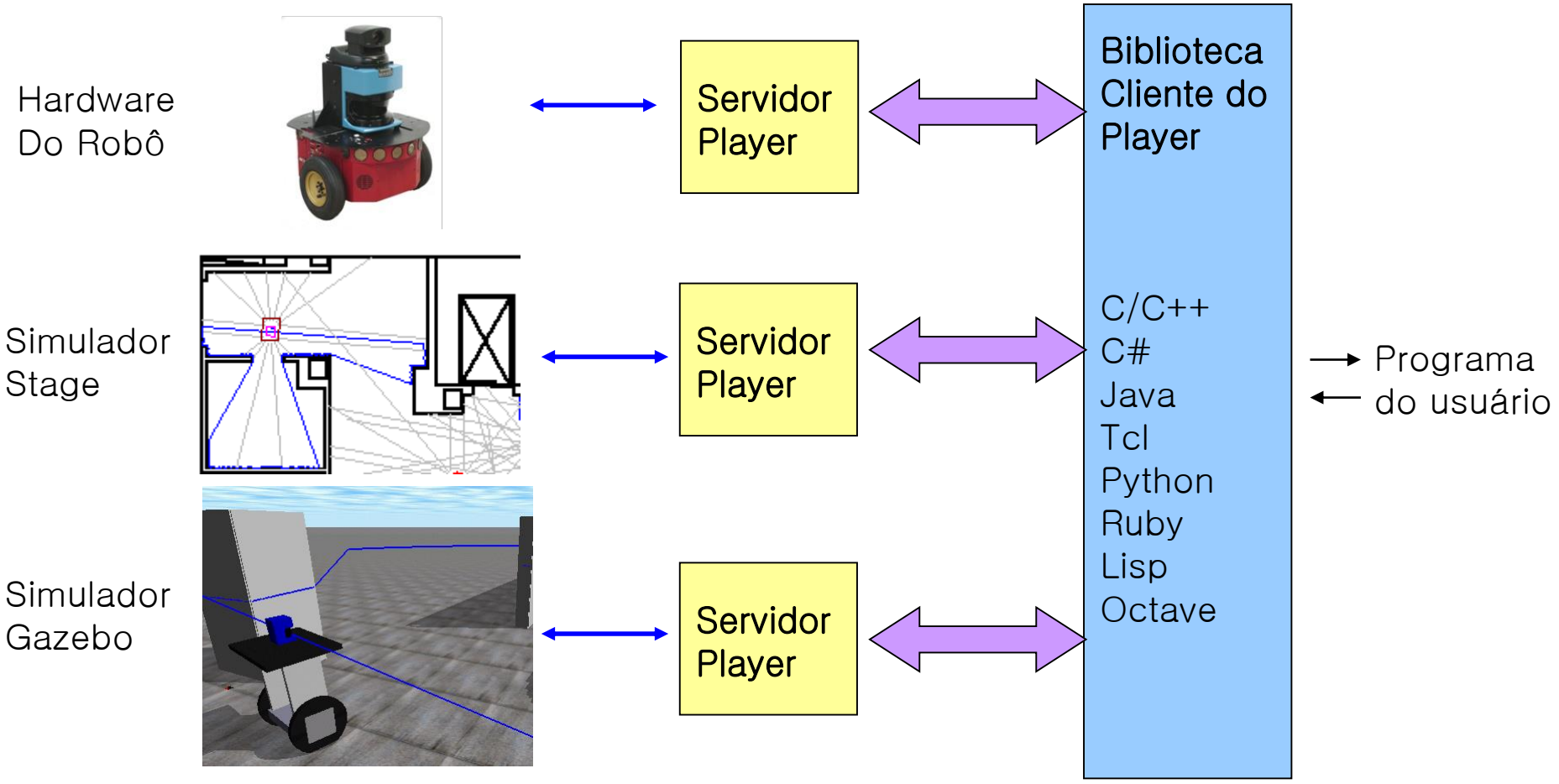
Programa de controle



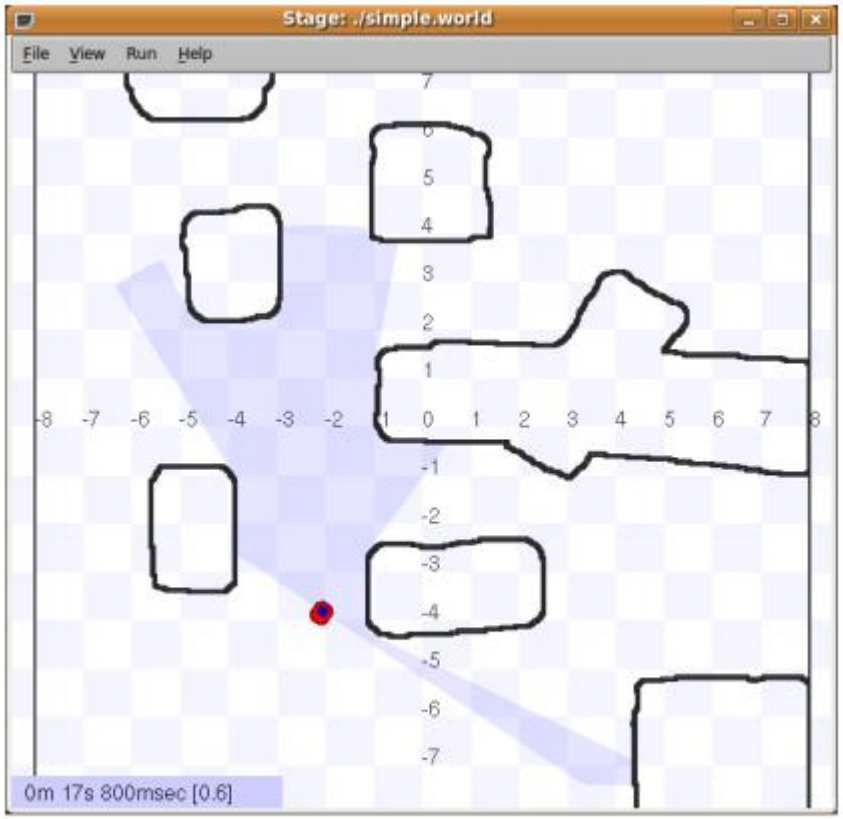
Player


Camera
Laser
Sonar
Odometria
Motores
PCI
USB
Serial
...
Serial
Canbus
...
Player
Aquisição de dados dos sensores
Comandos para o motor
Programa do usuário
Planejamento
Deslocamento desejado

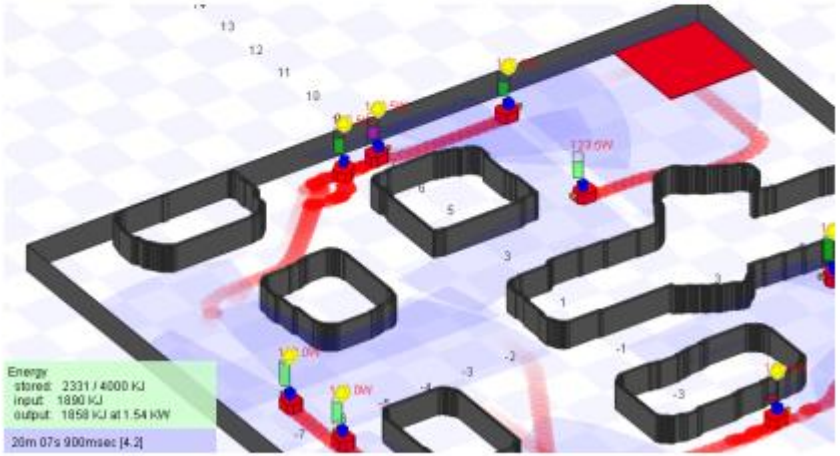
Abstração de hardware



Player + Stage (simulação)



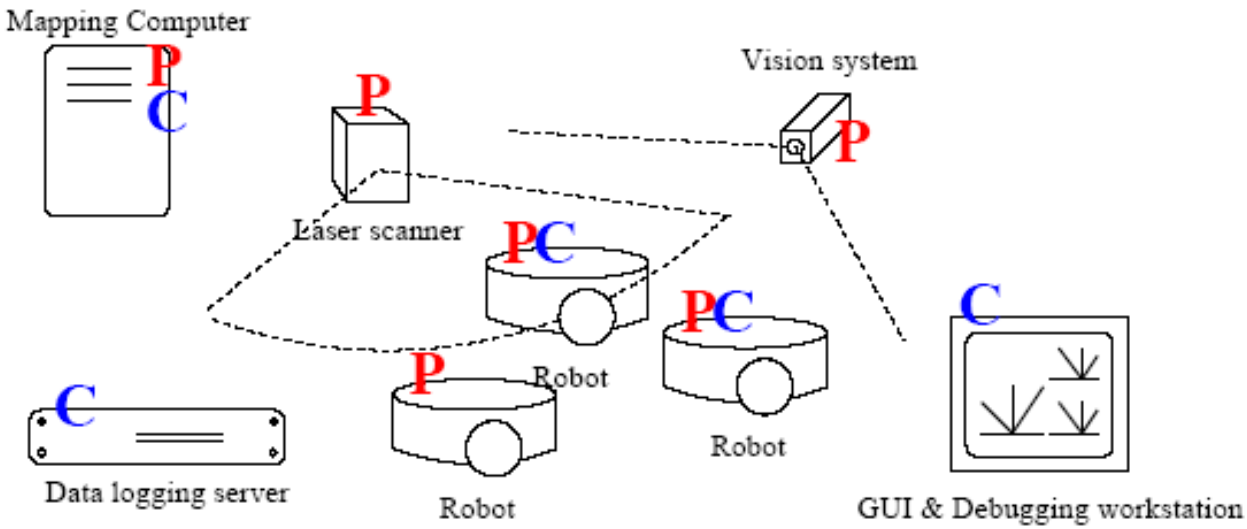
(a) 2D



(b) 2,5D

STAGE

Modelo Cliente/Servidor



- Clientes podem se conectar a múltiplos servidores
- Servidores aceitam conexão de múltiplos clientes
- Diferentes programas/processos/threads podem processar dados de diferentes sensores do mesmo servidor.
- Operação remota

Ambientes de Software: Aplicações Robóticas

- Middleware: Acesso aos Dispositivos de Hardware

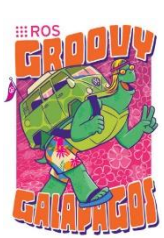
  Atuadores e Sensores => Ex. PLAYER/STAGE
- Sistema Operacional Robótico => ROS

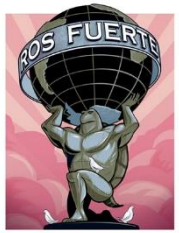
  ROS = Robot Operating System [2010-2016-...]

