European Robotics Challenges

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Boosting science through competition

http://www.dvice.com/2013-12-23/team-schaft-takes-top-honors-darpa-robotics-challenge

"UrbanChallenge StandfordRacingandVictorTango"
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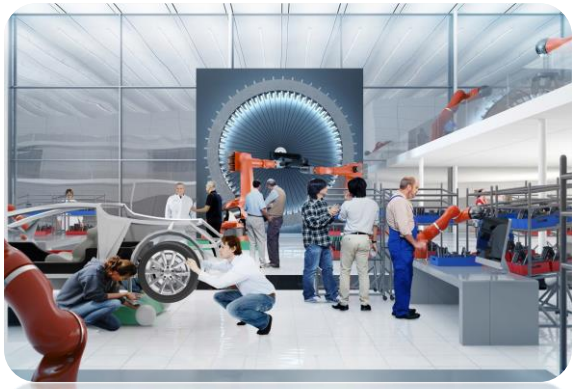
The European Challenges

- **Three industry-relevant Challenges**
  - Open call framework
  - Three stages of increasing complexity (incl. application experiments)
  - Benchmarking and performance evaluation on shared resources



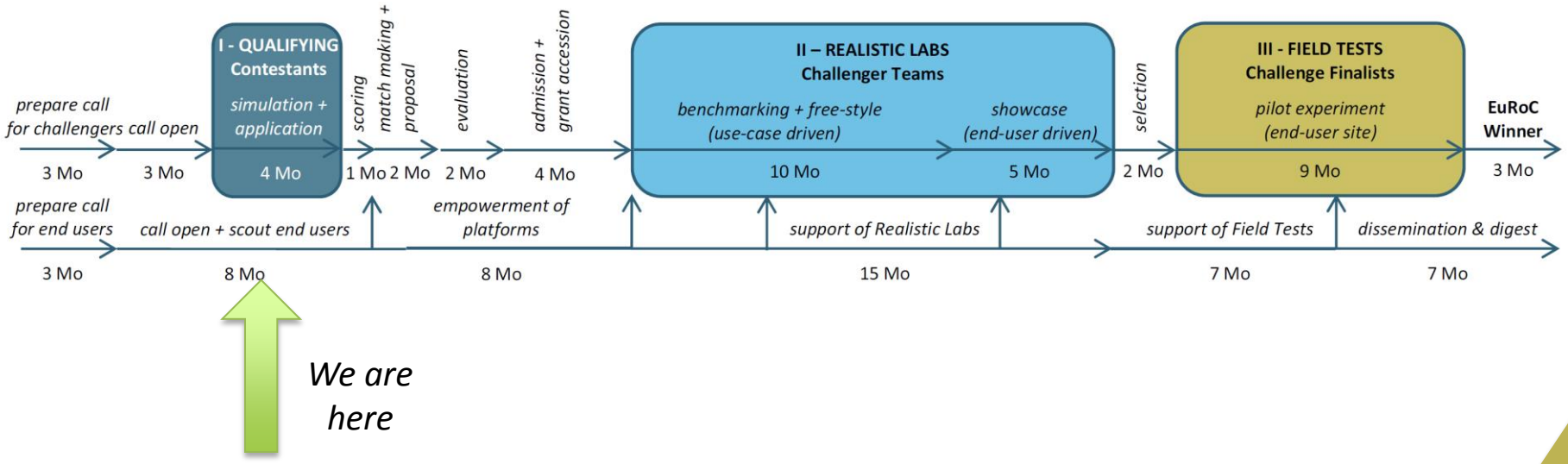
Reconfigurable Interactive Manufacturing Cell (RIMC)

Shop Floor Logistics and Manipulation (SFLM)

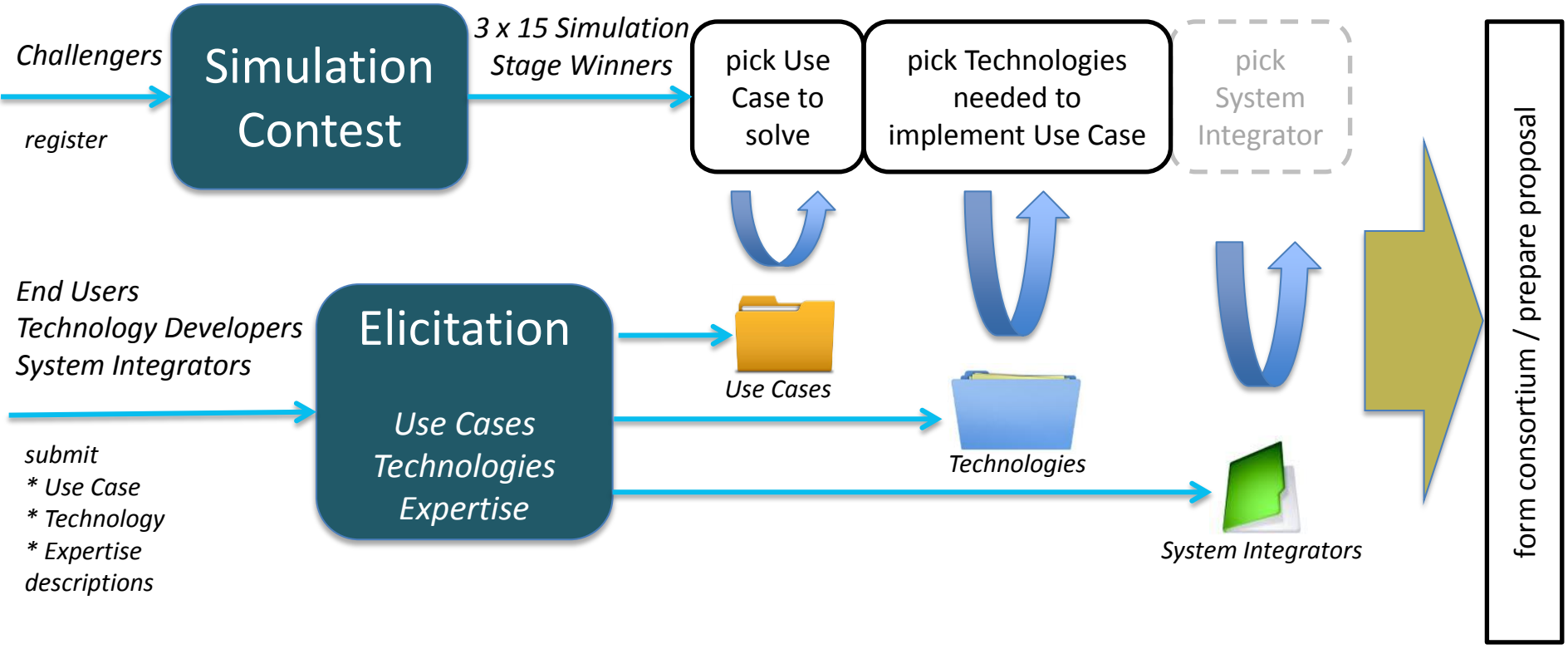
Plant Servicing and Inspection (PSI)

