

Robot Competitions Kick Innovation in Cognitive Systems and Robotics



Matteo Matteucci (POLIMI), Pedro U. Lima (IST-ID)
(ERF 2014 Workshop on Competitions)

RoCKIn Latest News

Competition Events



Camps and
Community Building



Benchmarking



RoCKIn@Work

RoCKIn@Home

Dissemination



Test Beds



Camps

2013 Kick-off Camp during RoboCup 2013 (Eindhoven)

- 12 Individual participants from 8 countries

2014 RoCKIn Camp (Rome)

- 63 Individual participants from 13 countries
- 19 teams (9 @Work, 10 @Home)



Venue of 2013 RoCKIn Kickoff Camp

Co-located with RoboCup 2013 at the Genneper Park in Eindhoven, in the Indoor Sports Center (June 28-30, 2013).



Last day the Camp was co-located with the RoboCup Symposium in the Auditorium of Eindhoven TU (July 1st, 2013).

Participants of 2013 RoCKin Kickoff Camp

12 Individual participants from 8 nations.



Selection from the RoCKin technical board.
Awareness of RoCKin also among RoboCup participants.



Venue of 2014 RoCKIn Camp

Antoniano Auditorium



Lectures at Dipartimento di Ingegneria Informatica e Gestionale



RoCKIn

Participants of 2014 RoCKin Camp

19 teams: 8 +1 @Work and 10 @Home

+ 5 individual participants (total 63 participants from 13 countries)

@HOME Track	10 teams	7 robots (5)
Team PAL Robotics	PAL Robotics	Spain
Team Assistobot B.V	Assistobot B.V.	The Netherlands
Team MAiRAp	Universitat Politècnica de Catalunya	Spain
Team CIT	Technical University of Kosice	Slovakia
Team SocRob@Home	Instituto Superior Técnico (Lisbon)	Portugal
Team homer@UniKoblenz	Univ. Koblenz-Landau	Germany
Team Watermelon Project	Universidad de León	Spain
Team PANDORA Robotics	Aristotle University of Thessaloniki	Greece
Team BORG	University of Groningen	The Netherlands
Team BARC	University of Birmingham	United kingdom
Team Mix @home	Dublin/Bremen/Izmir	Ireland/Germany/Turkey

Participants of 2014 RoCKin Camp

19 teams: 8 +1 @Work and 10 @Home

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@WORK Track	9 teams	7 robots (5)
Team IAS-Lab	University of Padua	Italy
Team Robotic team Gymspit	FEL CTU	Czech Republic
Team UvA@Work	Universiteit van Amsterdam	The Netherlands
Team Binary-b-it-bots	Bonn-Rhein-Sieg Univ.	Germany
Team b-it-bots-Neo	Bonn-Rhein-Sieg Univ.	Germany
Team METALHEADS	Ecole Centrale de Nantes	France
Team ISEP@Work	ISEP Porto	Portugal
Team youBot-Team Aachen	RWTH Aachen University	Germany
Team SPQR@Work	Sapienza Univ. Roma	Italy

Invited Speakers

- *Vision based (RGB-D) pattern recognition, object detection and localization* Michael Zillich (TU-Wien)
- *Object grasping and manipulation*, Norman Hendrich (Hamburg U.)
- *Human-robot interaction in natural language*, Matthew Walter (MIT)

Every day: *Benchmarking X (object recognition, manipulation, HRI)*
M. Matteucci, A. Bonarini (POLIMI)