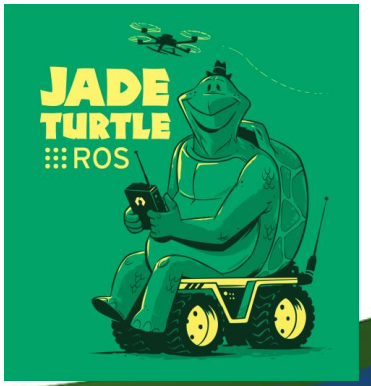
ROS.org

http://ros.org/
http://wiki.ros.org/Distributions

Open Source Robotics Foundation







Software

ABOUT US | DOWNLOAD | JOBS | CONTACT | SUPPORT

Willow Garage

ROBOTS | SOFTWARE | RESEARCH | BLOG | SEARCH

Software

Overview ➡

ROS

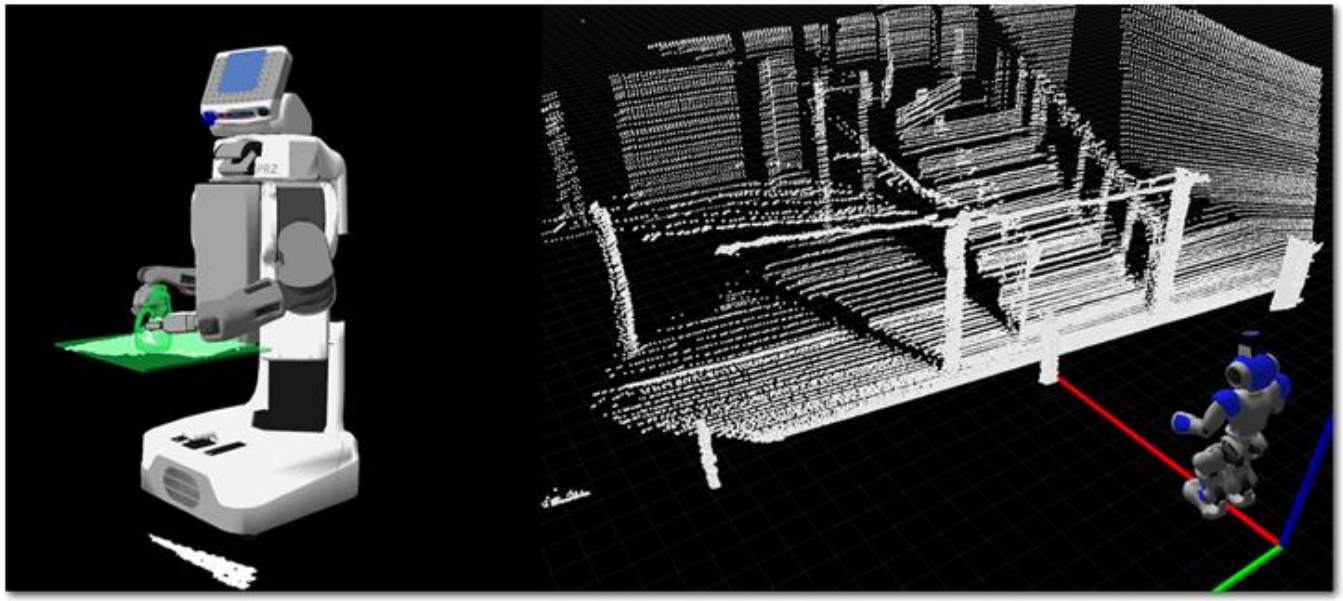
OpenCV

PCL

Gazebo

Player

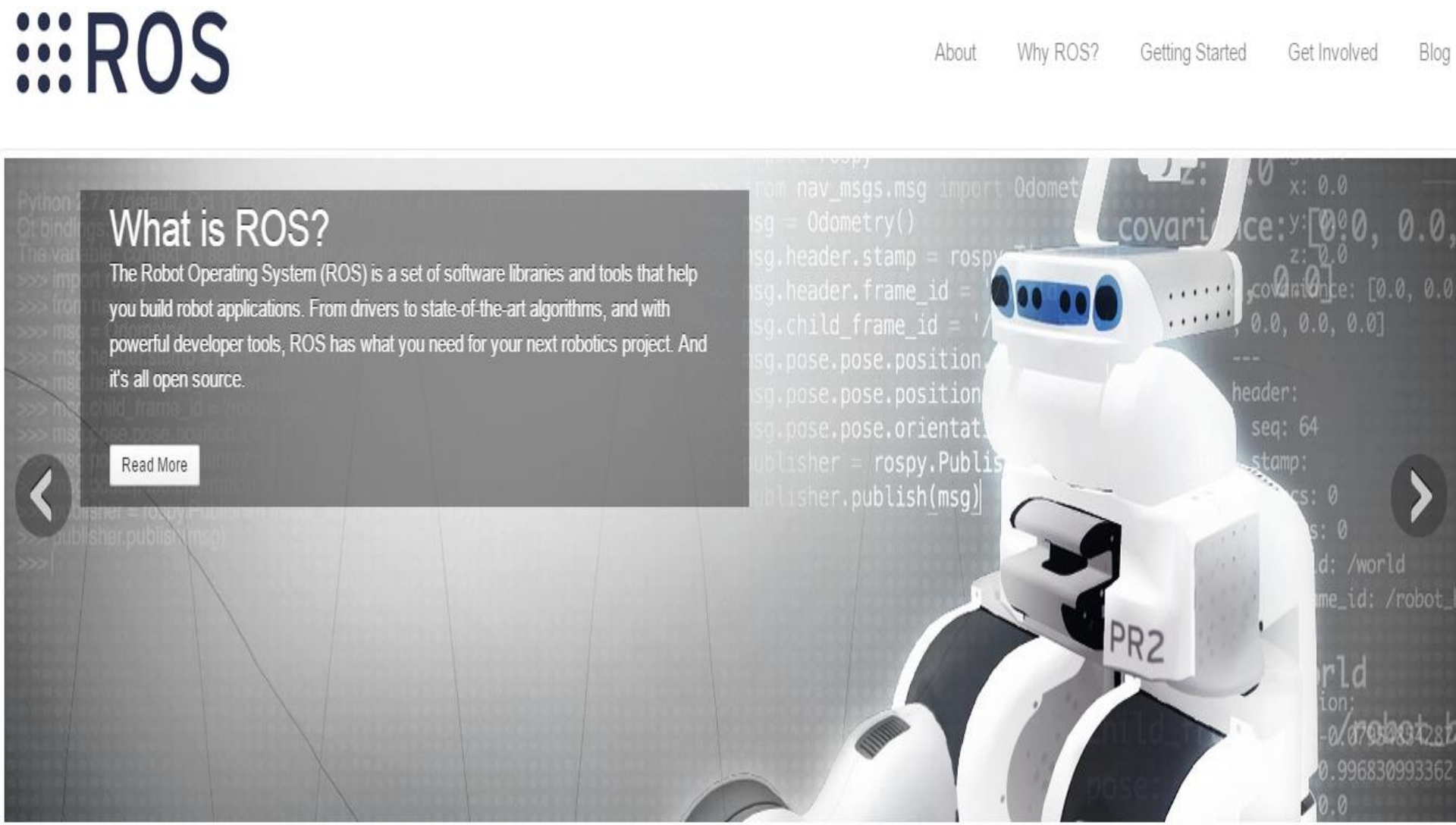
Overview



Our mission is to help advance the state-of-the-art in autonomous robotics technologies. We believe that great advances in robotics will come from the open source robotics community. That is why we work hard to support and contribute to the open source robotics community.

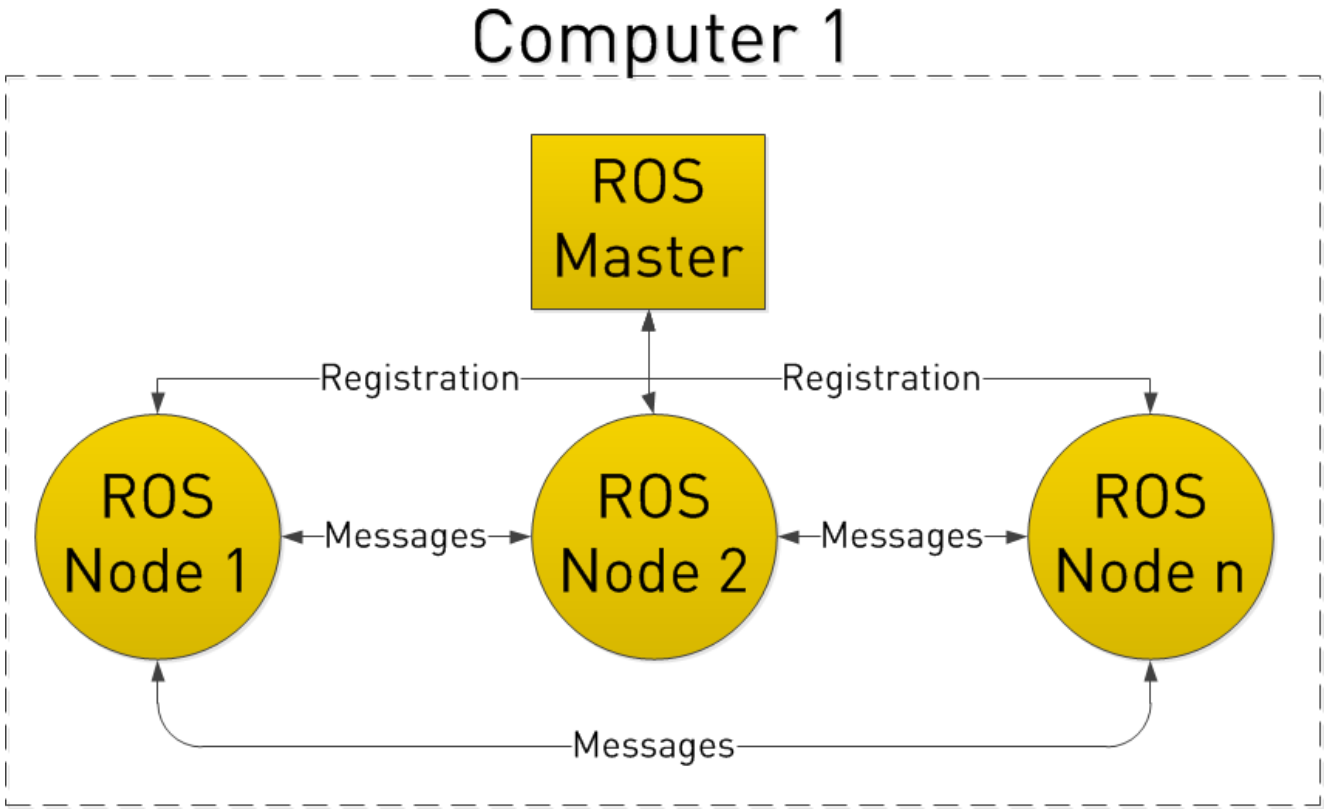
We're working on software from the lowest level with ROS (Robot Operating System) to the highest and in-between with our

What is ROS?


ROS
About
Why ROS?
Getting Started
Get Involved
Blog
What is ROS?
The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project. And it's all open source.
Read More
PR2

What is ROS?

- Exemplos...

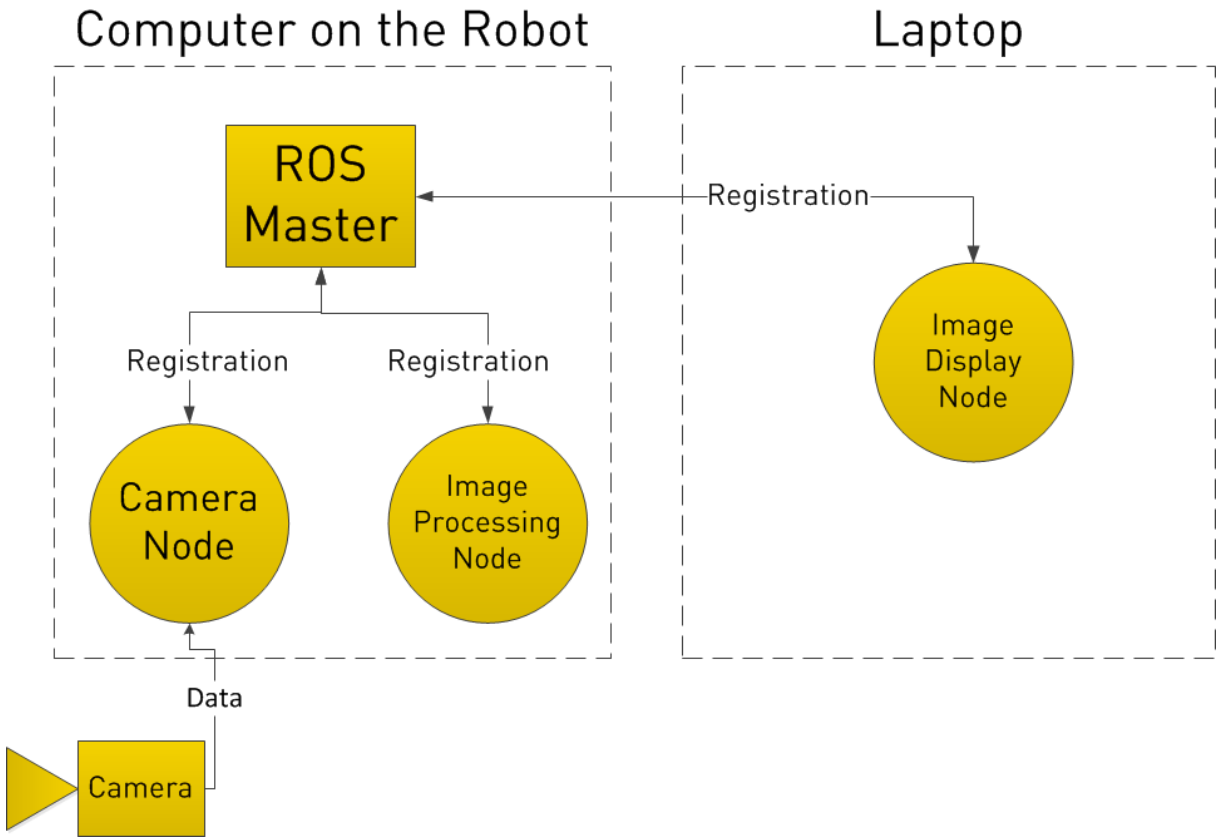


Services as Distributed Nodes:
- Publish
- Subscribe
- Messages

- Nodes & Packages

What is ROS?