The Timeline

- **Launch:** 1 April 2014
- **Three challenges articulated in three stages**
  - QUALIFYING
  - REALISTIC LABS
  - FIELD TESTS
- **Duration:** 48 months



The Match Making



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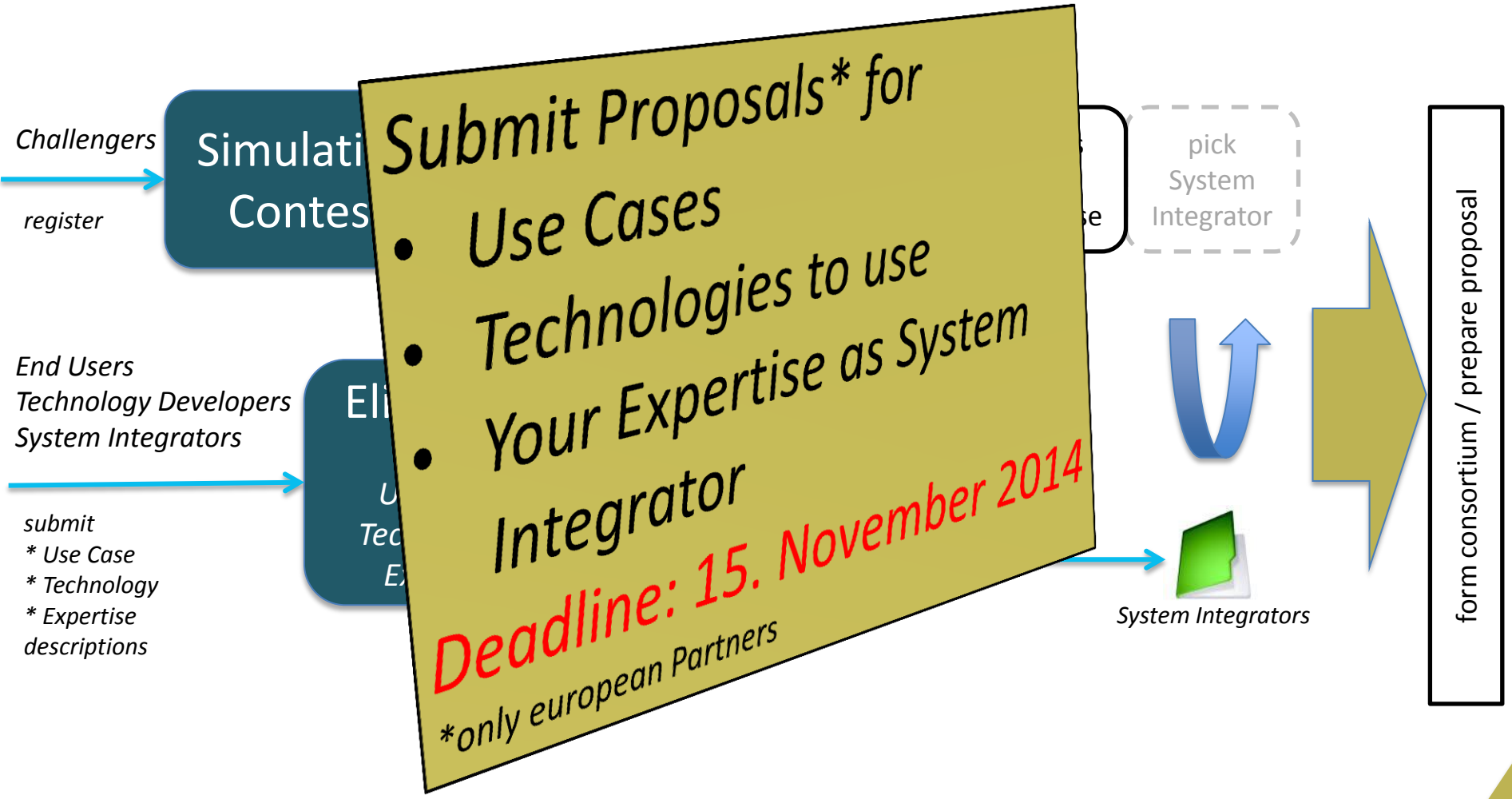
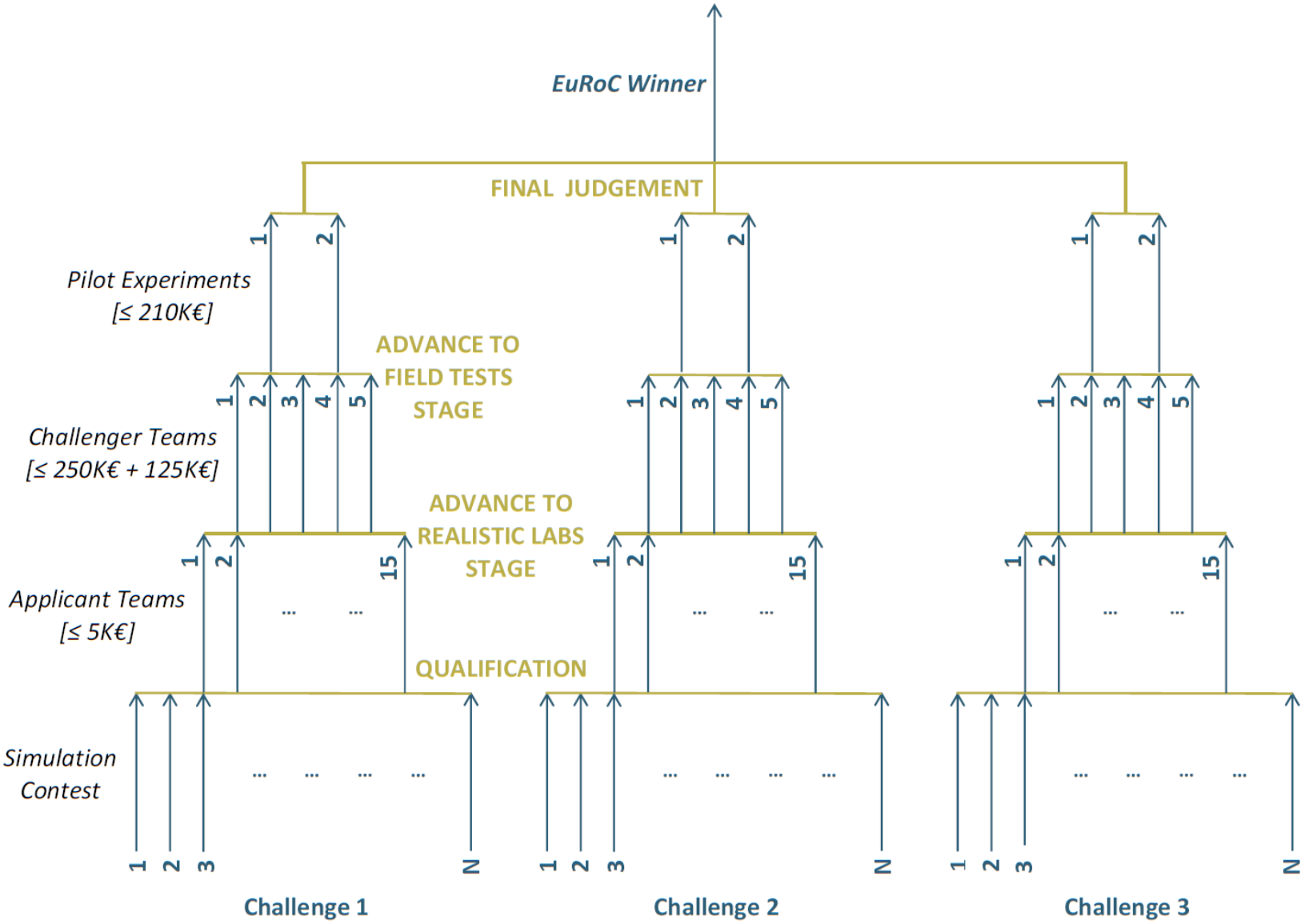