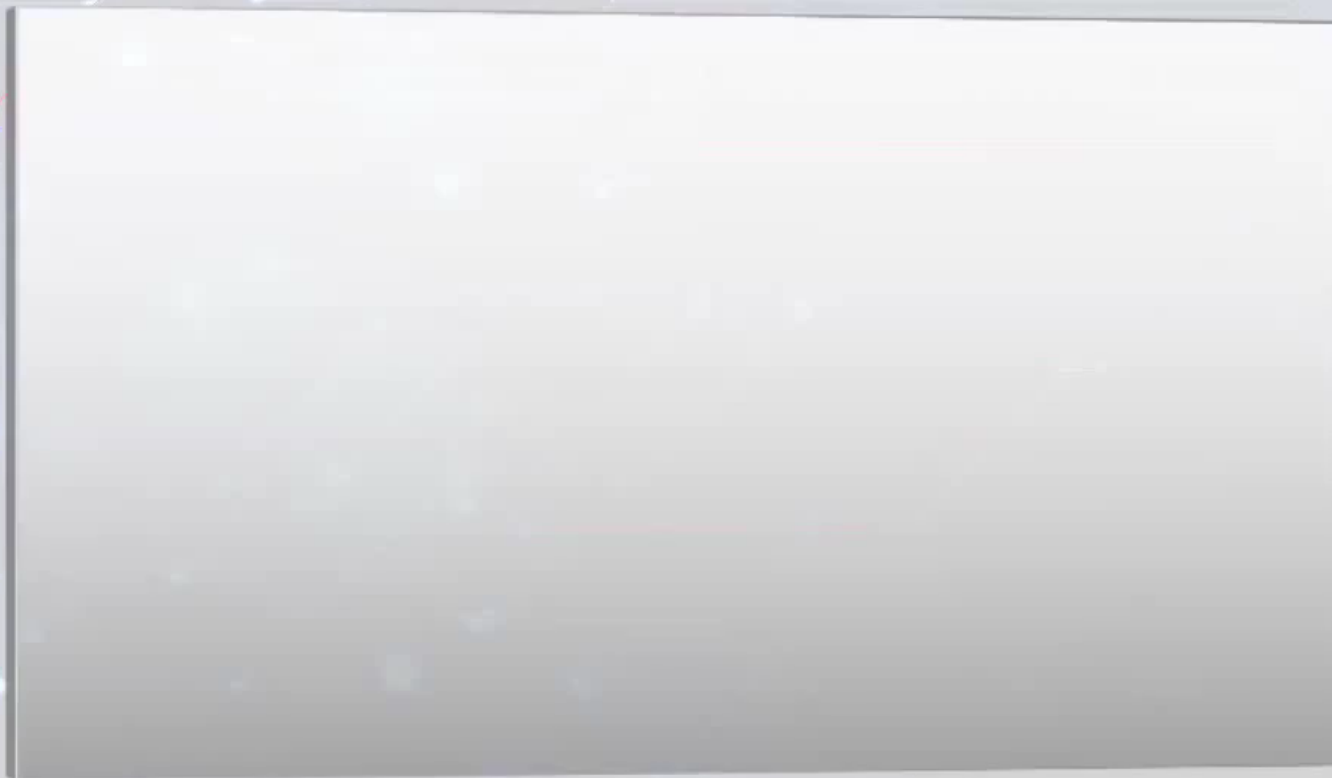
Practical support:

Jacopo Serafin, Roberto Capobianco, Emanuele Bastianelli (UNIROMA1)



2014 RoCKIn Camp Video

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RoCKIn

RoCKIn Competition 2014 (1)

- **La Cité de L'Espace, Toulouse,**
on 25-30 November 2014
(during the 2014 European Robotics Week / ERW 2014)
- co-located events:
 - research workshop on HRI and
 - workshop industry-meets-academia
- 20 teams expected (~ 10 @Work, 10 @Home)



Potential support by the City of Toulouse
and the Toulouse region
Core of a big event on S&T dissemination

Co-organized by Rachid Alami/LAAS



RoCKIn Competition 2014 (2)

- Call for Intention to Participate Open!
- Important Dates:
 - Rulebook online: 01 April 2014
 - Intention to participate deadline: 15 April 2014
 - Application deadline: 09 May 2014 (for all teams, even if no intention to participate was declared)
 - Decision on Qualified Teams: 31 May 2014
 - Registration open: 01 June 2014 - 1 July 2014 (for the qualified teams only)



Sponsorship (e.g., Team Travel Support)

- Securing sponsorship for RoCKIn Competition 2014
 - Platinum event sponsor,
 - Registration sponsor,
 - RoCKIn@Work sponsor,
 - RoCKIn@Home sponsor
 - + custom packages



The poster features a stylized tree where the branches are composed of white circuit traces on a black background. At the base of the tree, a robotic arm is depicted. Below the tree, the word "ROCKIN" is written in a large, metallic, 3D-style font. Underneath the name, the text "Competition Event 2014" is in a blue italicized font, followed by "Toulouse, France" in a smaller white font, and "24 November - 1 December 2014" in a smaller white font. At the bottom of the poster, the words "SPONSORSHIP PACKAGES" are written in a bold, orange, sans-serif font.