- Exemplos...



Services as Distributed Nodes:
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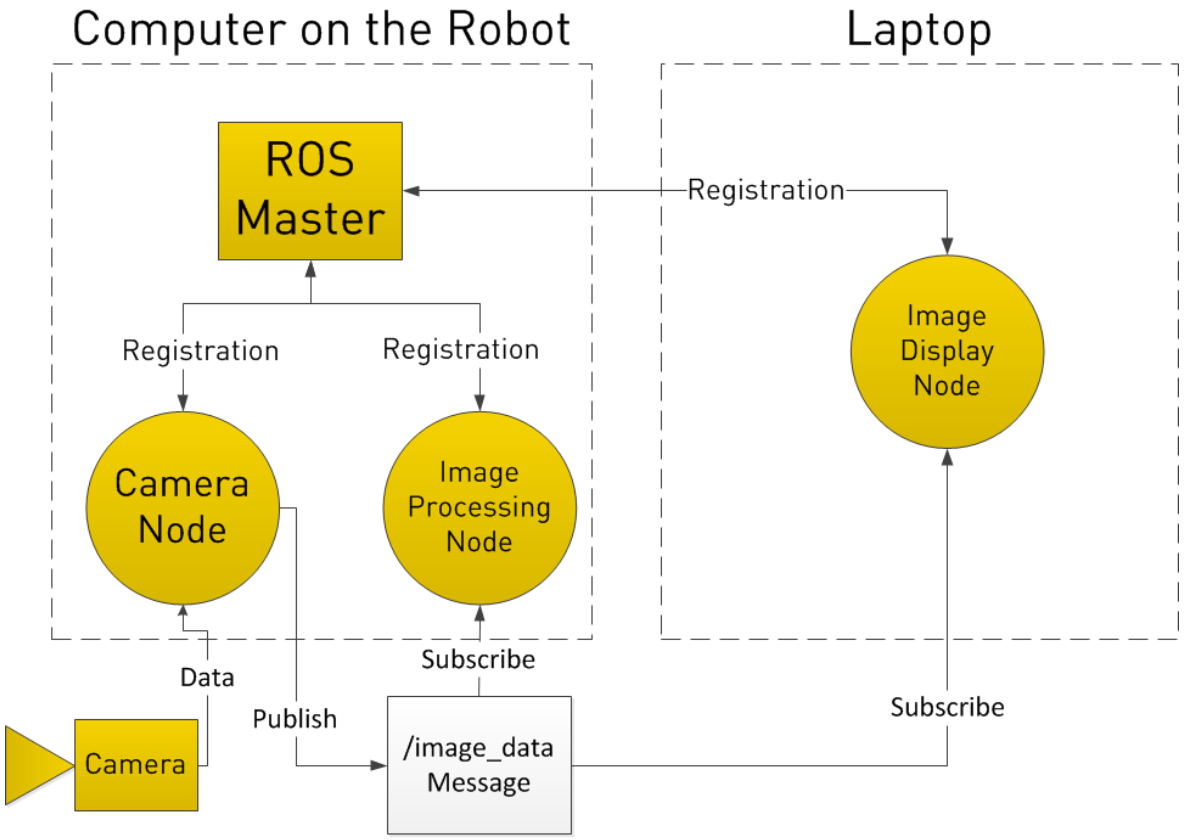
What is ROS?

- Exemplos...