The Challenge Chart



Scoring

Example: Qualifying Stage

RIMC, Task 1

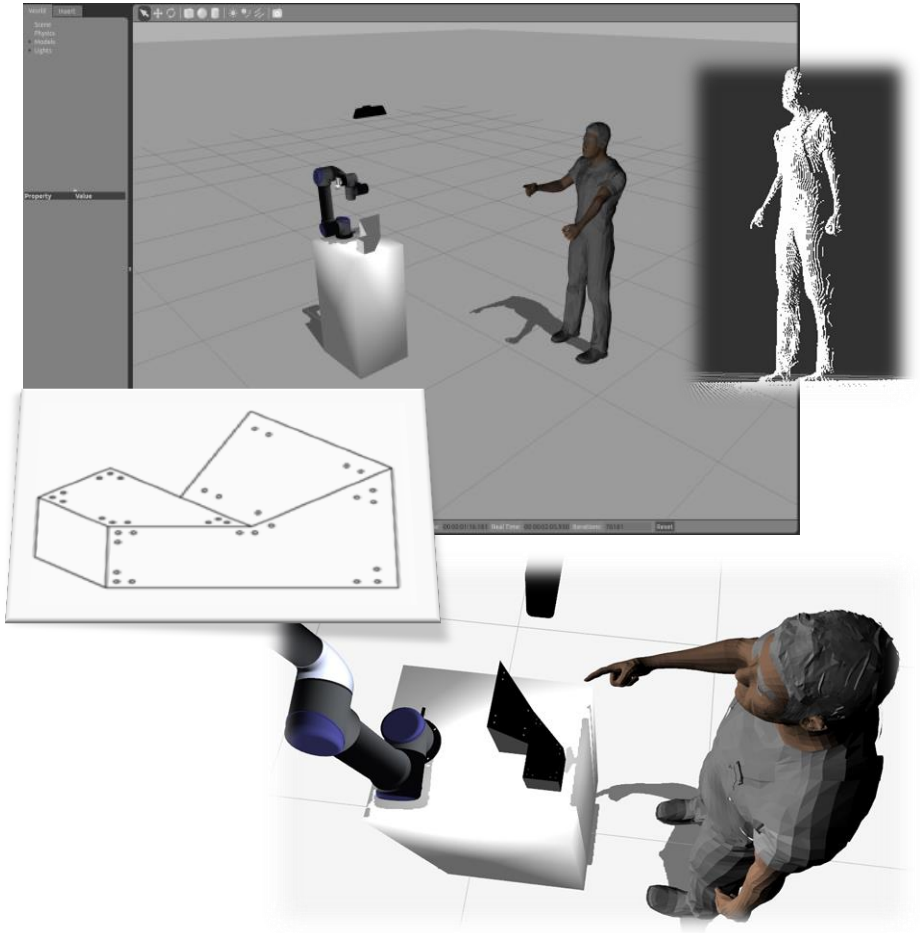
- **3 subtasks** (max. 10 Points each)
  - 1st Recognize the pointing gesture from the human (-> recognition rate)
  - 2nd Localize the box object based on its known geometry (-> accuracy)
  - 3rd Localize the position the human points to (on the box) (-> accuracy)
- **Preliminary scoring can be found at** http://www.euroc-project.eu/index.php?id=euroc_project0
- **Scoring example** for subtask 1

