

# *The first meeting of IEEE RAS TC on* **RoboCup**

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May 18, 2016

Stockholm Waterfront Congress Center (SWCC)



1. Self Introductions
2. Introduction of our TC
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## America:

Manuela Veloso, Carnegie Mellon University, Pittsburgh, USA  
Peter Stone, University of Texas, Austin, USA  
Amy Eguchi, Bloomfield College, USA  
Adam Jacoff, National Institute for Standards and Technology, Washington DC, USA  
Daniel D. Lee, University of Pennsylvania, USA  
Tucker Balch, Georgia Institute of Technology, USA  
Eric Chown, Bowdoin College, USA

## Europe:

Daniele Nardi, Sapienza University, Rome, Italy  
Gerhard Kraetzschmar, Bonn-Rhein-Sieg University of Applied Sciences, Sankt Augustin, Germany  
Luca Iocchi, Università di Roma La Sapienza, Italy  
A. Fernando Ribeiro, Universidade do Minho, Portugal  
Tijn van der Zant, University of Groningen, The Netherlands  
Oskar von Stryk, Technische Universität Darmstadt, Germany  
Luis Almeida, Universidade do Porto, Instituto de Telecomunicações, Portugal  
Sven Behnke, Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

## Asia/Oceania:

Itsuki Noda, National Institute of Advanced Industrial Science and Technology, Japan  
Hiroaki Kitano, Systems Biology Institute, Tokyo, Japan  
Minoru Asada, Osaka University, Japan  
Changjiu Zhou, Singapore Polytechnic, Singapore  
Claude Sammut, University of New South Wales, Sydney, Australia  
H. Levent Akin, Bogaziçi University, Istanbul, Turkey  
Oliver Obst, CSIRO Computational Informatics, Australia  
Komei Sugiura, National Institute of Information and Communications Technology (NICT), Japan

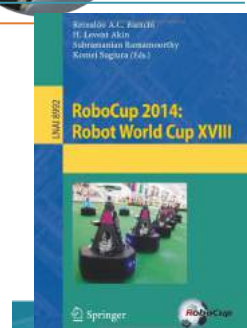
In addition to the list (Trustees of RoboCup Federation), we have a mailing list of more than 5000 RoboCuppers who are big potential of this TC members.

- Pedro Lima, Instituto Superior Tecnico, Lisbon, Portugal
- Martin Riedmiller, University of Freiburg, Germany
- Satoshi Tadokoro, Tohoku University, Sendai, Japan
- Sami Haddadin, University of Hannover, Germany
- Rodney Brooks, Rethink Robotics, USA
- Raffaello D'Andrea, EHT, Switzerland
- Chad Jenkins, Brown University, USA
- Edwin Olson, University of Michigan, USA
- Martial Hebert, Carnegie-Mellon University, USA
- Luc Steels, Sony CSL Paris, University of Brussels, Belgium
- Dieter Fox, University of Washington, USA
- Auke Ijspeert, EPFL, Switzerland
- Ulises Cortés, Technical University of Catalonia, Spain

## 2.1 Motivation

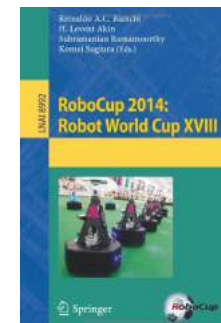


- **RoboCup**, founded in the mid 90s, has been a vehicle to promote robotics and AI research, by offering a publicly appealing, but formidable challenge.
- Building a team of robots in environments with great uncertainty (soccer, rescue) will have significant social and economic impact, and reaching the specific soccer 2050 goal will certainly be considered a major achievement for the scientific fields of Robotics and AI.
- ***The main purpose of the TC on RoboCup is to further share the challenges pursued by RoboCup researchers with the RAS community.***
- TC on RoboCup plays a role as a bridge connecting robotics and AI communities, and another bridge with the existing TCs related to TC on RoboCup by promoting soccer, rescue, and @home competitions.



Forum for AI and robotics technologies and researchers as RAS TC on RoboCup:

1. Multi-robot teamwork in the presence of adversarial and highly uncertain environments
2. Human-robot interaction in daily life and crisis environments
3. Verify models and systems through RoboCup competitions and symposia, WS and organized sessions at ICRA, IROS, IJCAI, AAAI.