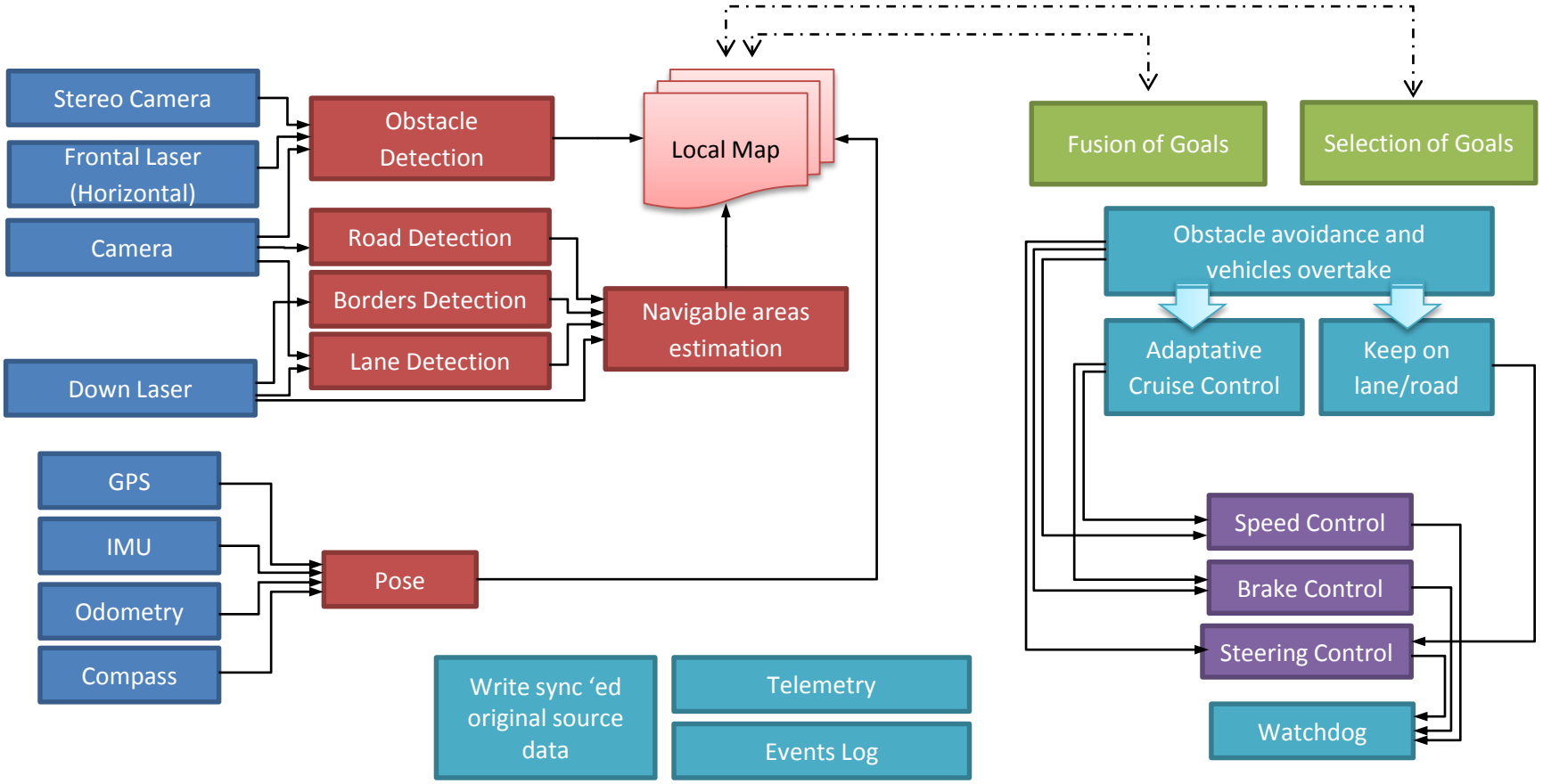


Services as Distributed Nodes:
- Publish
- Subscribe
- Messages

- Nodes & Packages

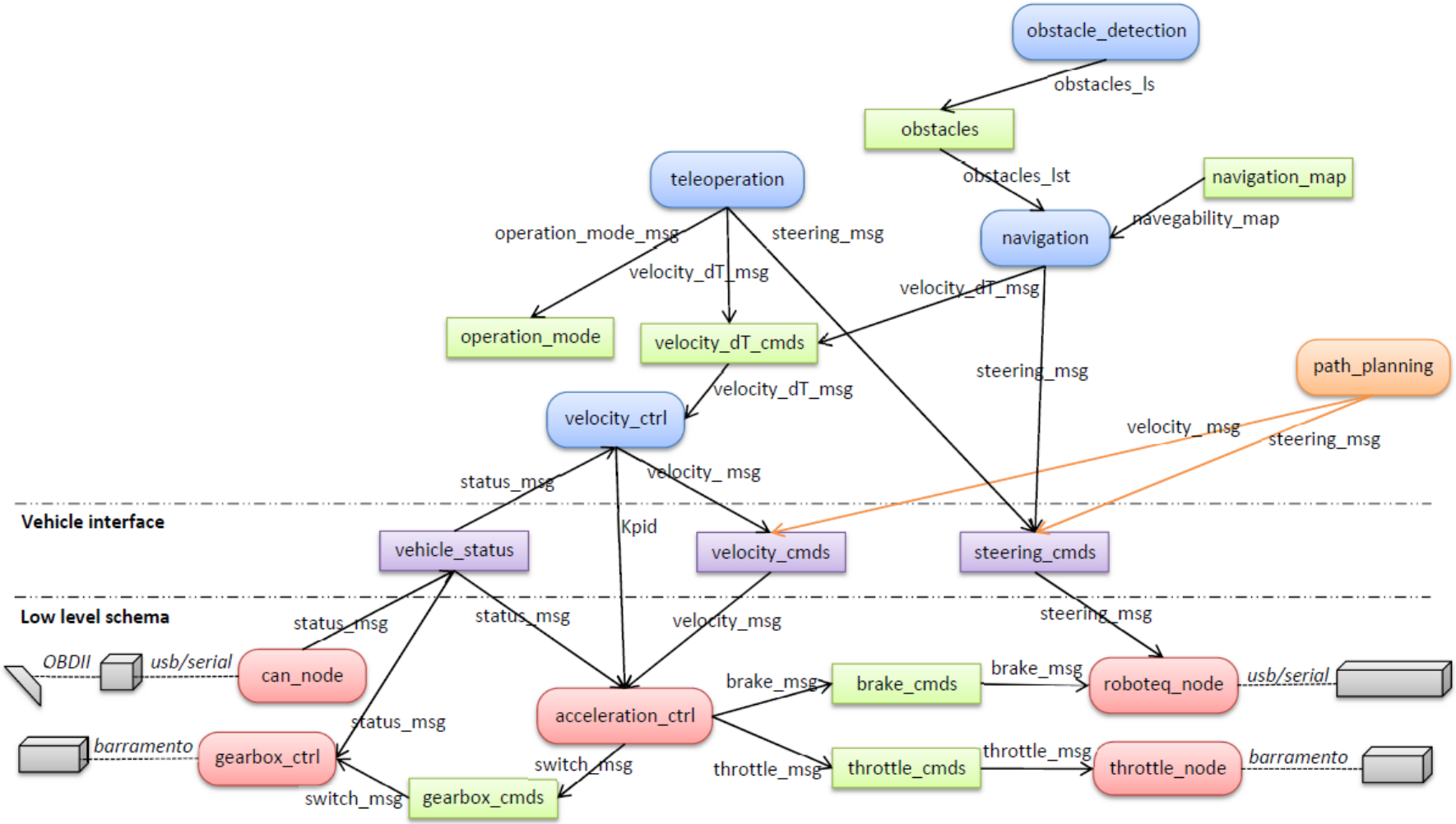
Projeto CaRINA I : R&D

Arquitetura de Software

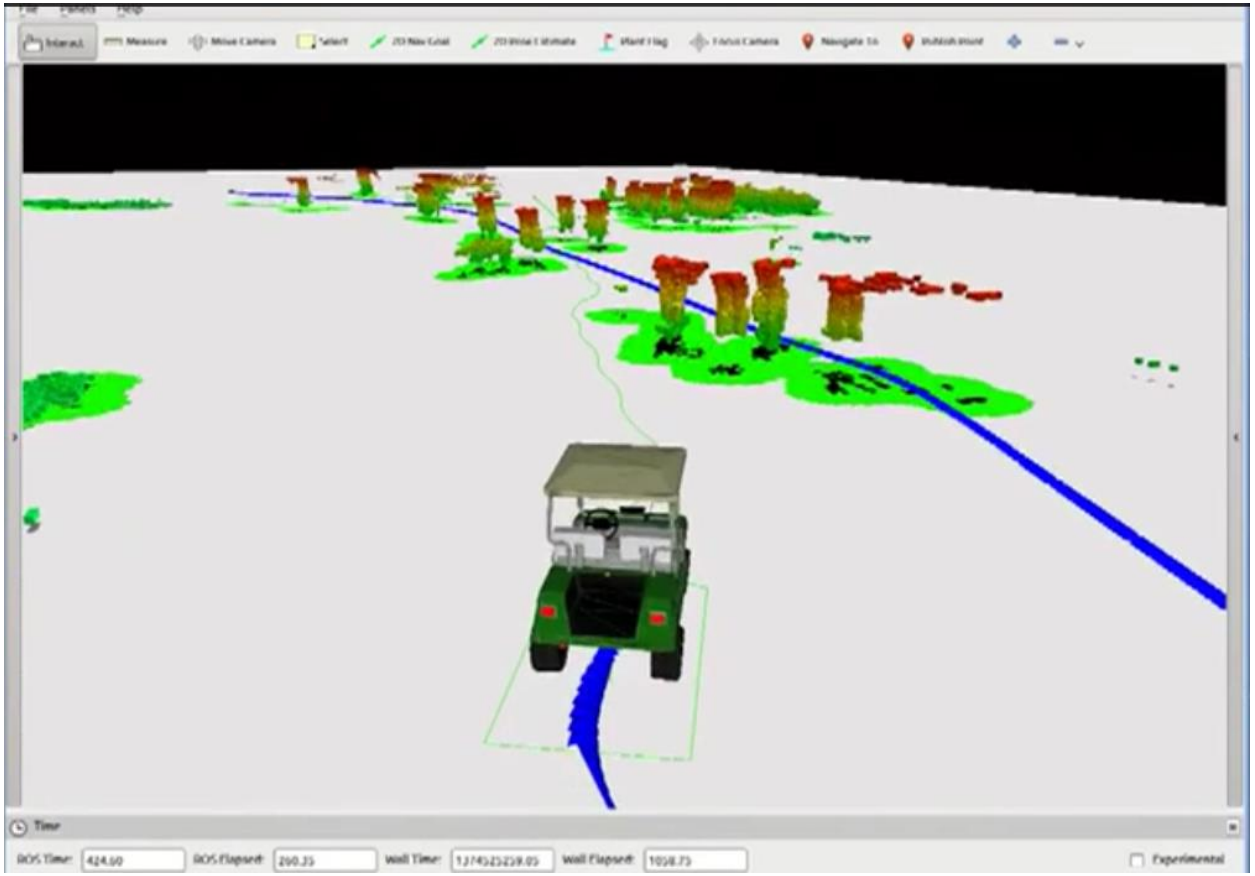


Projeto CaRINA II : R&D

Arquitetura de Software



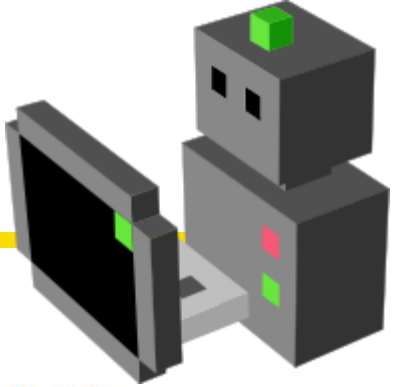
ROS + GAZEBO Simulation



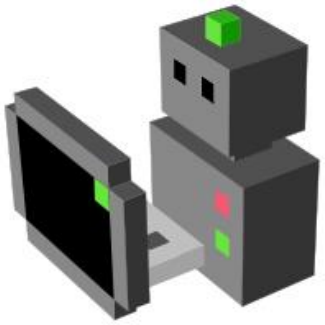
GAZEBO
http://gazebosim.org/

https://www.youtube.com/user/rlklaser/videos

Software de Simulação
MORSE



https://www.openrobots.org/wiki/morse/



What is MORSE?¶

MORSE is an **generic simulator for academic robotics**. It focuses on realistic 3D simulation of **small to large environments, indoor or outdoor**, with **one to tenths of autonomous robots**.

MORSE can be entirely controlled from the **command-line**. Simulation scenes are **generated from simple Python scripts**.

MORSE comes with a set of *standard sensors* (cameras, laser scanner, GPS, odometry,...), *actuators* (speed controllers, high-level waypoints controllers, generic joint controllers) and *robotic bases* (quadrotors, ATRV, Pioneer3DX, generic 4 wheel vehicle, PR2,...). New ones can easily be added.

MORSE rendering is based on the Blender Game Engine. The OpenGL-based Game Engine supports shaders, provides advanced lightning options, supports multi-texturing, and use the state-of-the-art Bullet library for physics simulation.

Simulation with MORSE¶

Robotic Tools

TOOLS:

Player-Stage (Old)

Gazebo – Gazebosim Robot Simulator

ROS – Robot Operating System

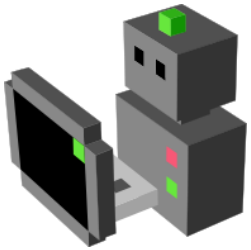
OpenCV – Open Source Computer Vision Library

PCL – Point Cloud Library

Morse - Modular OpenRobots Simulation Engine

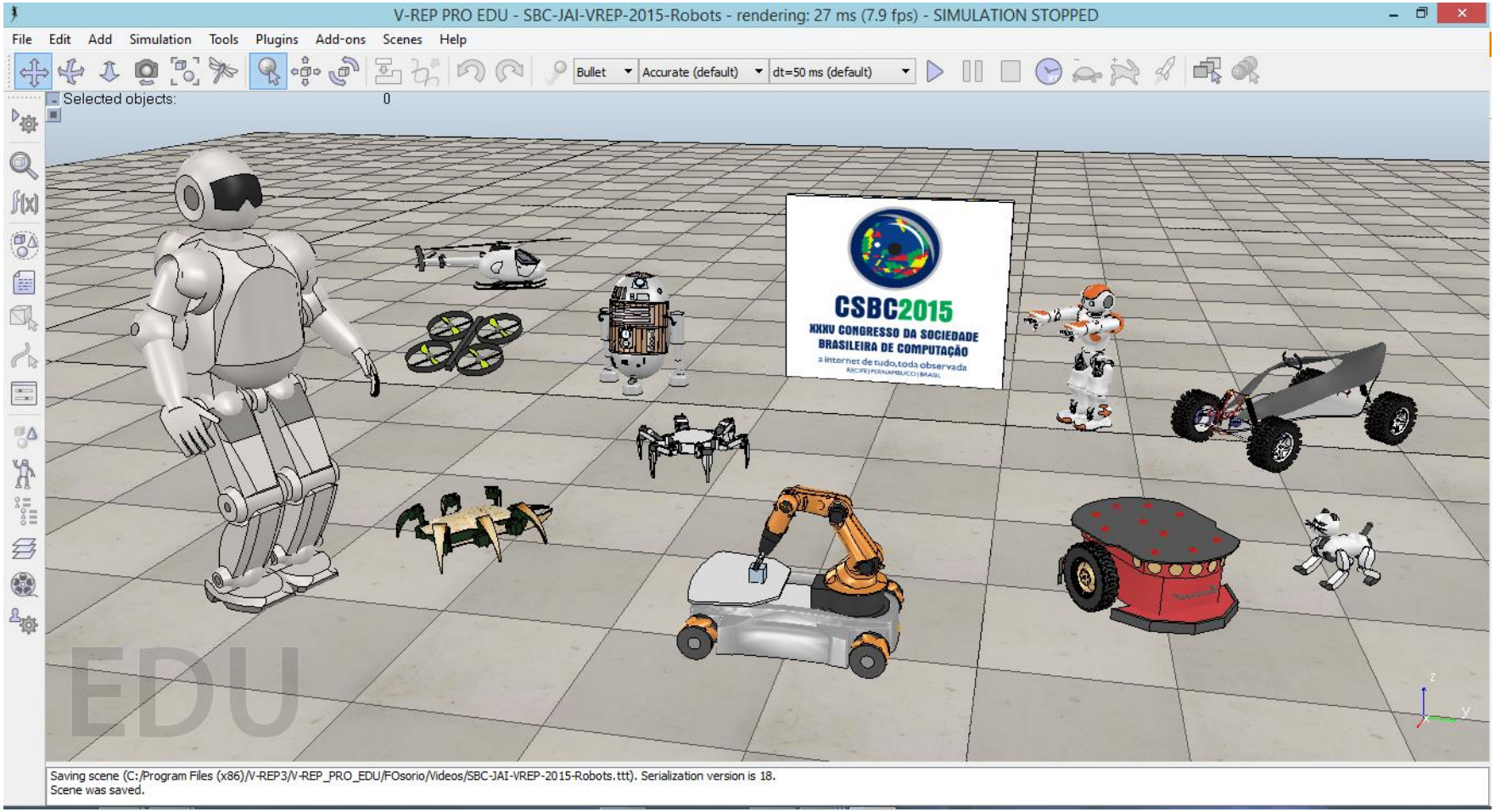
Microsoft Robotics Studio, Webots, Aria, ...

Matlab, Weka, SNNS/JavaNNS, FANN, GALib, Python, ...