TASK 1					
TASK	**SUB-TASKS**	**BENCHMARK**	**METRICS**	**SCORING INTERVALS**	**POINTS GIVEN (MAX SCORE 30 POINTS)**
Derive from human gesture where the holes for riveting are *Total 30 points*	1. Recognize pointing gesture *Total 10 points*	1.1 Success of gesture recognition (20 gesture samples)	1.1A Number of correctly recognized pointing gestures (true positives) out of 20 tests (containing 10 true positives and 10 true negatives) Penalty points apply[1]	0-4 true positives	0
				5-7 true positives	2
				8-10 true positives	5
				10 true positives	10

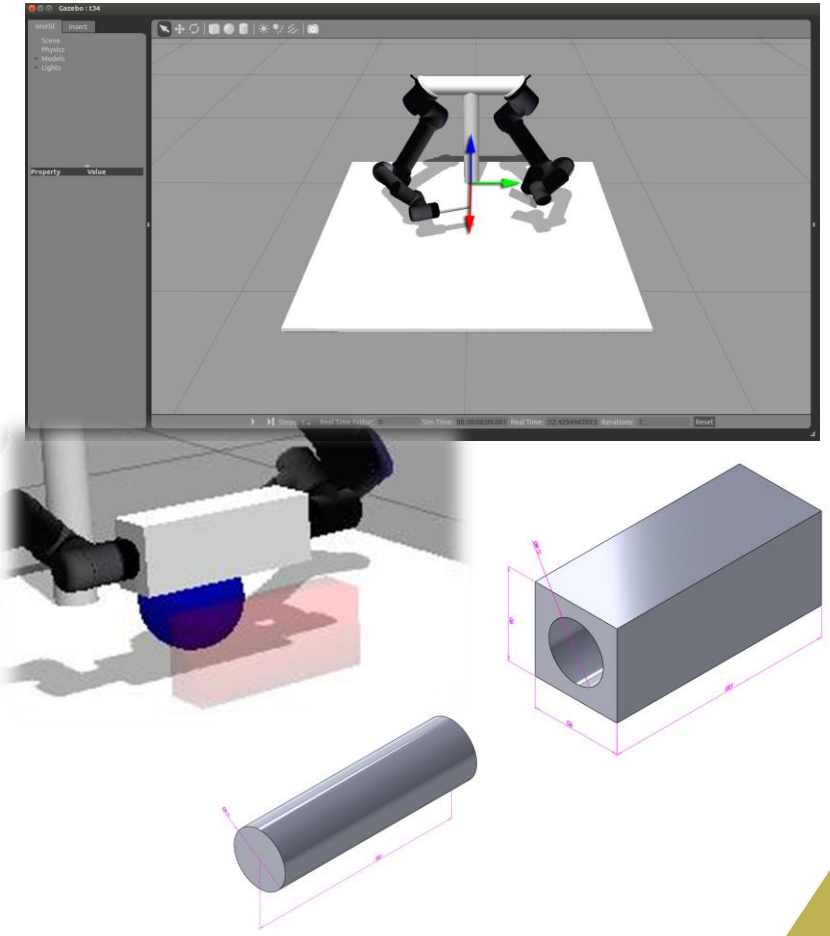
Technical Insights

Qualifying Stage - RIMC

Task 1: Human-robot collaboration



Task 2: Flexible dual-arm assembly



Technical Insights

Qualifying Stage - RIMC

Challenger Virtual Machine

- Ubuntu 12.04
- ROS Hydro

- Software Solution created by Challenger
- Additional Software packages, libraries, …

- Provided helper-functions, libraries, …
- Logging of Results

ROS Msgs

ROS Srvs

Simulation Virtual Machine

- Ubuntu 12.04
- ROS Hydro

- Gazebo server
  - Models
  - Scenes
  - Plugins
- State machine for task coordination
- Logging

