H2020 funded
GA no. 732287

rosin-project.eu

ROS-I Academy Training

Gazebo simulator

MASCOR Institute
Mobile Autonomous Systems and Cognitive Robotics Institute (MASCOR)

2017ff

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

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Outline

- Motivation
- Simulation at a glance
- RCLL Simulation
- Developing in Gazebo

Motivation

Task

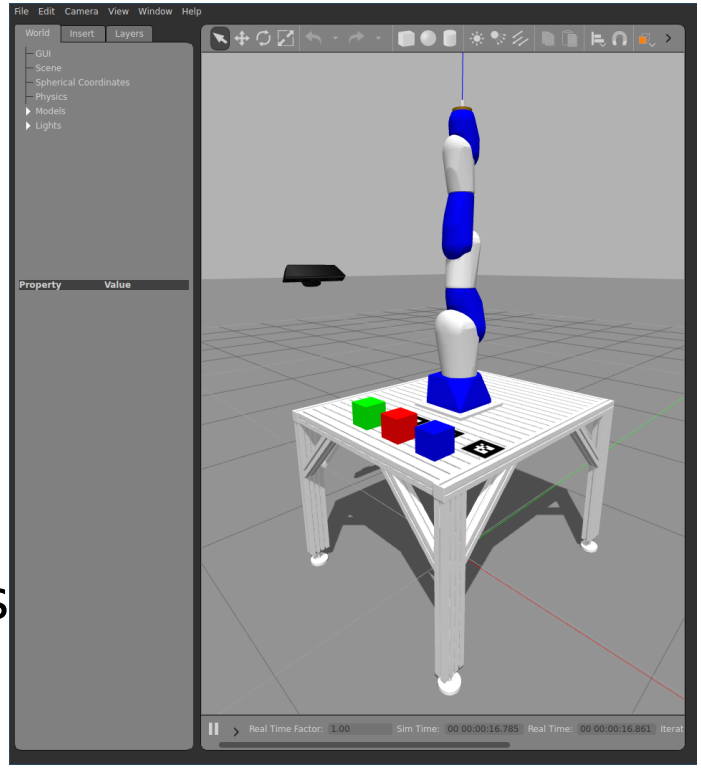
Provide a testing environment to allow quick evaluation of new developments

Problems:

- Hardware usually expensive
- Operational robot hardware required
- Lower level components need to work
- Time consuming setup of tests (specially with multiple robots)

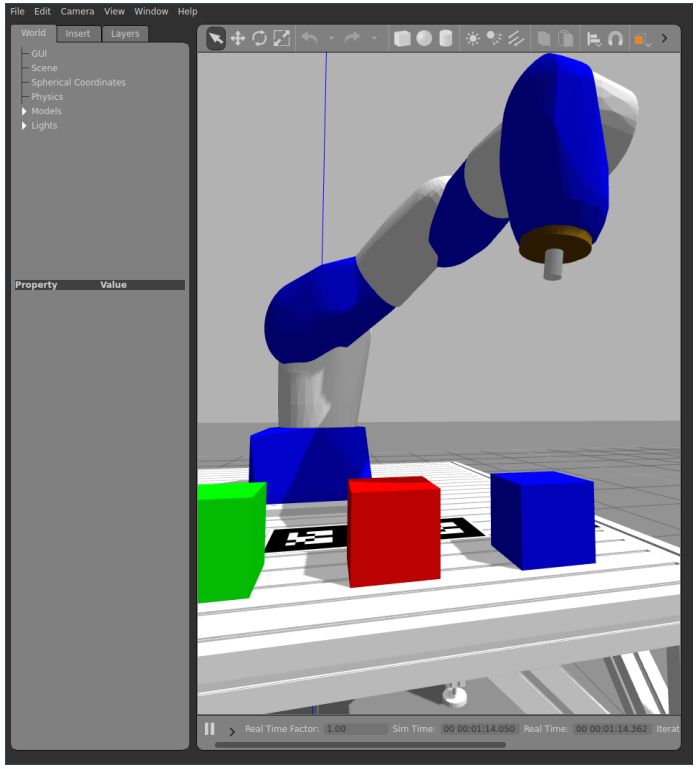
Simulation at a glance

- Simulation of the SIA10F robot
- Testing in a virtual environment
- Close to real testing
- Based on Gazebo Simulator
- 3D Simulation, Physics, Visual
- (Multi-Robot)
- Exchanges sensors and actuators with simulated ones