- The main focus → cooperative multi-robot and multi-agent systems (fully autonomous) in dynamic adversarial environments.
1. **Wheel-based mobile robots:** intelligent multi-robot/agent cooperation and control in a highly dynamic environment with a hybrid centralized/distributed system with remote sensing (small size league) or all sensors are on-board, therefore full autonomy and cooperation at plan and perception levels (middle size league); novel hardware.
  2. **Humanoids:** dynamic walking, running, and kicking the ball while maintaining balance, visual perception of the ball, other players, the field; self-localization, and team play; standard platform and novel hardware.
- The competitions → to educate and entertain the public around S&Tissues.



## 2.2.2 RoboCup Rescue



RoboCup Rescue → to promote research and development in this socially significant domain at various levels involving:

1. multi-agent team work coordination,
2. physical robotic agents for search and rescue,
3. information infrastructures,
4. personal digital assistants,
5. a standard simulator and decision support systems,
6. evaluation benchmarks for rescue strategies and robotic systems that are all integrated into a comprehensive systems in future.



- Rescue Robot League and Rescue Simulation League



To develop service and assistive robot technology with high relevance for future personal domestic applications, particularly in near future high-aging human societies.

- Human-Robot-Interaction and Cooperation
- Navigation and Mapping in dynamic environments
- Computer Vision and Object Recognition under natural light conditions
- Object Manipulation
- Adaptive Behaviors
- Behavior Integration
- Ambient Intelligence
- Standardization and System Integration.



**RoboCup** scientific and engineering methodology:

→ (1) *research*, (2) *integration & implementation*, (3) *verification* of the robot systems supported by AI technologies  
 → Very unique at RAS and with great potential impact at the publicly appealing RAS site.



New issues to existing TCS:

- teamwork in the presence of adversarial and highly uncertain environments, real-time perception, cognition, and action, hardware
- human-robot interaction in daily life environments
- expertise in competitions – yearly updated, international, community organization, roadmap to visionary outcomes



### Related existing TCS:

- MRS, Humanoid Robotics, Safety, Security and Rescue Robotics,
- Computer & Robot Vision, Networked Robots, Robot Learning, Telerobotics
- Algorithms for Planning and Control of Robot Motion
- Performance Evaluation & Benchmarking of Robotic and Automation Systems

## Collaborations and Connections

### **3 years:**

- Organize technical (workshops, special sessions) and social events at RAS, nonRAS conferences.
- Propose new technical challenges
- Create Advisory Board with experts from different related areas
- Maintain website with news, updates, videos, competitions, etc.
- A mailing list: relevant news → disseminate TC activities.

### **6 years:**

- Establish regular events (e.g., workshops, tutorials,...)
- Evaluate the technical challenges proposed by this TC, and proposal of a new league focusing on the new issues
- Organize regular special issues in (RAS and not) journals and magazines, to gather the most relevant advances in RoboCup.
- Create an active community → researchers and industry in moving towards massive real world deployment of RoboCup.

New goals every year, driven by the research community.

- Mixed heterogeneous robot teams
- Automated coach
- Automated referee
- Learning from experience
- Human-robot interaction
- Increase number of players
- Outdoors
- Flying robots
- Increased reality



**Title:** Multi-Robot Autonomy in Robot Soccer as an Adversarial Domain

**Organizer:** Minoru Asada (Osaka Univ.)

**Co-organizers:** Manuela Veloso (CMU), Daniele Nardi (Univ. of La Sapienza), Dan Lee (U-Penn).

## 3. 2 Objectives



In this tutorial, we will introduce robot soccer as a problem involving planning for the coordination among multiple robots in response to an opponent team. We will focus on presenting a variety of techniques used in robot soccer, including (i) multi-robot strategies that respond to the score of the game in a finite horizon game, (ii) role assignment through predefined and negotiated agreements; (iii) distributed state sharing and decision making; (iv) decentralized sparse interaction planning under uncertainty; and playbook generation, learning, and adaptation. The tutorial will be illustrated with RoboCup games of the different soccer leagues, namely simulation, small-size, middle-size, standard platform, and humanoids.

## 3. 3 Topics of interest



- RoboCup Soccer
- multi-robot strategies
- role assignment through predefined and negotiated agreements
- distributed state sharing and decision making
- decentralized sparse interaction planning under uncertainty



### Time Talk

9:00 - 9:10 Opening

9:10 - 9:45 Talk 1: History of RoboCup and Multi-Robot Strategies (Asada)

9:45 - 10:20 Talk 2: Role Assignment Through Predefined And Negotiated Agreements (Lee)

10:20 - 10:40 Coffee Break

10:40 – 11:15 Talk 3: Distributed State Sharing And Decision Making (Nardi)

11:15 – 11:50 Talk 4: Decentralized Sparse Interaction Planning Under Uncertainty(Chen)

11:50 - 12:00 Closing