Technical Insights

Qualifying Stage - RIMC

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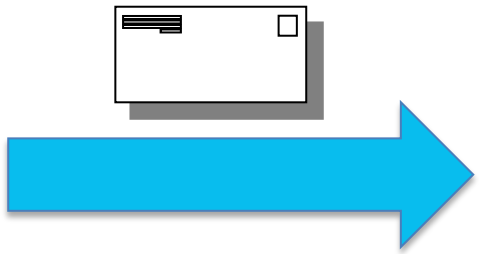
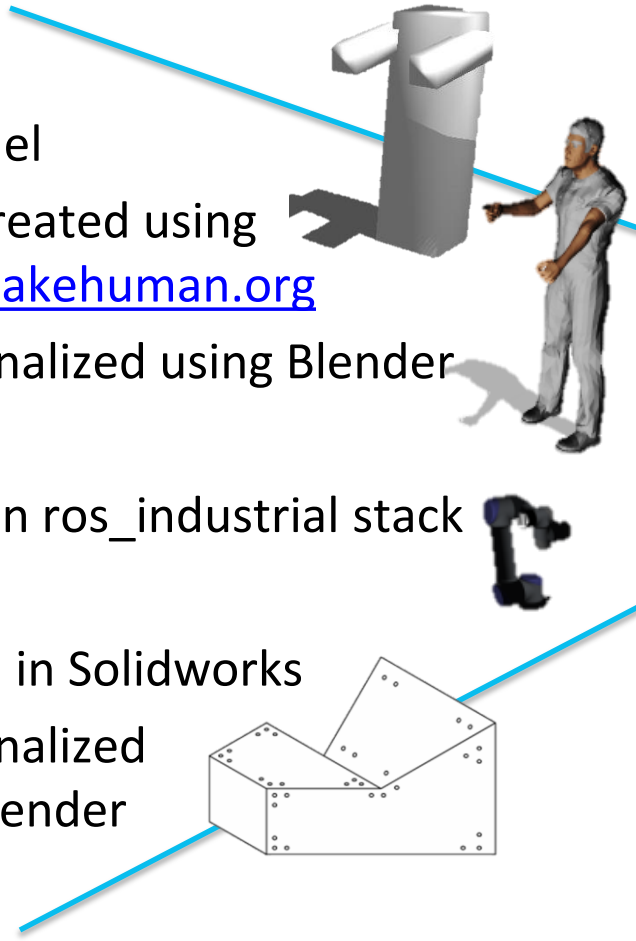


Evaluation

Technical Insights

Key facts

- Human model
  - Mesh created using www.makehuman.org
  - Mesh finalized using Blender
- UR5 Robot
  - Based on ros_industrial stack
- Work piece
  - Created in Solidworks
  - Mesh finalized using Blender



Simulation Virtual Machine

- Ubuntu 12.04
- ROS Hydro
- Gazebo server
  - Models
  - Scenes
  - Plugins
- State machine for task coordination
- Logging

Technical Insights

Key facts

- Human
  - Cartesian movement based on a mobile robot plugin
  - joint_effort_controller for arms
- UR5 Robot
  - joint_effort_controller
- Kinect sensors for human gestures
- Cameras attached to the robot tool
- Bumper plugin for collision detection

Simulation Virtual Machine

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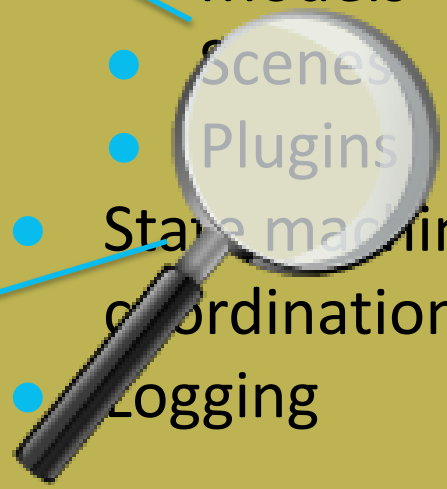
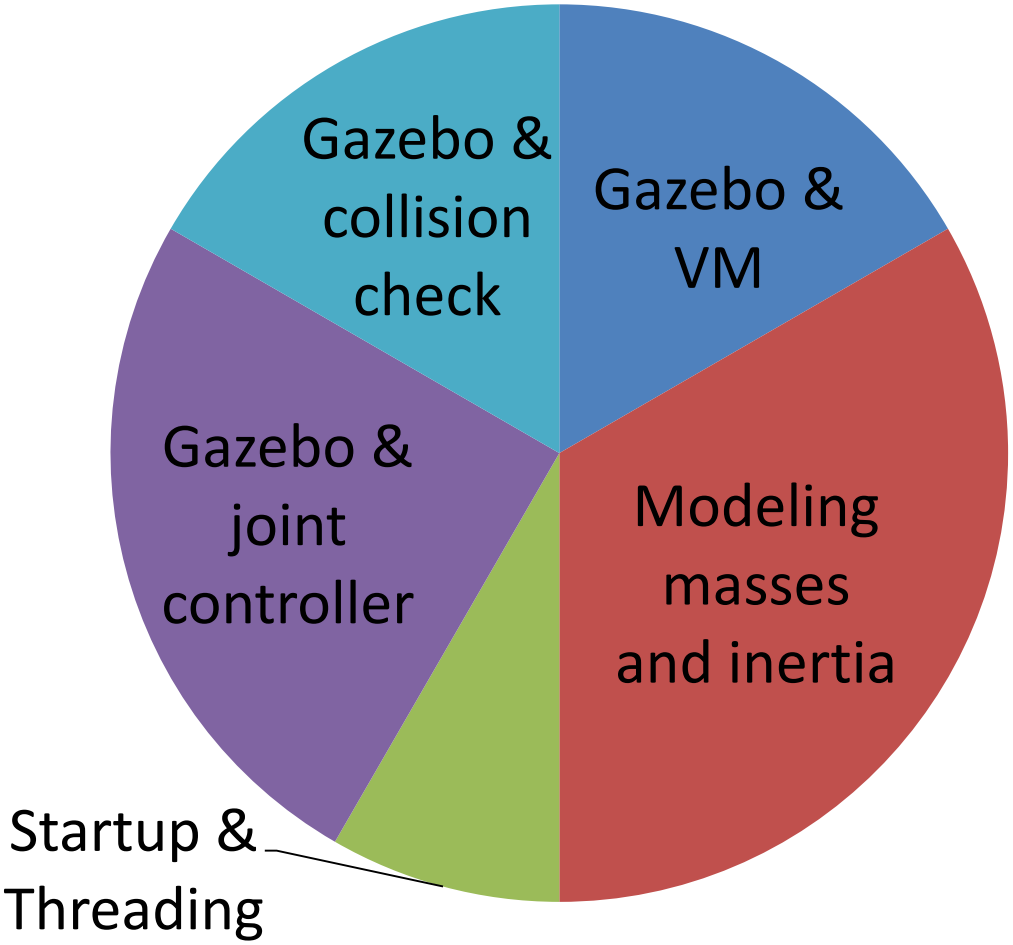


