



DLR SpaceBot Cup – robot race on artificial planet

13 November 2013

On 12 November 2013, after two exciting and eventful days, the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) SpaceBot Cup drew to an end with no clear winner and no real loser. "All 10 teams were highly motivated and came up with innovative, technical solutions. All participants deserve to be congratulated! The tasks put before them were complex and the demands were high. On the whole, the individual achievements of each team were so close that the panel of judges were unable to choose a clear and outright winner. Although none of the teams managed to achieve the mission objective, their reaction and that of the audience was very positive. This encourages us to continue," said Gerd Gruppe, Member of the DLR Executive Board for the German Space Administration, during the certificate awarding ceremony. Daniel Nölke and Thilo Kaupisch, members of the competition administration team, which forms part of the DLR Space Administration, said that: "During the development stage, all the robots demonstrated their ability to function, but the transfer of the technologies to a real space mission requires more work – something that both the teams, and us as organisers, can take away from this competition.

The aim of the SpaceBot competition is to give space robotics a new and innovative impetus, as well as to develop expertise within this field in Germany. "We want to bring ideas, creative scientists and the necessary finance together, and to cast an eye on the ever more significant transfer of technology that is emerging," said Gruppe. "We have seen high levels of performance from the technologies employed, but this is still not enough for an actual space mission. Nevertheless, we have an excellent basis on which we can continue to grow. In the future, we would like to see more interdisciplinary teamwork, along with a sharper eye on achieving the overall goal."

On 11 and 12 November 2013, the competition – organised by the DLR Space Administration and supported by the German Federal Ministry of Economics and Technology (Bundesministerium für Wirtschaft und Technologie; BMWi) – attracted a large number of visitors to the Supercrosshalle in Rheinbreitbach, near Bonn. The exhibition hall had been transformed into an artificial planetary landscape.

Sven Halldorn, Head of Technology Policy at BMWi, stated during the opening stages of the competition that: "The competition offers an ideal testing ground for new developments that could be used in space and on Earth. We are not only promoting that, but are simultaneously setting an example of the future for science and technology facilities in Germany, because that gets young people interested in the world of high-tech, natural sciences and engineering. Knowledge and expertise, together with innovative technologies, are vital for economic growth."

Robots will play an important part in future missions to other planets within the Solar System. Daniel Nölke and Thilo Kaupisch stated that: "Robots are intelligent tools. Space robotics leads the way for robots used here on Earth, such as deep-sea robots and robotic systems for medicine. We would like this competition to provide spaceflight with expertise that has, until now, remained undiscovered or concealed, but that can also be used on Earth."



Video: DLR SpaceBot Cup

Each of the teams participating in the DLR SpaceBot Cup had 50,000 euro to develop and create their robotic system. After six months of development, it was crunch time. On the first day, the following teams competed: the Berlin Rockets from the Free University of Berlin; the NimbRo Centauro from the University of Bonn; the Space-Bot 21-team from the College of Higher Education in Buxtehude; the ARTEMIS team from the German Research Centre for Artificial Intelligence (DFKI), and the Jacobs Robotics team from Jacobs University in Bremen. On the second day, the teams to enter their robots into the race were: the Chemnitz University Robotics team from the Chemnitz University of Technology; the Locomotec Research team from Locomotec GmbH in Augsburg; the SpaceLions from the Braunschweig University of Technology; the SEAR team from the Technical University of Berlin, and the LAUROPE team from the Research Center for Information Technology in Karlsruhe.

All the teams had one hour to carry out typical tasks encountered during exploratory missions (see info box). With the landing zone as their point of departure, the teams had to demonstrate that their robots were capable of moving autonomously and locating three objects, more specifically: a battery pack, a beaker of water and the 'base object', which was fixed to the floor and had a slot on the side for the battery pack. The robots had to place the beaker of water onto a specifically marked-out area the right way up. During the tasks, each of the robots was able to 'communicate' with its team at 'ground control'.

A panel of five independent judges assessed how well each individual task was performed. The spokesperson for the panel, Frank Schneider from the Fraunhofer Institute for Communication, Information Processing and Economics (FKIE), said: "We were impressed by the wide variety of approaches used to solve these tasks. Having said that, the performance of each group under the conditions set was not enough to be able to rank the teams; this is not unusual for these kinds of competition. The first DARPA Grand Challenge in the United States also ended with no clear winner. Nevertheless, this competition has yielded significant results. In our opinion, this was the first of a series of recommended events for space robotics." His fellow panel member, Jürgen Rossmann, Head of the Institute for Man-Machine Interaction at RWTH Aachen, added: "We have seen fascinating robots here that are able to operate and move over various terrains, pick up objects, climb hills, and which clearly possess all of the prerequisites for successfully completing the tasks required by this competition. However, we do think that all of the teams underestimated the specific challenges that space travel poses, such as delays in communication, loss of communication and isolation."

Other panel members included: Sabine Klinkner from Hoerner & Sulger GmbH, André Schiele from the Telerobotics and Haptics Laboratory at the European Space Agency (ESA) Centre of Technology in the European Space Research and Technology Centre (ESTEC), and Andreas Ciossek from the telerob Gesellschaft für Fernhandlungstechnik mbH [Telerobotics Company for Remote Handling Technology]. The 10 teams participating in the DLR SpaceBot Cup had from March 2013, the official start date of the Cup, to develop their robot systems and, more specifically, to prepare for the competition.

