

# RoboCup 2009 GRAZ

June 29 - July 5 2009  
Stadthalle Graz  
www.robocup2009.org



## RoboCup Soccer: Football tournament – the crowning event of the Robot World Championship

Dribbling, attacking and defending, our footballer robots kick-start major progress in the field of artificial intelligence research: the robot football tournament is a unique scientific showcase event that makes robotic research comparable while treating the audience to an exciting competition. At the RoboCup 2009 in Graz, the artificial players will compete in five leagues – on two legs, on wheels or just “virtually” on the monitor.

It is the combination of high speed with dynamic and complex movement patterns that has made football the most popular of all robot sports disciplines. Football presents major challenges for robots. They need to take the initiative and engage in action in a real environment. They need to recognize objects such as the ball. They need to establish their own and other players' positions, respond to counterattacks, plan their movements, execute movements and ultimately put the ball in the right goal. Matches are played in two halves of 15 minutes each. All matches are played according to the FIFA rules, i.e. the rules of the World Football Federation for professional 'human' football, with just one exception: the offside rule does not apply to the intelligent robots.



### Football as a demonstration of the power of robotics

“And the winner is - the robot team”. This is what we want to hear in 2050 when a team of autonomous robots wins against the human world champions for the first time. At least this is the ambitious goal of the RoboCup initiative. Actually, football is “only” a means to an end. The purpose of the game is to make robotics and artificial intelligence research outcomes comparable. And football is ideally suited to this purpose. Robots have to be dynamic, fast and flexible. At the same time, the standardized rules provide a framework for the performance evaluation. The other big advantage of RoboCup Soccer is that everybody knows football. Nothing can rival the ability of robot football to combine research with entertainment and attract a big audience.

Virtual challenge: Soccer Simulation League  
(© TU Graz/Bergmann)

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## The five RoboCup Soccer leagues

### Simulation League

In this league, two entirely virtual teams with eleven completely autonomous players compete against each other both in 2D and 3D simulations. The basic idea of the Simulation League is to gain experiences with strategies, tactics and group behaviour so that they can be implemented subsequently in humanoid robots. Scientifically, the main points of interest are the co-operation and communication of the virtual players.



Nao in action (© RoboCup 2008)

### Small Size League

In the Small Size League, each team consists of five robots on wheels. The players have only few sensors on board; most of the information is provided by cameras that are fitted above the playing field. This information is then sent to an external computer which sends commands to the robots through a wireless link. In this league, the research teams can decide freely how they wish to design their robots. There are no restrictions concerning the choice of materials, shape and software, only the size (diameter and height) of the robots is restricted. As the robots are controlled by external computers, the players in this league are regarded as semi-autonomous.

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### *Middle Size League*

In the Middle Size League, each team consists of six middle-sized robots. All sensors are "on board". Players in this league weigh up to 40 kilograms and have to locate themselves with their own on-board cameras. This is the big difference compared with the Small Size League where a so-called overhead camera senses the position of all players. The robots communicate by WLAN, external human interventions are not allowed. Normally, each robot is equipped with a computer to which the sensed information is sent, where it is interpreted and where it is compared with existing knowledge to initiate new actions. One of the main scientific challenges in this league is the need to combine the developed hardware with suitable software.

### *Standard Platform League*

The big advantage for the participants in this league is also the biggest challenge: all teams use identical robots, with the two-legged "Nao" replacing its four-legged and now retired predecessor "Aibo". As all participants use the same hardware, this competition will be decided by the software. The focus is on playing as a unit, co-operation and strategy. The robots act autonomously and are only allowed to communicate via WLAN.

### *Humanoid League*

In this league, teams of humanoid robots – robots with human-like body and the relevant sensors – play each other. The players are completely autonomous, no human intervention of any kind is allowed during the match. A tricky task indeed, for the two-legged players must be able to keep their balance whether they are standing, running or kicking the ball. If they fall, they must be able to get up by themselves. The humanoid robots belong to either of two size categories: KidSize (less than 60cm) or TeenSize. Just like in the Middle Size League and the Standard Platform League, the humanoid robots carry their sensors, i.e. cameras and computers, on their "body" during the fast game. Consequently, the camera shots are quite wiggly. Notwithstanding this sketchy visual input, the robots in all three leagues must be able to extract the essential information, interpret it correctly and base their actions on this information.

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