Technical Insights

Lessons learned



Technical Insights

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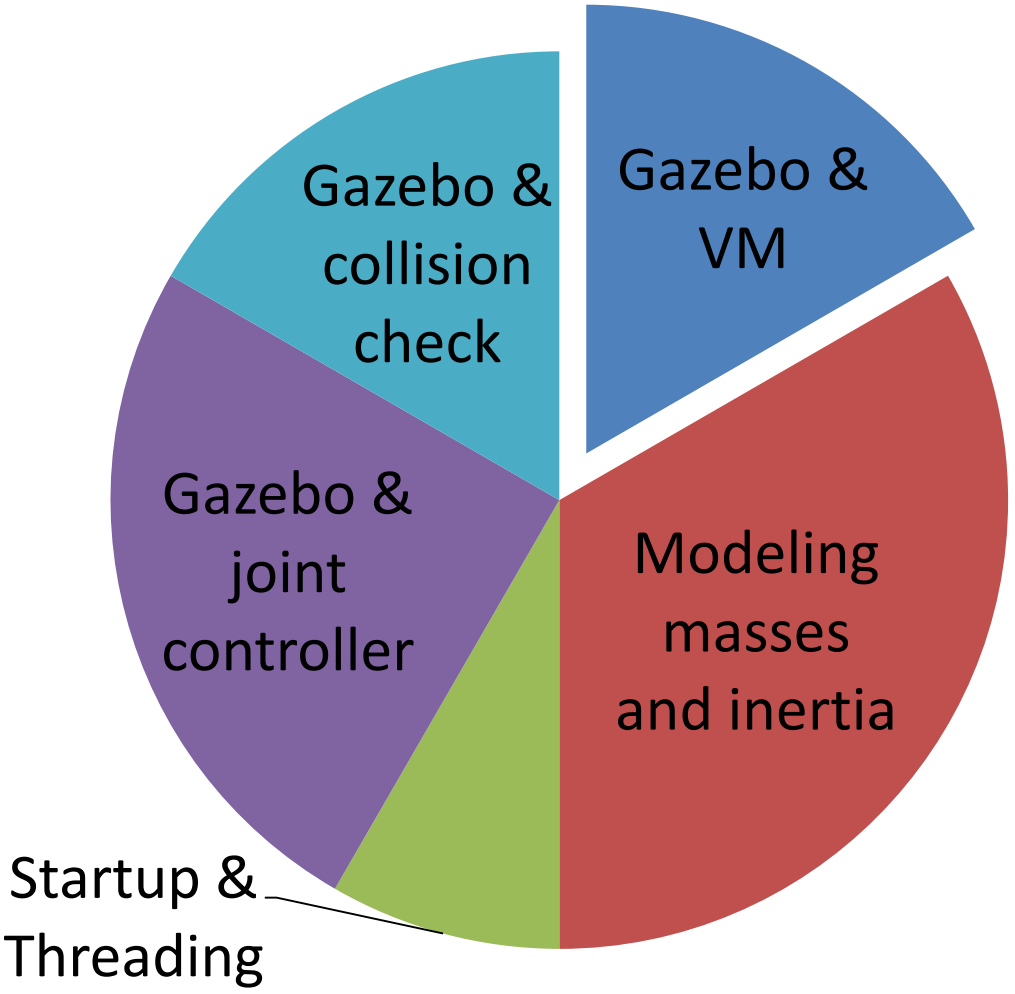

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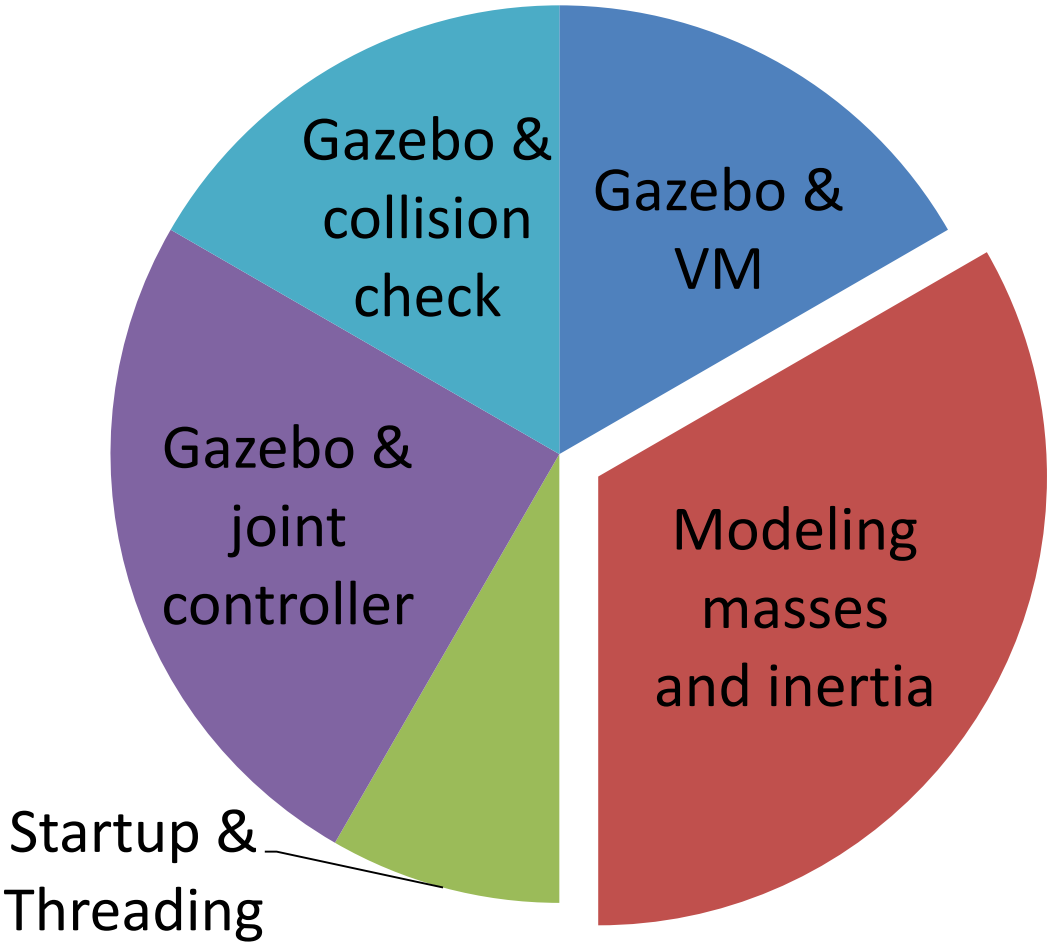