Morse

Simulação com V-REP



Free Educational, Easy-of-Use, Multi-Platform
Large set of Sensors, Actuators and Robots

VREP

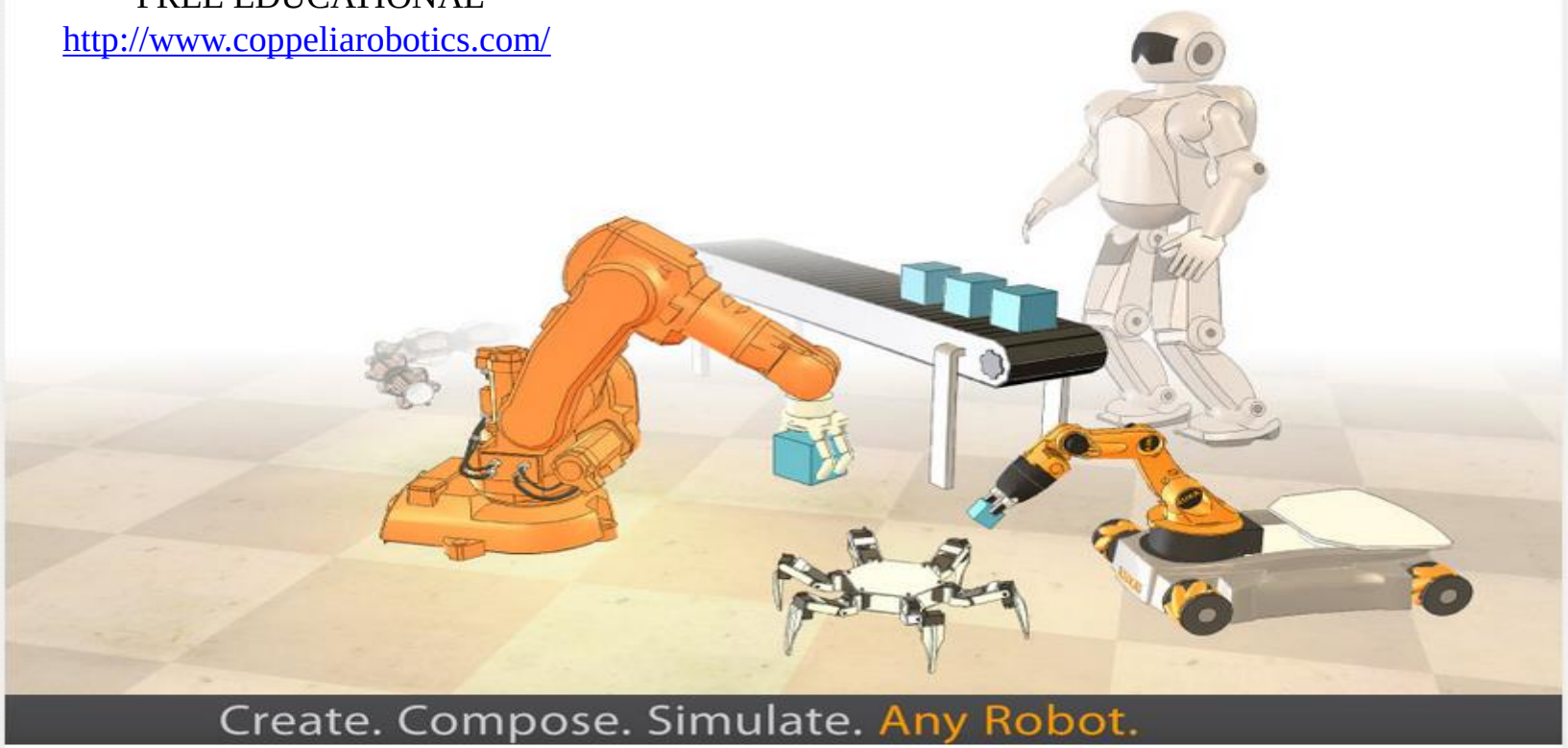
Simulador V-REP

v-rep
virtual robot experimentation platform

home features videos downloads licensing resources partners contact

Cross-Platform & Portable

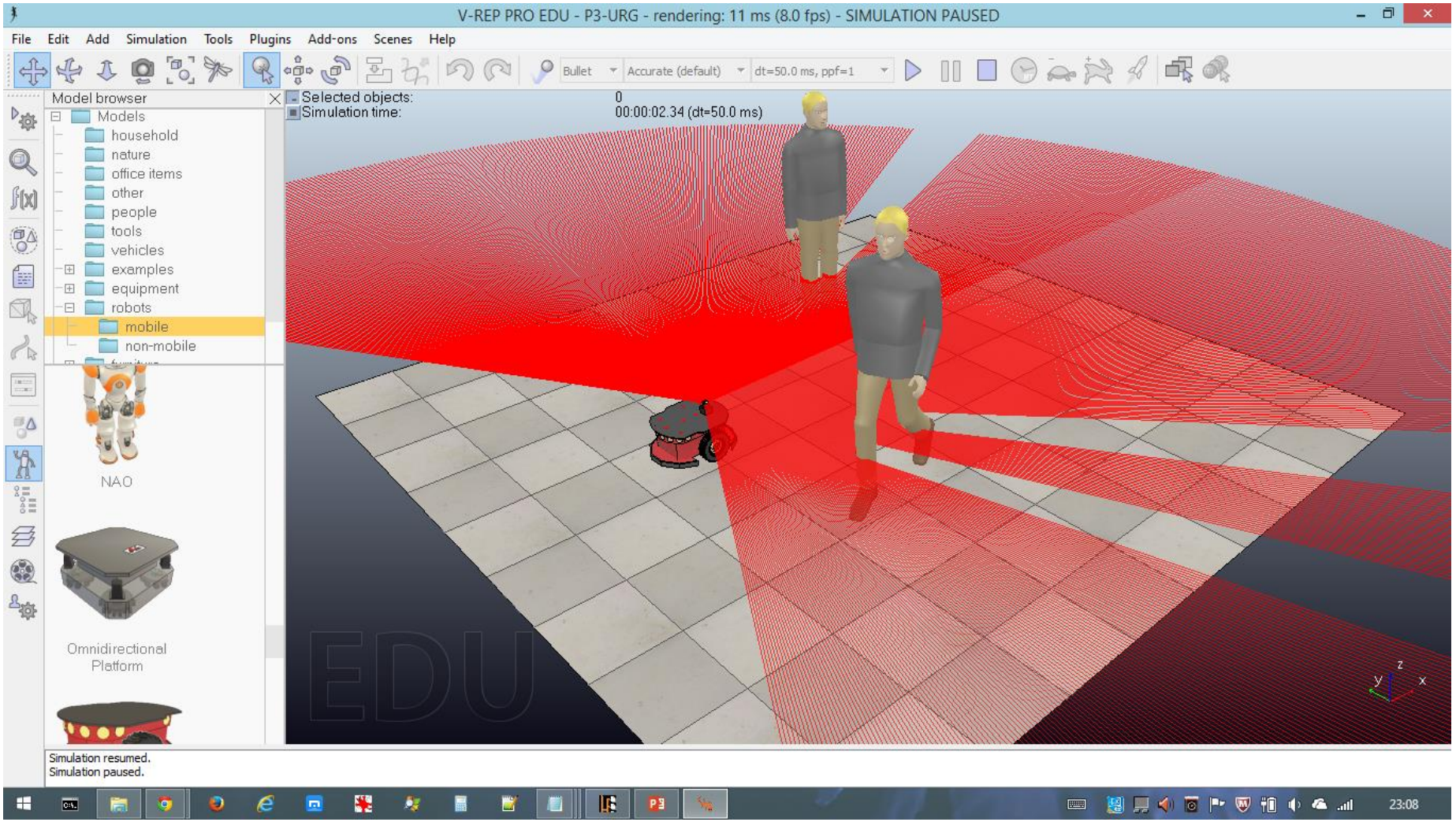
FREE EDUCATIONAL
http://www.coppeliarobotics.com/



Software V-REP

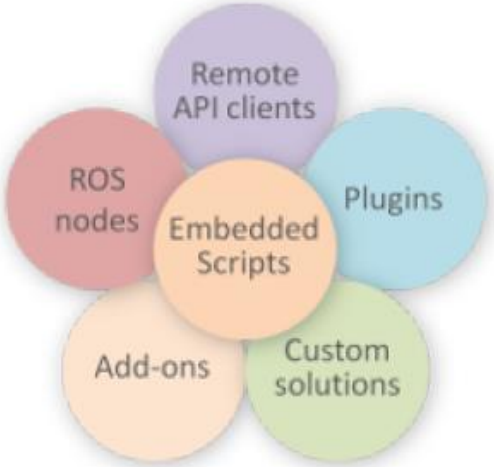
v-rep
virtual robot experimentation platform

http://www.coppeliarobotics.com/



Simulador V-REP

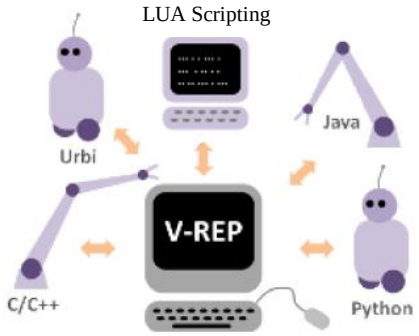
VREP is cross-platform, and allows the creation of portable, scalable and easy maintainable content: a single portable file can contain a fully functional model (or scene), including control code.
6 Programming Approaches

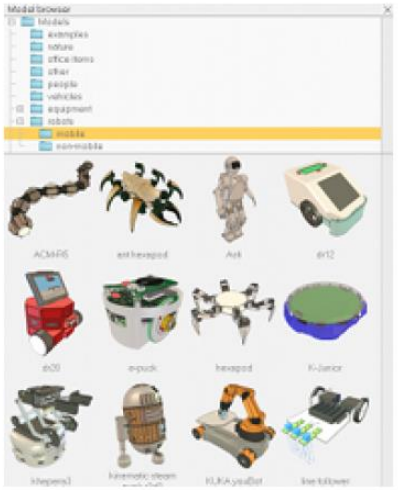


Regular API: 400 functions (C/C++ & Lua)
Remote API: 100 functions (C/C++, Python, Java, Matlab, Octave & Urbi).
ROS interface: 100 services, 30 publisher types, & 25 subscriber types.
Remote API