The scenario

Each robot system was equipped with a rough map of the environment at the start. Shortly after 'landing', the robots began an exploratory trip that was filled with obstacles. Rocks, steep hills and a variety of terrains all obstructed the way. The robots were equipped with high-tech cameras, which captured the surroundings and produced an accurate map. In addition to this, and as much as was possible, they had to move around the course, find objects, recognise the objects found, transport them and build an entire system as independently as possible.

Radio contact to ground control can take a very long time when travelling to another planet. That means that the control that can be exercised over the robot from Earth is very limited. The conditions faced when on Mars or the Moon also had to be overcome in Rheinbreitbach. Although ground control was only 10 metres away from the robots, the teams did not have any direct contact with their robot, and any contact they did have was very limited. They were allowed to take control three times, but even then had to endure time delays. The teams were also allowed to service the systems remotely, including extensive uploads, system checks, reconfigurations and software updates. However, a penalty was awarded for each intervention made by the team. That means that the robots had to carry out all the tasks by themselves as much as possible. The crews received images of the planetary surface whilst in ground control, albeit delayed. On two occasions, once after 20 minutes and the other after 40 minutes, all contact with the robot was completely lost, just as it would be on a day-to-day basis during a real exploration. The screens went black and a long four minutes passed without any contact with the robot.

Speed was another factor taken into consideration by the panel of judges. The DLR SpaceBot Cup was a race against the clock. All the tasks had to be completed within one hour. If not, penalties were awarded.

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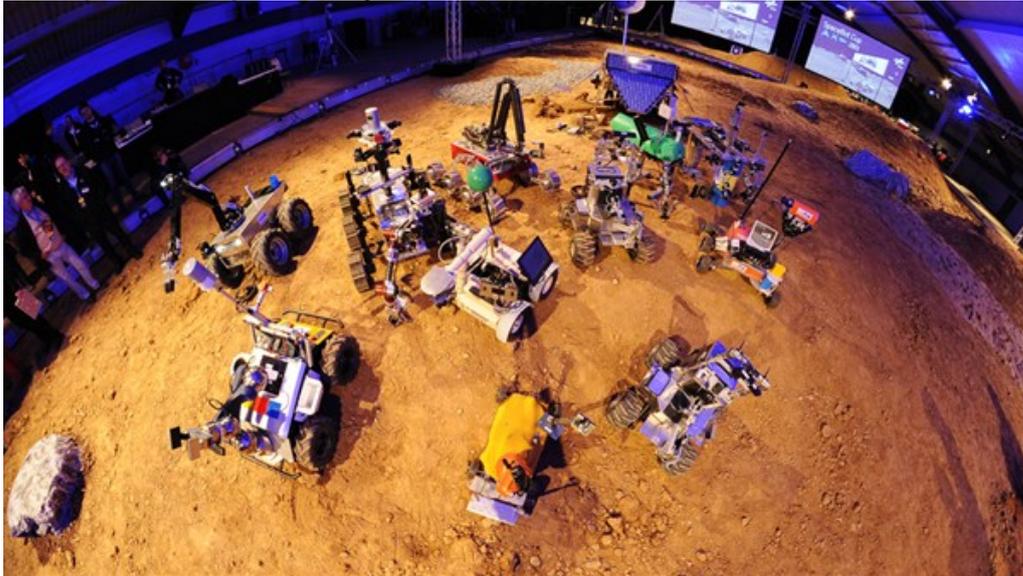
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DLR SpaceBot Cup –bird's-eye view of all robots



On 11 and 12 November 2013, the robots of 10 teams from across Germany competed against one another in the first DLR SpaceBot Cup. The Supercrosshalle in Rheinbreitbach near Bonn was transformed into a planetary landscape with mountains, valleys and a variety of different terrains.

Credit: DLR (CC-BY 3.0).

Certificate awarding ceremony of the DLR SpaceBot Cup



At the end of the robot competition, DLR Executive Board Member Gerd Gruppe (2nd from the left), and Sven Reutzel, from BMWi (on the left), congratulated all the participants and thanked them for taking part.

Credit: DLR (CC-BY 3.0).

The DLR SpaceBot Cup's judges, with DLR Executive Board Member Gerd Gruppe (on the left)



On 11 and 12 November 2013, five experts in space robotics judged the achievements of the robots participating in the DLR SpaceBot Cup. From the right: Andreas Ciossek from the telerob Gesellschaft für Fernhandlungstechnik mbH [Telerobotics Company for Remote Handling Technology], Sabine Klinkner from Hoerner & Sulger GmbH, André Schiele from the Telerobotics and Haptics Laboratory at the European Space Agency's (ESA) Centre of Technology in the European Space Research and Technology Centre (ESTEC), Frank Schneider from the Fraunhofer Institute for Communication, Information Processing and Economics (FKIE) and Professor Jürgen Rossmann, head of the Institute for Man-Machine Interaction at RWTH Aachen. On the left is Gerd Gruppe, Member of the DLR Executive Board for the German Space Administration.

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