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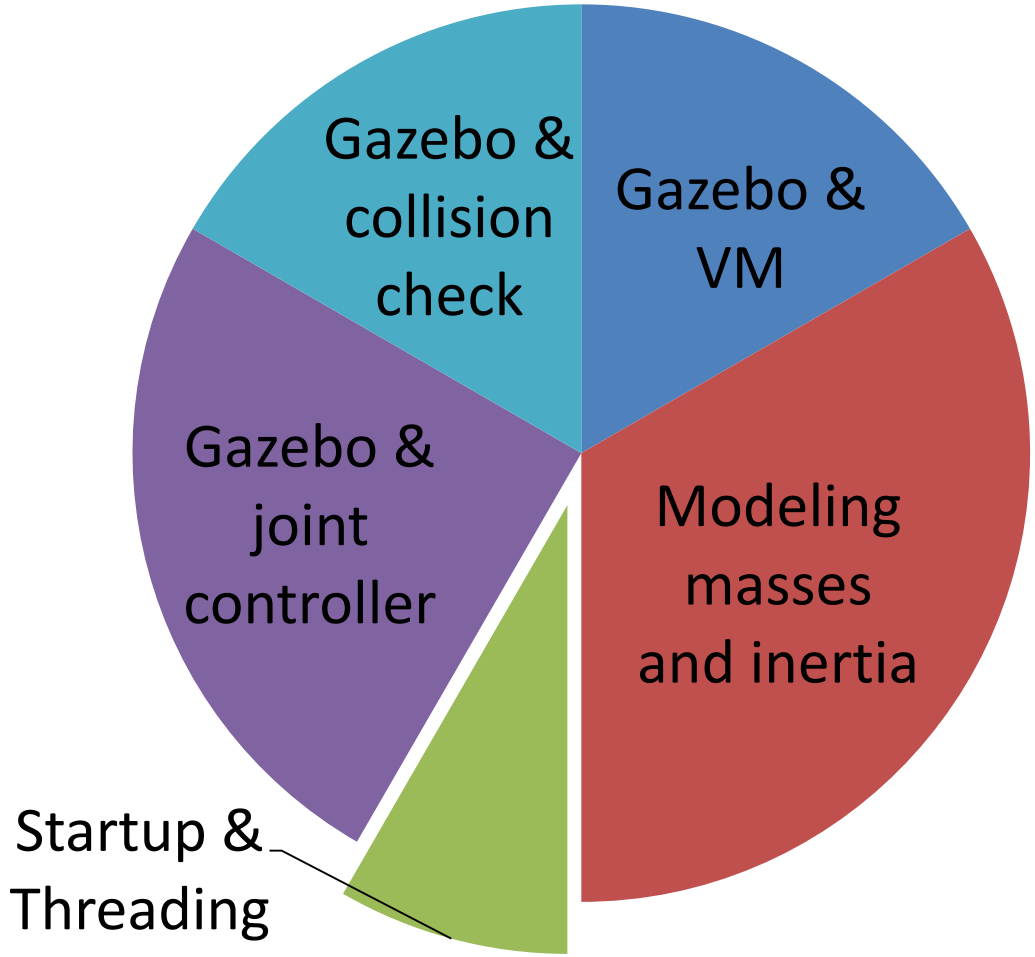