Using competitions to innovate for smarter, more dependable robots at home and at work.

RoCKIn is an EU robotics project that will run until 2015, consisting of competition events, symposiums, educational camps and workshops. Building on the principles of challenge-driven innovation laid down by RoboCup, the project aims to facilitate cognitive and networked robot systems' testing, and streamline research and development through standardized testbeds and benchmarks. Ultimately we want to spur the development of smarter, more dependable robots at home and at work.

"Robotics Competitions Kick Innovation in Cognitive Systems and Robotics"



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RoCKIn approach to benchmarking

Hey look Ma! No hands!

“One-time demonstrations of robot performance (e.g., grand challenges or other competitions) in robotics are one way of comparing the performance of robots, but they do not necessarily prove that one's robotics research is consistently better or worse than another lab's.”

Leila Takayama (Google[x], formerly at Willow Garage)

“Towards a Science of Robotics: Goals and Standards for Experimental Research”

- Benchmarking activities in RoCKIn are aimed at
 - Inspiring the design of competitions to allow for benchmarking
 - Designing suitable metrics for the competitions (and for robotics)
 - Applying such metrics during the competitions
 - Comparing results after the two competitions



Competitions as Experiments

“Challenge and competition events in robotics provide an excellent vehicle for advancing the state of the art and evaluating new algorithms and techniques in the context of a common problem domain.

[...] treat competitions and challenges as repeatable experiments.”

Monica Anderson, Odest Chadwicke Jenkins, and Sarah Osentoski
“*Recasting Robotics Challenges as Experiments*”

The experimental method suggest experiments to allow for:

- Comparison
- Reproducibility / repeatability
- Justification / explanation



What Makes an Experiment

Comparison: to know what has been already done in the field, to avoid the repetition of uninteresting experiments, and to get hints on promising issues to tackle.

Reproducibility and repeatability: they are related to the idea that scientific results should be severely criticized to be confirmed; reproducibility is the possibility for independent scientists to verify the results of a given experiment by repeating it with the same initial conditions, instruments and techniques; repeatability is the property of an experiment that yields the same outcome from a number of trials performed at different times and/or in different places.

Justification and explanation: it is not sufficient to collect as many precise data as possible, but it is also necessary to look for an explanation, namely all the experimental data should be interpreted in order to derive the correct implications that lead to the conclusion.



Functional and task benchmarks

- Competitions may challenge robots at two different levels (ability vs capability in SRA?)
 - Task Level: evaluation of whole systems on a specific task (e.g., the “bring me the glasses” tasks)
 - Functionality Level: evaluation of modules implementing, in a general manner, functionalities required by the competition tasks (e.g., grasping and manipulation)
- Benchmarking competitions should allow independent evaluation at both levels
 - To encourage participation of people interested in specific aspects of robotics (e.g., object recognition)
 - To evaluate at what extent the interplay among modules is relevant (e.g., the precision in positioning before grasping)



RoCKIn “Episode I” and related tasks

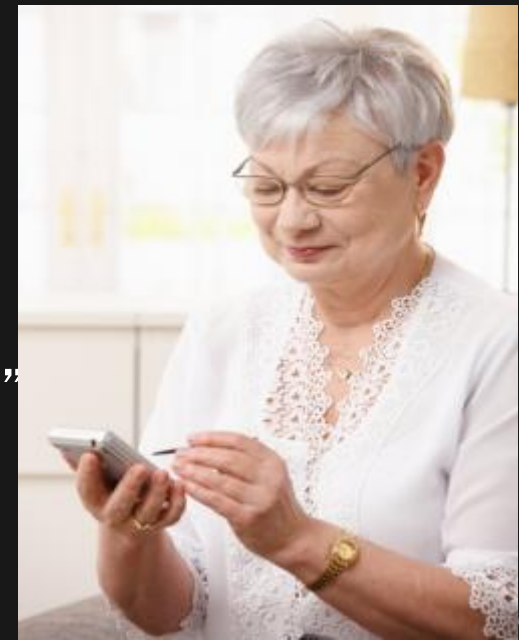
User Story: Granny Annie

Granny Annie is a nice but slightly seasoned lady. Luckily, she could get into a new program, sponsored by her health & social security insurances, by which elderly people are supplied with household and elderly care robots to assist in managing and mastering their daily lives.