Simulation advantages

- Develop and test everywhere
- Cheap, fast, scalable way for testing
- Evaluate multiple test-runs on a server automatically
- Useful for integration testing



Gazebo Simulator

`http://gazebosim.org/`

- 3D Multi-robot simulator
- Physics simulation (ODE,Bullet)
- Open Source
- Widely used

⇒ Many existing models/plugins

- e.g. used in the Darpa Robotics Challenge

Gazebo Simulator - Building Blocks

World, Robots, Objects

- Built with **S**imulation **D**escription **F**ormat (SDF)
- XML-like modeling of parts, joints, sensors
- Advantages to URDF
  - URDF can only specify the kinematic and dynamic properties of a single robot in isolation.
  - URDF can not specify the pose of the robot itself within a world.
  - URDF can "only" describe robots (e.g. no lights)

Robot Control, Sensor Logic, World Logic

- Plugins written in C++
- Publisher/Subscriber messaging with Protocol Buffers (Protobuf)

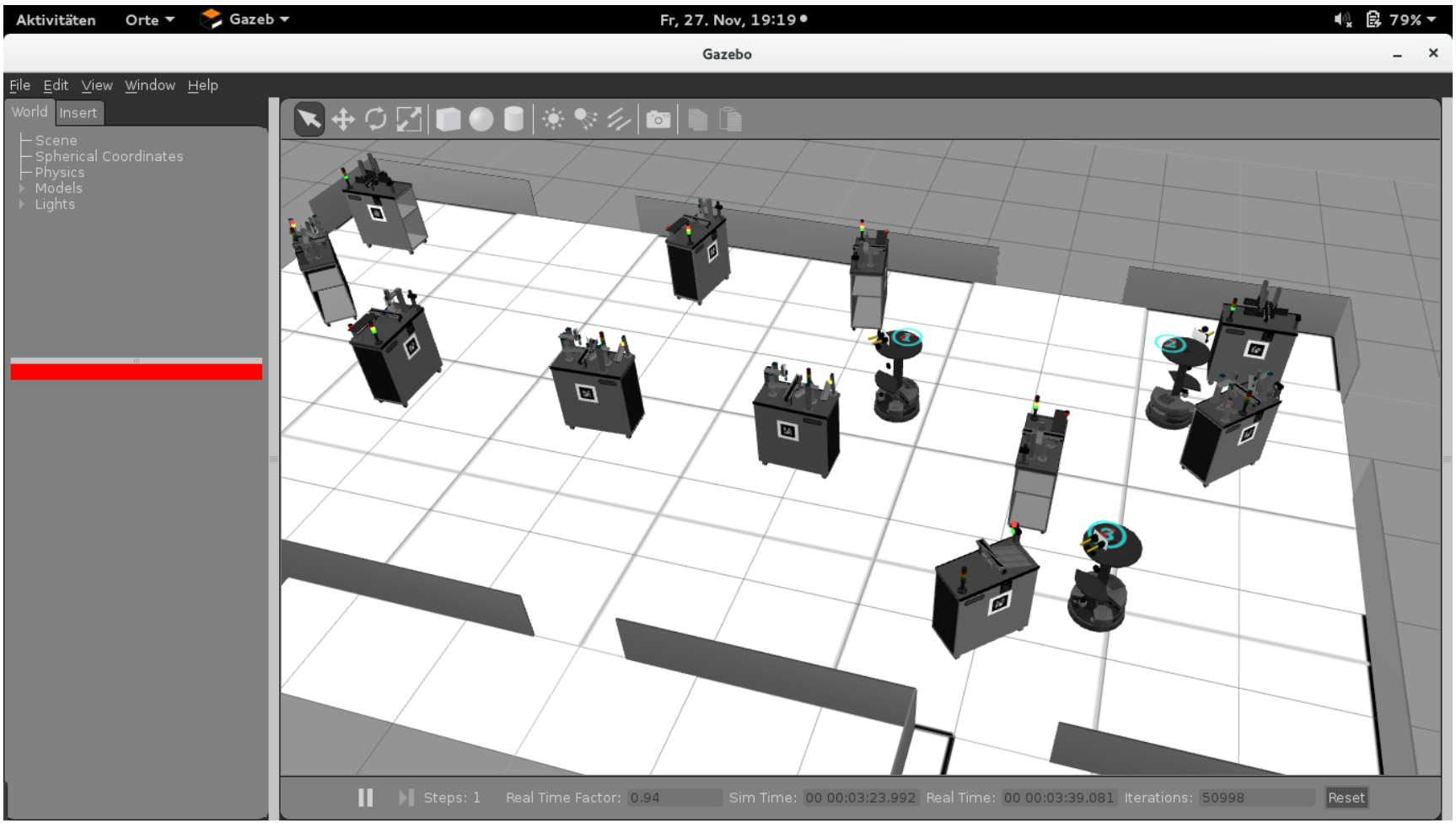
Gazebo - Interfaces

Gazebo
- Direct access through pub-sub middleware
- Allows integration with any existing software

ROS
- Widely used with Gazebo
- Gazebo integration exists for most sensors

Other software adapted
- Fawkes
- YARP
- MATLAB
- ...

RCLL Simulation - Demo



RCLL Simulation - Features

Actuators

- Robotino 3 (Motor Command)
- Logical Gripper

Sensors

- Laser-/Distance- Sensors
- Cameras