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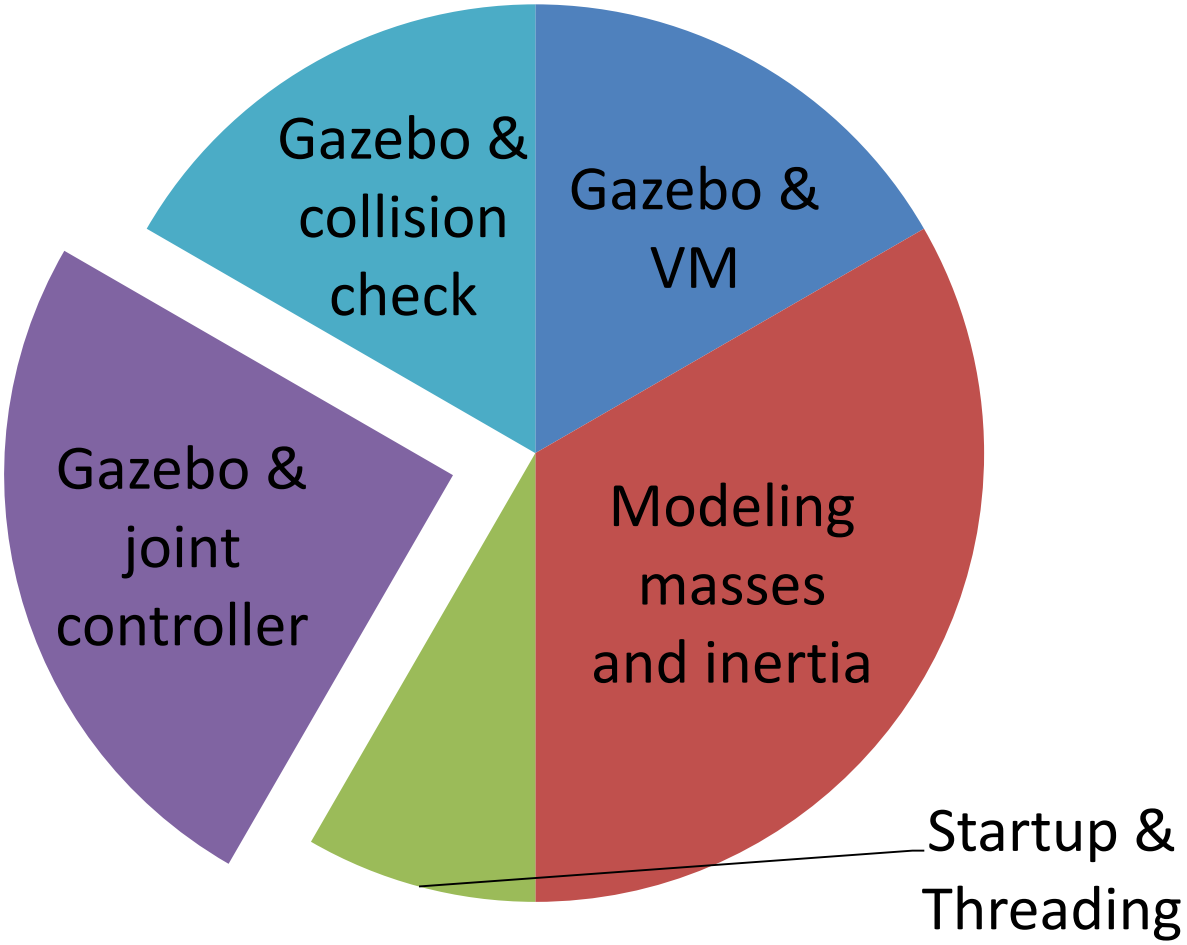

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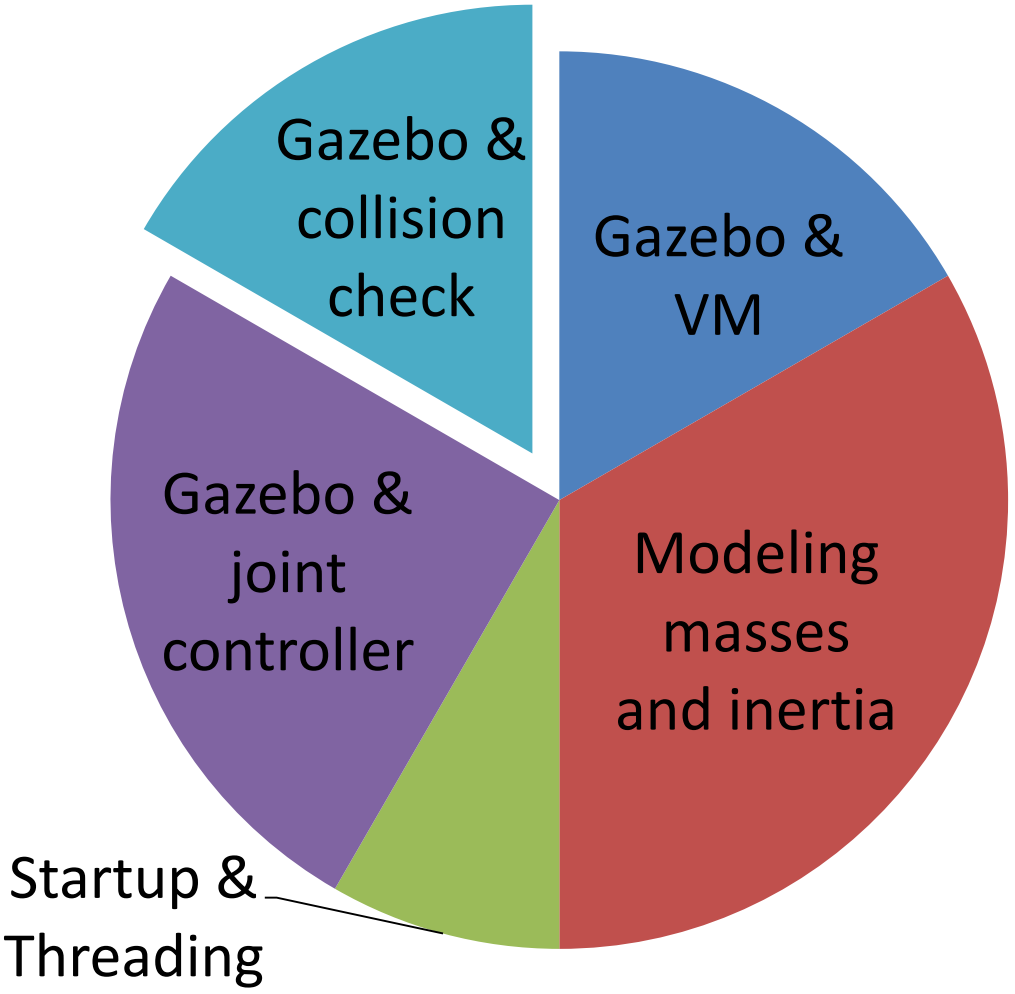

Summary

- **The European Robot Challenges are open**
- **Three industry-relevant Challenges**
  - Open call framework
  - Three stages of increasing complexity (incl. application experiments)
  - Benchmarking and performance evaluation on shared resources
- **Connecting Scientists, Engineers, Technology Provider, System integrators and Industry**
- **Submits are still possible until the 15th of November!**

- **Next EuRoC is planned in about 3 years! Be prepared.**

European Robotics Challenges