- Task: “Getting to know my home”

Granny Annie is waking up and today she feels a bit tired because she has not slept very well. Still a number of tasks need to be taken care of. The home robot will help her in all these tasks.

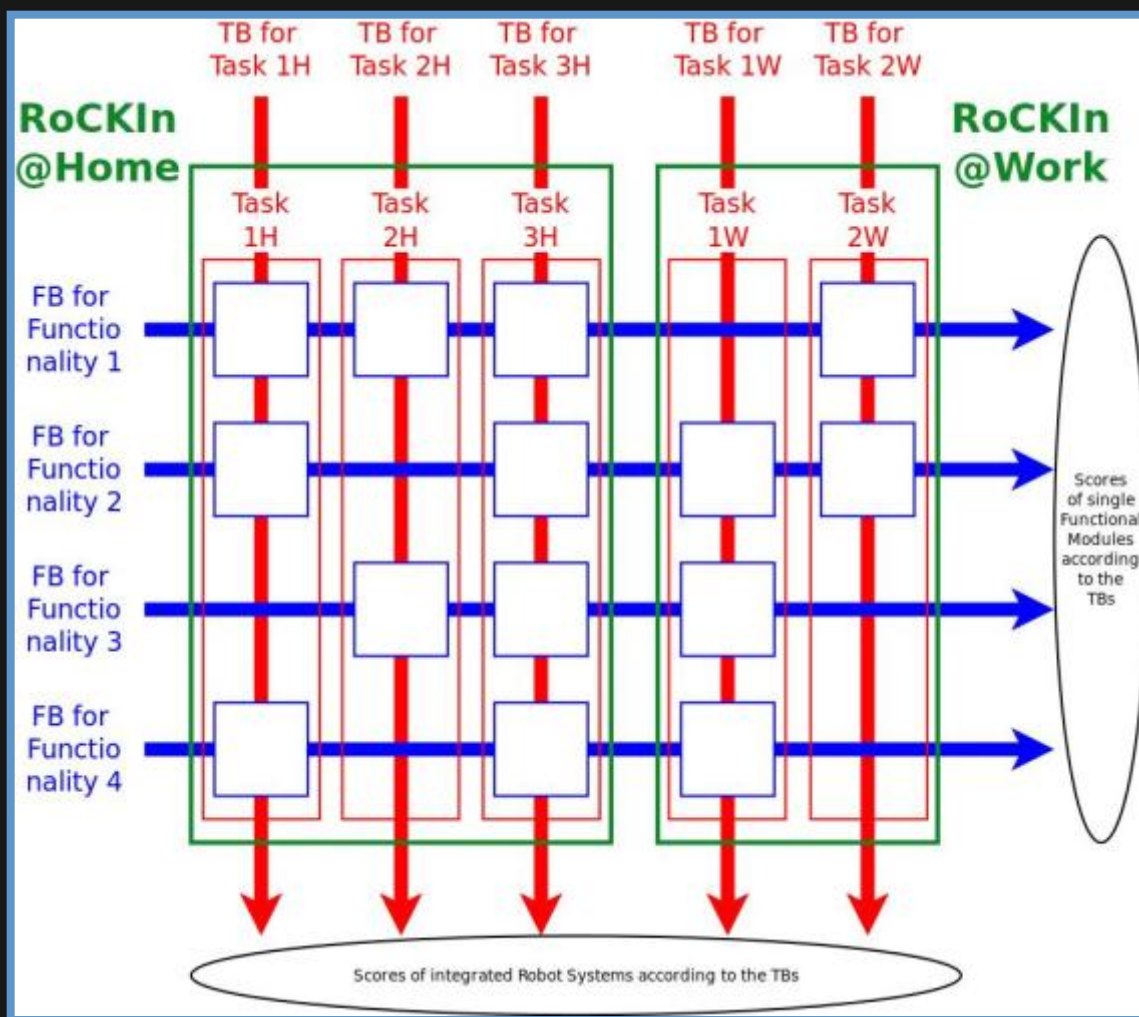
- Task: “Catering for Granny Annie’s comfort”
- Task: “Welcoming visitors”
- ...