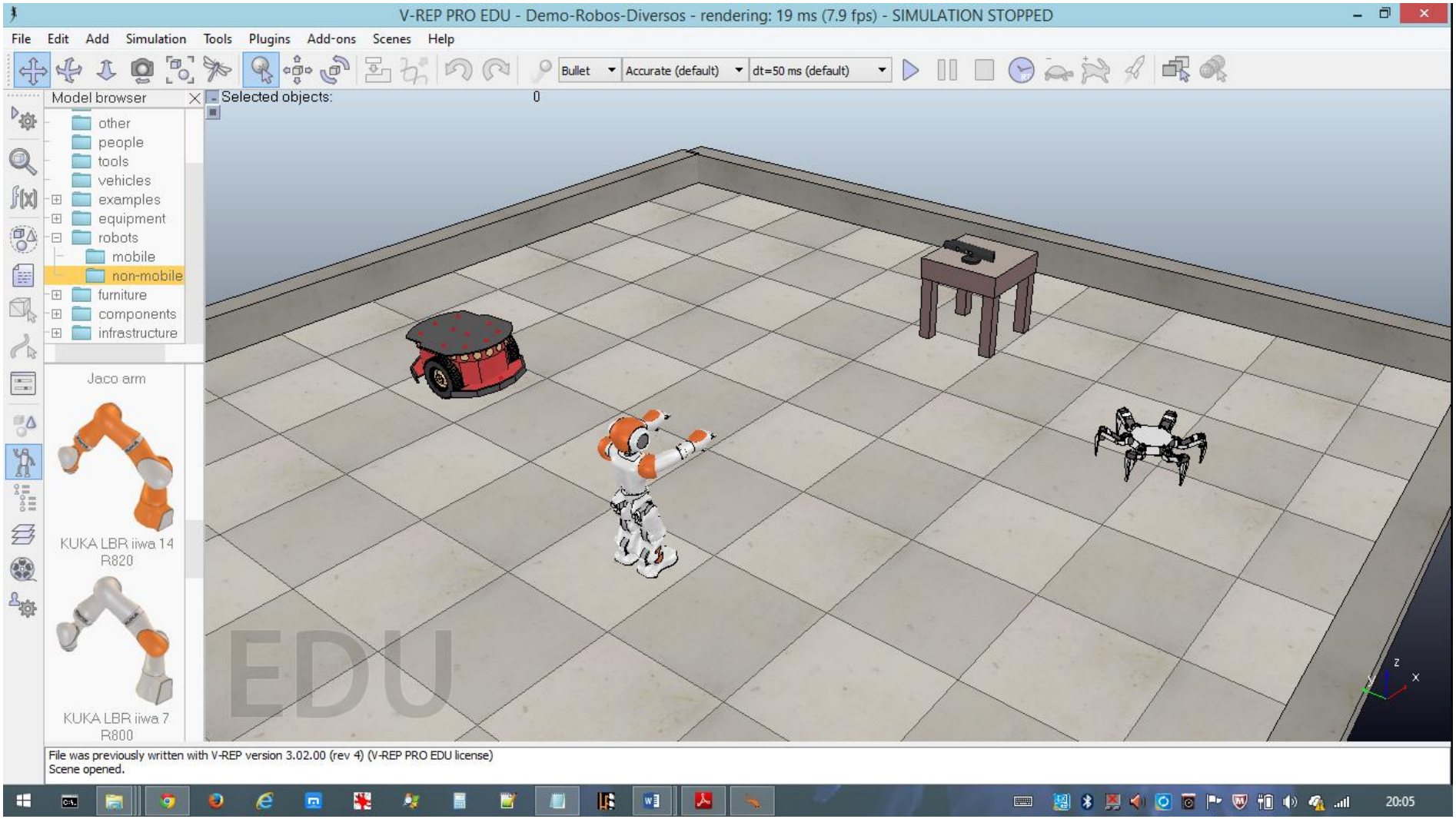
LUA
C / C++

Multiple Robot Models:
Mobile Robots
Humanoids
Manipulators
Aerial

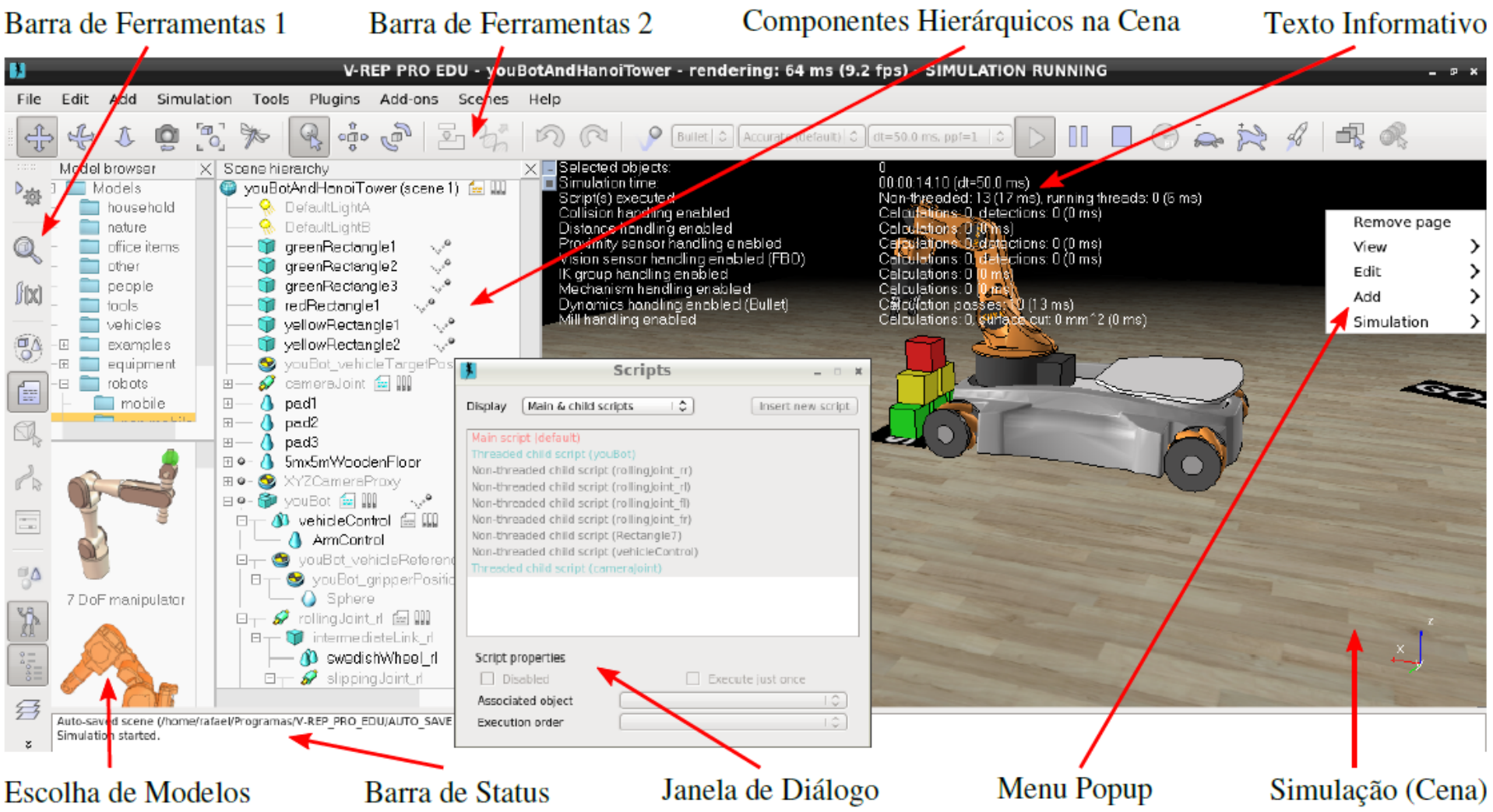




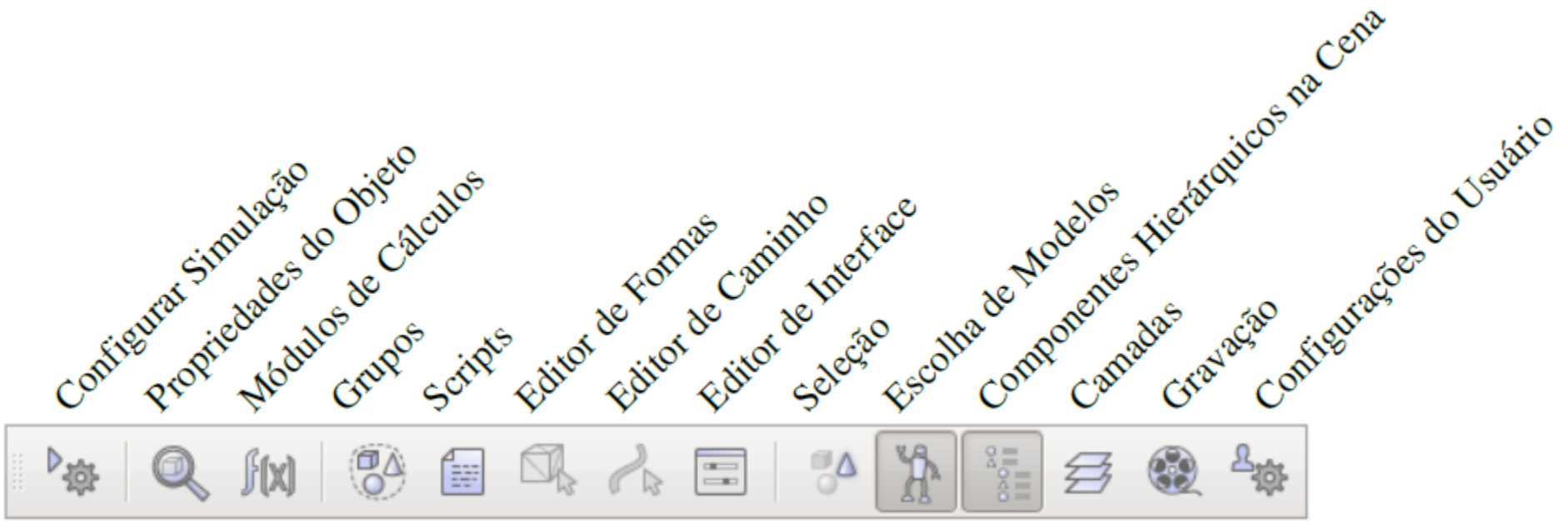
V-REP – Janela de aplicação



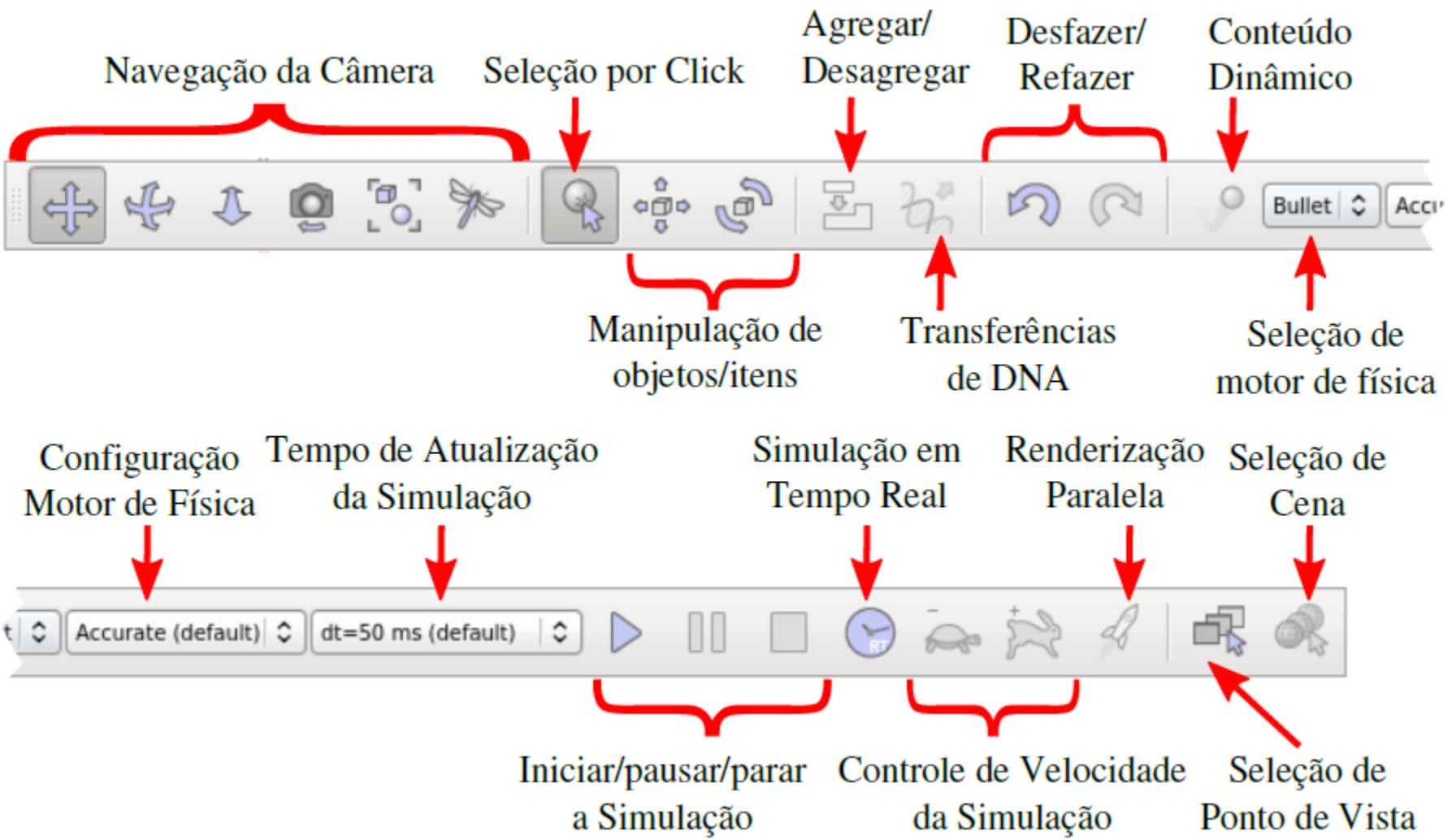
V-REP – Componentes de tela



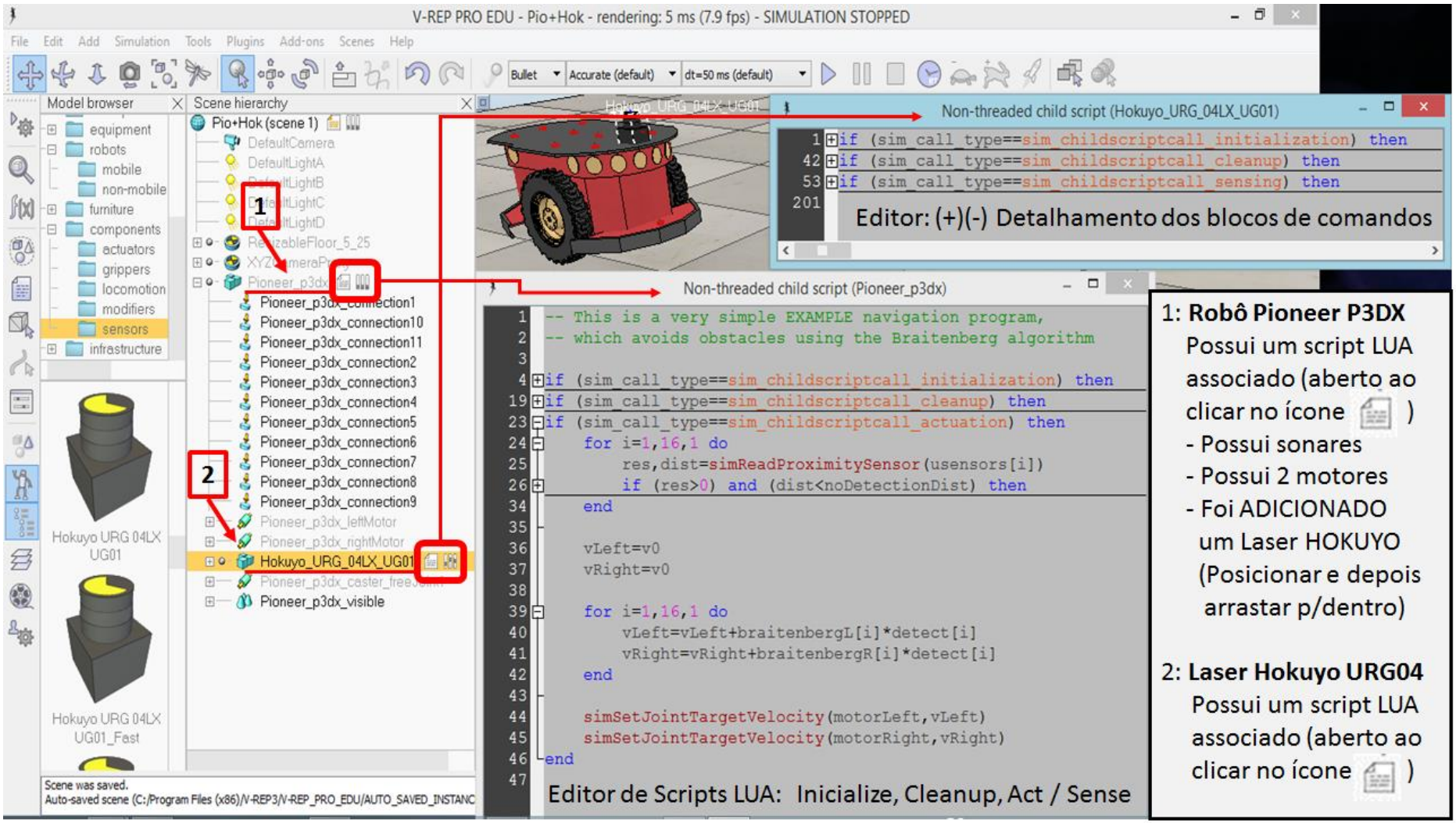
V-REP – Barra de ferramentas 1



V-REP – Barra de ferramentas 2

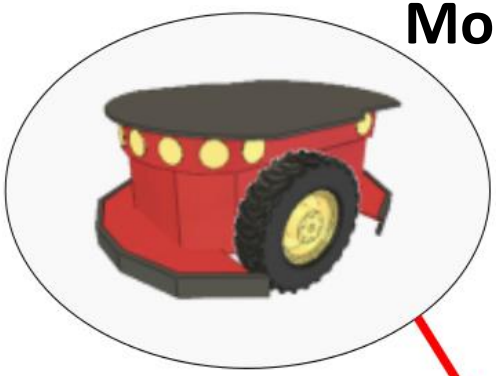


V-REP – Robô, Componentes, Scripts LUA

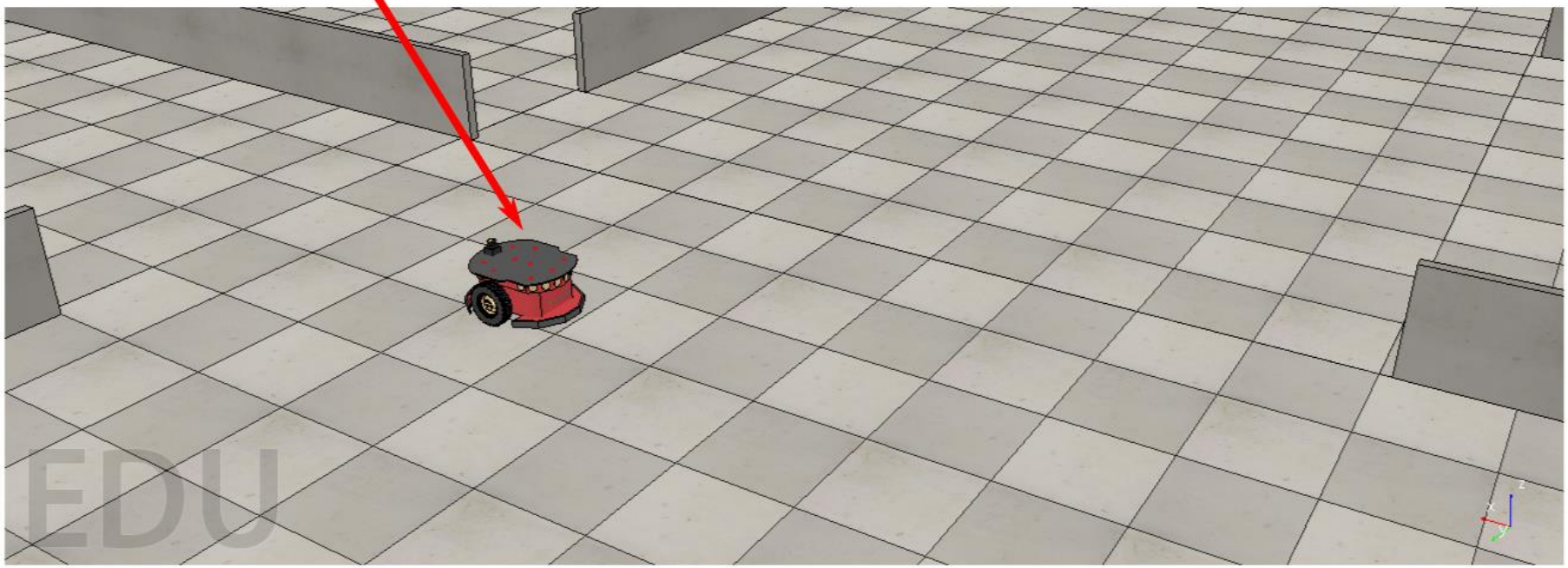


V-REP – Principais elementos

Modelo - subelemento da cena (extensão “ttm”).

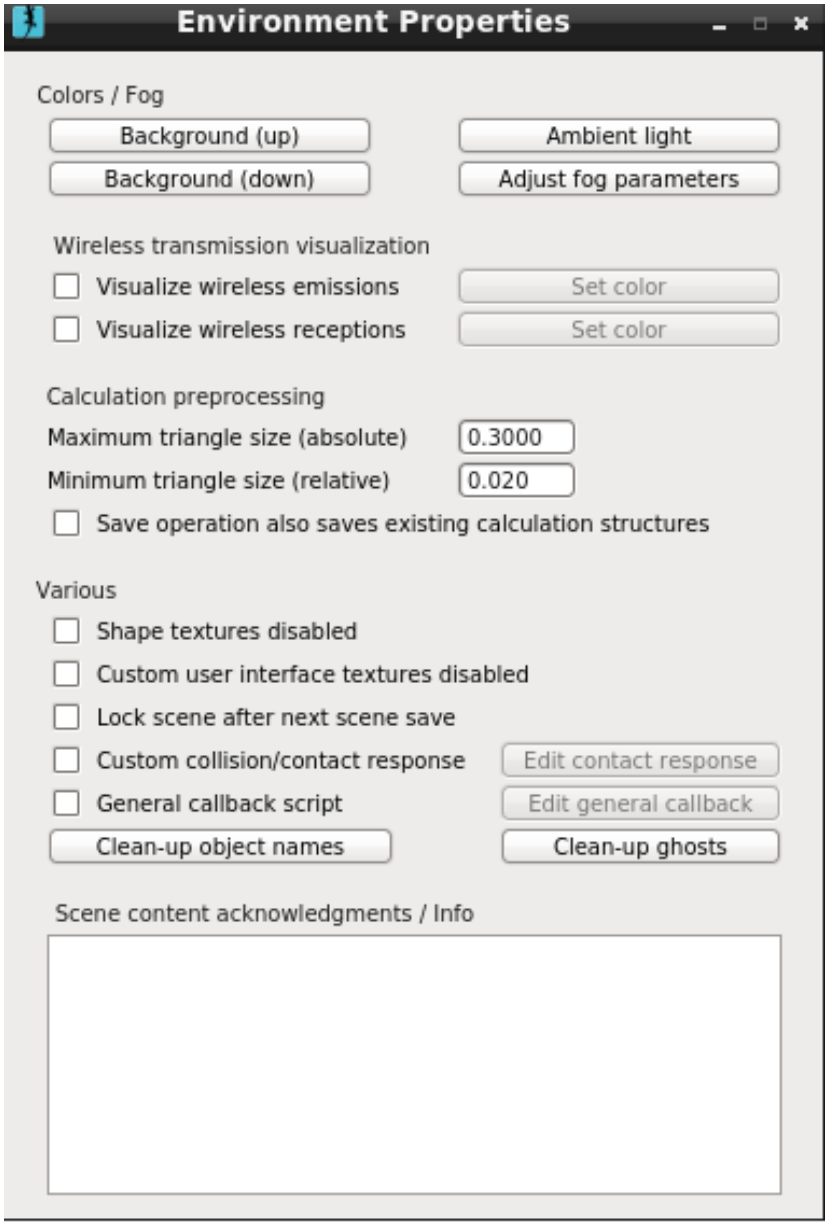


Cena - contém toda a informação necessária para a reabertura e simulação (todo o ambiente, script principal e pontos de vistas em um “ttt”).



V-REP – Ambiente

- Alguns parâmetros:
  - cores de fundo,
  - parâmetros para inclusão de nevoeiro,
  - luz ambiente,
  - informação para a criação da cena,
  - etc.
- Via menu: Tools / Environment



V-REP – Entidades

- Tipos: objeto ou uma coleção de objetos;
- Propriedades especiais de Objetos e Coleções:
  - Collidable,
  - Measurable (distância entre objetos),
  - Detectable (sensores de proximidade),
  - Cuttable,
  - Renderable (visto por sensores de visão).
- Propriedades especiais somente de objetos:
  - Viewable (objetos transparentes ou exibem imagem, ex: TV).

- Acessível em Tools / Scene object properties.