- Ground Truth Localization, Vision (e.g. Light Signal)

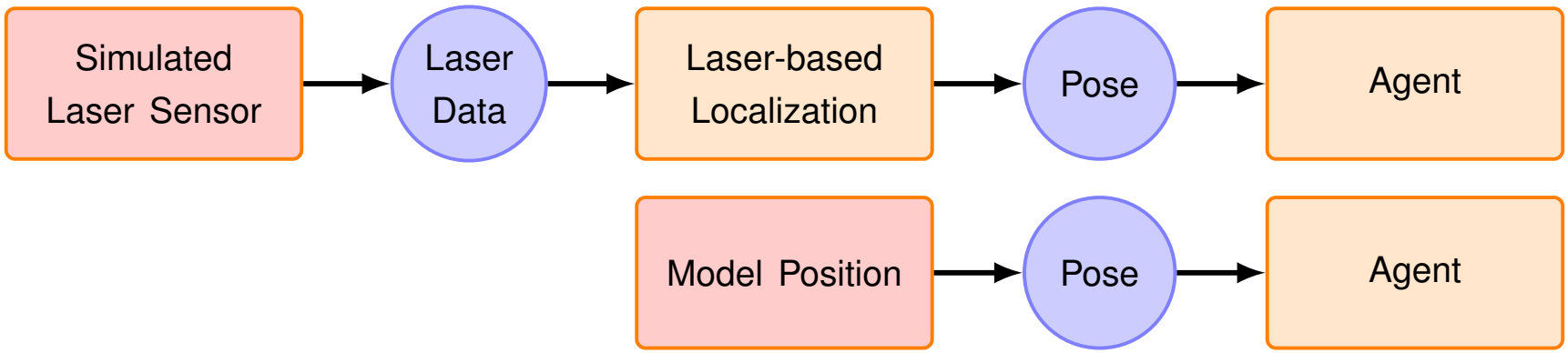
Game

- Physics simulation
- Refbox integration
- MPS and Light Signal simulation

Fawkes

- Already integrated (same interface as on real robot)
- Automated Simulation Runs/Competition

Multi-Level Abstraction



Higher level abstraction

- Bypass acquisition of sensor data
- Allows to run with fewer functional components

Lower level abstraction

- Generate sensor data from simulation
- Run functional processing components

Demonstration videos

- Simulation_FB8_Gazebo_Goethe.mp4
- MBZIRC_Simulation.mp4

Simulation Description Format (SDF) World

- Specification
  `http://sdformat.org`
- Load world with
  `gazebo llsf.world`
- Change simulation speed with step size and update rate
- Include other models with name
- Pose x,y,z,roll,pitch,yaw in parent frame
- Plugin used in World,Model,Sensor

```
<sdf version="1.4">
  <world name="LLSF">
    <physics type="ode">
      <max_step_size>0.004</max_step_size>
      <real_time_factor>1</real_time_factor>
      <real_time_update_rate>300
        </real_time_update_rate>
    </physics>

    <include>
      <uri>model://german_open_field</uri>
    </include>
    <include>
      <name>C-BS</name>
      <uri>model://mps_base</uri>
      <pose>-5 4.9 0 0 0 0</pose>
    </include>

    <plugin name="mps_spawn"
            filename="libmps_placement.so"/>
  </world>
</sdf>
```