What functionalities for Granny Annie?

	welcome	bedroom	pets	glasses	visitor
Task Planning	(X)	(X)	X	X	X
Autonomy ¹	(X)	(X)	X	X	X
Geometric Mapping (or SLAM)	X	-	-	-	-
Semantic Mapping (or SLAM)	X	-	-	-	-
Self-localization	-	X	X	X	X
Path planning (mobile base)	(X)	X	X	X	X
Path following (mobile base)	-	X	X	X	X
Object recognition	(X)	X	X	X	-
Object state perception	-	X	X	-	X
Object tracking	-	-	X	-	-
Face detection	-	-	-	-	X
Face recognition	-	-	-	-	X
Path planning (arm)	-	(X)	X	X	-
Path following (arm)	-	X	X	X	-
Grasp planning	-	(X)	X	X	-
Grasp execution	-	X	X	X	-
Operate physical devices (e.g., doors, switches)	-	X	X	-	X
Input from humans through Data	-	X	-	X	-
Input from humans through Gesture	(X)	-	-	X	-
Input from humans through Speech	X	X	X	X	X
Output to humans through Display	-	-	-	X	X
Output to humans through Speech	(X)	X	X	X	X
Interactive communication with humans	-	-	-	X	X
Data exchange with physical devices	-	-	-	X	-
...					

A big picture ...



RoCKIn@Home Tasks & Functionalities

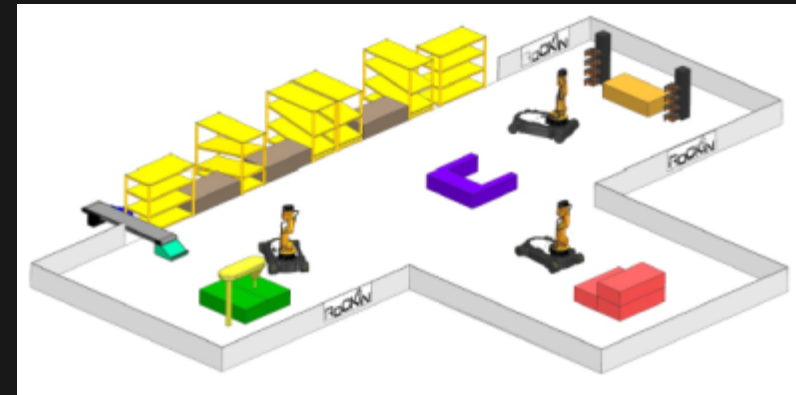
- Tasks Benchmarks
 - Comfort Providing Task Benchmark
 - Visitor Handling Task Benchmark
 - Environment Learning Task Benchmark
- Functionality Benchmarks
 - Object Perception Functionality Benchmark
 - Object Manipulation Functionality Benchmark
 - Speech Recognition Functionality Benchmark



RoCKIn@Work Tasks & Functionalities

- Tasks Benchmarks

- Assemble-Aid-Tray Task Benchmark
- Plate Drilling Task Benchmark
- Fill a Box Task Benchmark



- Functionality Benchmarks

- Object Perception Functionality Benchmark
- Visual Servoing Functionality Benchmark
- Planning and Scheduling Functionality Benchmark



RoCKIn Functional Reference Platform

- RoCKIn FRP for Benchmarking
 - aims at defining functionalities required by RoCKIn benchmarks
 - aims at identifying functionalities that require “internal” data to be benchmarked and the interfaces for getting these data
 - aims at identifying in a focused way the possible variability of a setup, suitable metrics and a scoring mechanism
- Different functionalities, different benchmarks:
 - Some functionalities can be measured and benchmarked “externally” (e.g., position in pick-and-place)
 - Some functionalities of robots require “internal” data to be measured and benchmarked (e.g., accuracy of maps used for path or trajectory planning)



RoCKIn



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- Find out more:
 - <http://rockinrobotchallenge.eu>
 - Twitter: @RoCKInchallenge
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