V-REP – Tipos de objetos

Tipos de Objetos:

Shape 

Vision sensor 

Camera 

Graph 

Joint 

Force/torque sensor 

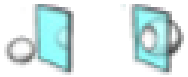
Light 

Path 

Proximity sensor 

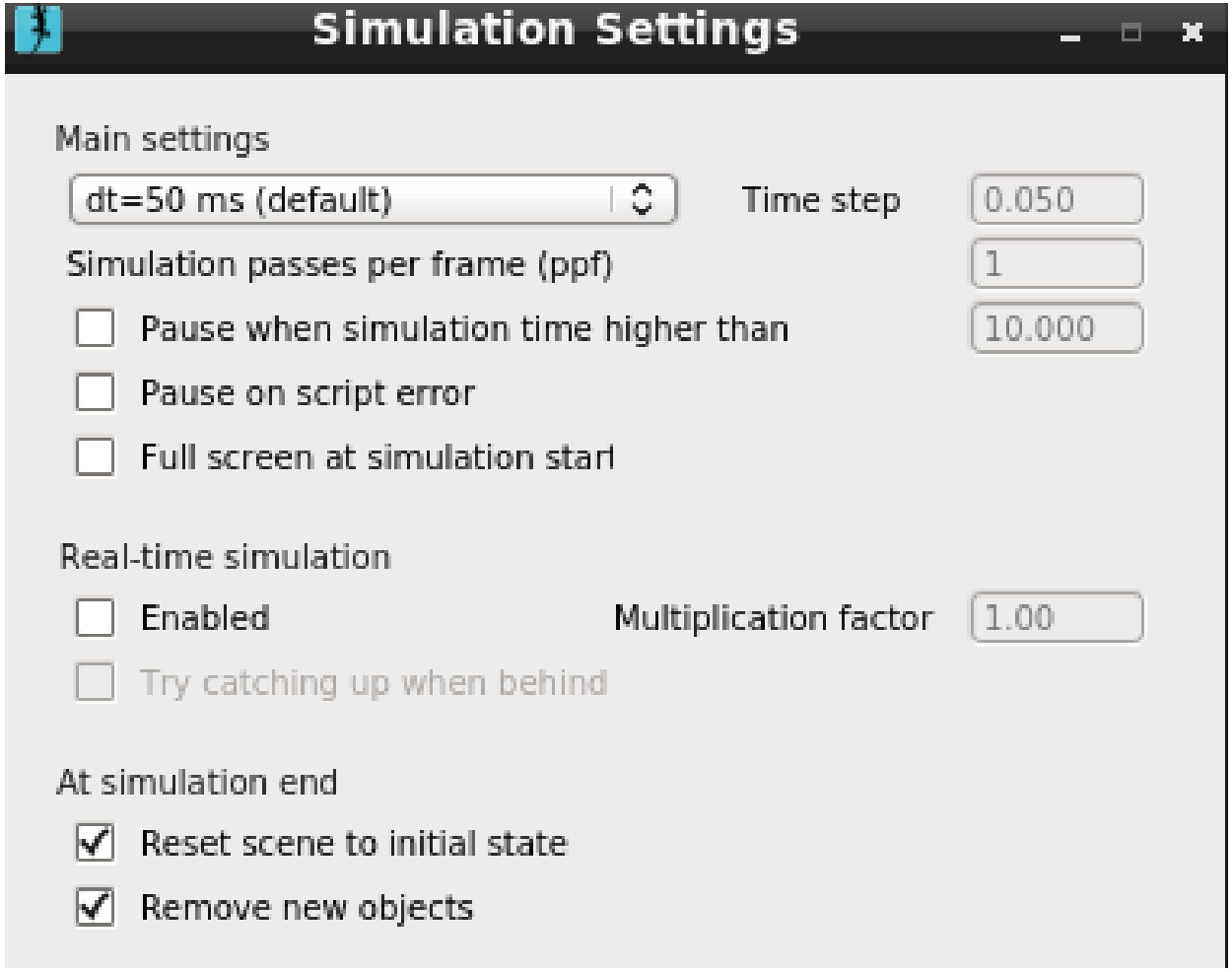
Mill 

Dummy 

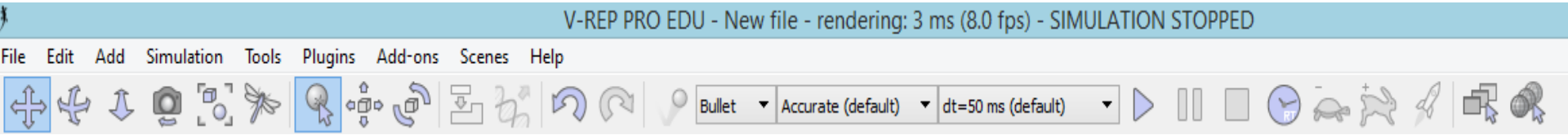
Mirror 

V-REP – Configuração da Simulação

- Disponível em Simulation / Simulation Settings.



Simulador V-REP



Botões de controle da Câmera Virtual 3D: Posicionamento de Observação da Cena
Principais opções: Deslocar (Pan), Girar (Rotação ao Redor dos Elementos), Zoom (Avança/Recua)

Botões de controle do Objeto Virtual
Principais opções:
Selecionar Objeto, Mover o Objeto (pode indicar/selecionar os eixos: X, Y ou Z de deslocamento),
Girar o objeto (pode selecionar os eixos: X, Y ou Z de rotação)

Botões de controle da Simulação Virtual:
Play, Pause, Stop => Inicío/Fim Simulação
Acelerar ou ir mais devagar no “passo” de simulação

Simulador V-REP

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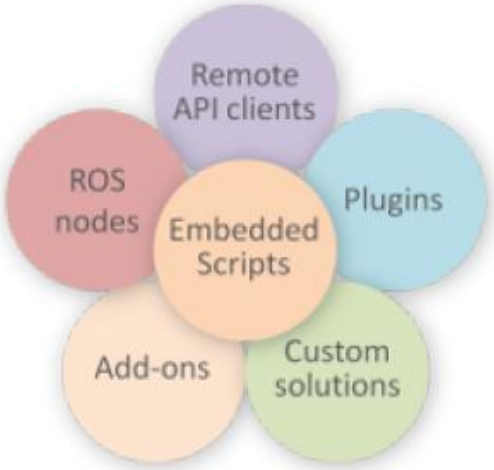
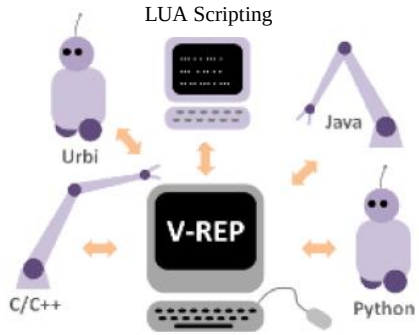


Regular API: 400 functions (C/C++ & Lua)
Remote API: 100 functions (C/C++, Python, Java, Matlab, Octave & Urbi).
ROS interface: 100 services, 30 publisher types, & 25 subscriber types.
Remote API

LUA
C / C++

Multiple Robot Models:
Mobile Robots
Humanoids
Manipulators
Aerial

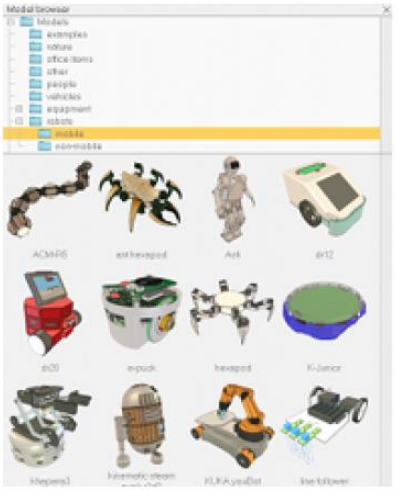


Dynamics/Physics

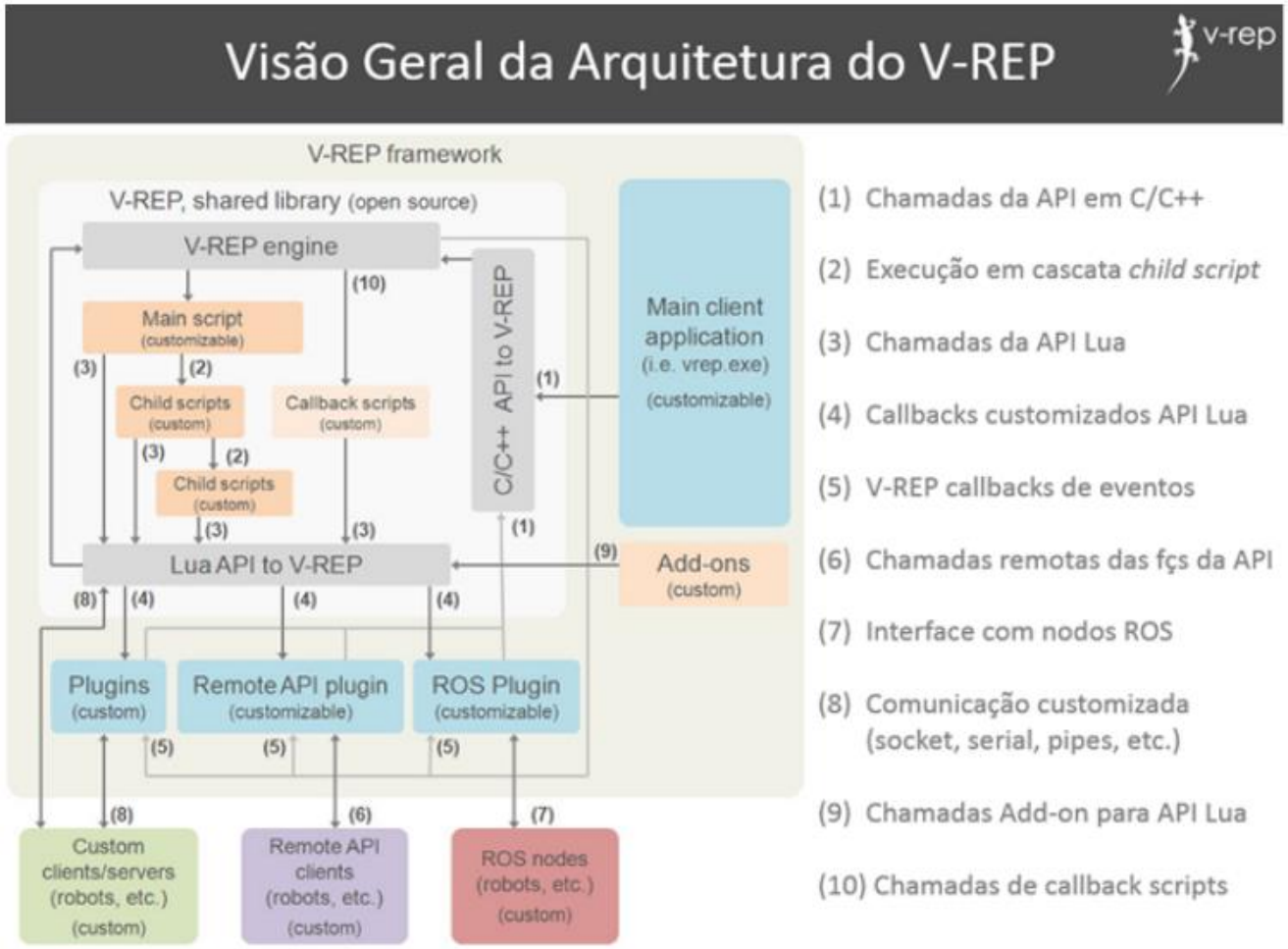
Bullet

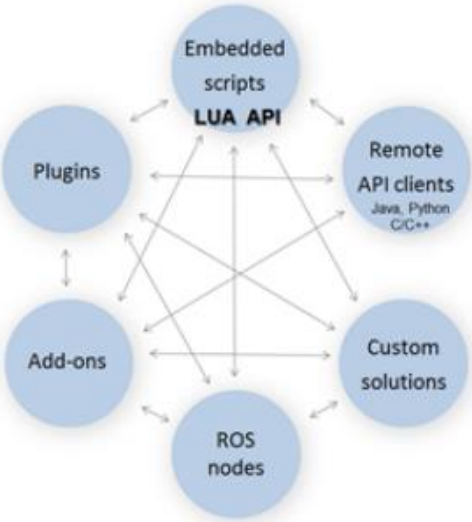
ODE

Vortex



Simulador V-REP





Nativo: LUA Scripts API: C/C++, Python, Java Client/Server, ROS, MATLAB

PROGRAMAÇÃO USANDO O V-REP

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Vídeos: http://youtube.com/lrmicmc

https://www.youtube.com/user/lrmicmc/videos