

# The 2012 Safety, Security, and Rescue Robotics Summer School

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**Abstract** --- The 2012 IEEE Robotics and Automation Society Safety, Security, and Rescue Robotics Summer School was held from the 9th to the 15th of September in Alanya, Turkey, and brought together a select group of students, researchers, responders, manufacturers, and standards organization representatives for a week of learning, dissemination of challenges and best-in-class solutions, and networking. This event builds on a series of summer schools that started in Rome in 2004 and were significant in their combination of lectures, hands-on practicals, and networking opportunities, all carried out in one all-inclusive venue. In this paper, we report on the outcomes and novel aspects of the latest incarnation of this event.

**Keywords:** *Rescue Robotics, RoboCup, Summer Schools*

## I. INTRODUCTION

The 2012 Institute of Electrical and Electronic Engineers (IEEE) Robotics and Automation Society (RAS) Safety, Security, and Rescue Robotics (SSRR) Summer School (SSRRSS) brought together 58 students, first responders, researchers, and representatives of manufacturers and standards organizations (Figure 1) for a week of learning, dissemination, and networking. We identified and disseminated needs, realistic development goals, and best-in-class capabilities in the field of SSRR. The RoboCupRescue Robot League [1] (RRL) and the ASTM International standard test methods, being developed by the National Institute of Standards and Technology (NIST) and others, under sponsorship by the United States Department of Homeland Security (DHS), were the environment and language that enabled structured exchanges among these groups.

We were inspired by events that date back over a decade, starting from the RRL competition in 2001. The 2004-07 Rescue Robotics Camps held in Rome, Italy, and the 2009-10 Rescue Robotics Workshops held in Pattaya, Thailand, served as the basic model for the SSRRSS. At these events, lectures and practical development sessions were usually provided at one venue, along with meals and accommodation. This immersive experience proved to be much more effective in dissemination and networking compared to traditional workshops and summer schools. We also drew inspiration from more focused events including the 2010-12 Robot Operating System (ROS) Summer Schools held in Koblenz, Germany and Graz, Austria, and the 2010 Rescue Robotics Camp, focusing on operational testing of robot systems and held in College Station, USA [2]. These events played a pivotal role in many



Fig. 1. The participants of the 2012 IEEE-RAS SSRRSS, along with the robots and standard test method apparatuses present at the event.

young researchers' careers and spread many of the best-in-class capabilities that are now common in the SSRR community.

The host country, Turkey, has a great need for response robots. Two major fault lines, diverse geology, and proximity to recent political changes in the region mean that disasters occur of both natural and artificial origin. Turkey, with a growing economy ranked 17th in the world, has an active and growing research community that already has participants and a clear action plan to engage the RRL in coming years. We aimed to jumpstart the interest, dissemination, development, and use of robotic technologies, not only among the Turkish research community but also among the Turkish responders and public.

The goals of this event were to give all participants from the different groups -- students, academics, responders, manufacturers, and standards organization representatives -- a broad overview of SSRR, a hands-on and in-depth experience with a particular topic in SSRR, and an opportunity to network with their peers and other groups from around the world. Each day started with morning lectures to give all participants an overview of a wide variety of topics. Afternoon practicals allowed participants from diverse backgrounds to focus their learning and creative problem solving skills on a single topic. All participants were accommodated at the same hotel, which also provided meals and numerous social activities, adding to opportunities for networking. The technical areas were open 24 hours a day, allowing time to work on problems together. A whole day introductory tutorial on ROS was held on the Sunday preceding the main event.

## II. TALKS AND PRACTICAL DEVELOPMENT SESSIONS

The 20 invited talks started with committee members of the RRL and standards organizations, including ASTM International E54.08.01. They presented the state of competitions including the Defense Advanced Research Projects Agency (DARPA) Robotics Challenge, RRL, and RoboCup@Home, and standard test methods for response and service robots, including the ISO 13482 standard for robot safety. Three European FP7 projects, ICARUS, NIFTi, and TIRAMISU, were presented along with the European Land Robotics (ELROB) competitions. We also saw presentations on the state of the Thai and Japanese response robot research communities. The significant involvement of the responder community in this event included talks by representatives of the Federal Emergency Management Agency Urban Search and Rescue Task Force team from Washington (WA-TF1) from the US, the NIST liaison to the National Bomb Squad Commanders Advisory Board from the US, Arama Kurtarma Derneği (AKUT) from Turkey, and the Japanese disaster response community. The current state of rescue robotics development in ROS and the outcomes of the 2012 ROS Workshop in Graz were presented, along with more general robot architecture issues. Three different Simultaneous Localization and Mapping (SLAM) solutions, two of which are now available as ROS modules, were also presented. User interface and classical control issues were also covered as were machine learning techniques for higher level perception and behaviors. The six practicals focused on six key areas: SLAM, robot simulation in Gazebo, ROS for SSRR, robot design and testing, machine learning, and user interface design. These practicals aimed to give students an opportunity to experiment and learn in a hands-on, in-depth manner. To promote an environment of development and experimentation, we encouraged the practical groups to adopt the mentality of a start-up company, trying to invent the next big thing to change the world. We also encouraged collaboration across practicals to prepare demos that incorporated multiple elements.

## III. OUTCOMES

A major success story of this event is that, for the first time, responders were formally integrated into all practicals and social activities. The responders saw the capabilities and talent that exists in the lab and that could make a real difference to their work. Other participants were able to personally connect with responders and gain a deep understanding of their challenges. In particular, the young and well resourced Turkish response community gained valuable exposure to the use of robots in the international community. We look forward to their future involvement in global SSRR development.

We look forward to several new teams joining the 2013 RRL competition in Eindhoven, Netherlands, building on what they have learned during the practicals and adding their own developments. Several participants brought robots and were shown how to write ROS drivers and implement a variety of capabilities on their own hardware. The HectorMapping SLAM module from the Technical University of Darmstadt

was particularly widely deployed, including extensions for distributed data collection on “Raspberry Pi” boards and simultaneous use of multiple laser scanners. Recent 3D SLAM implementations using range imager data were also demonstrated, a technology that the responders identified as being directly applicable to the mapping of confined space voids, which they often encounter. This inspired the creation of the confined space mapping test method which researchers used to demonstrate emerging capabilities. Several robot models were built in Gazebo, as well as software to automatically generate standard test method apparatuses such as the Symmetrical Stepfield terrains. In the robot design and testing practical, several new test methods were developed and prototyped for open and confined space obstacles, for mapping, and for mobile robot manipulation for structural shoring.

Collaboration was enhanced by local facilities for recording and sharing data, to be made publically available after the event. Resources, including papers, slides from the talks, datasets, models, and instructions, were distributed to all participants by the end of the event. All talks were video recorded and, with the help of IEEE.tv, will be made available to the public to further help disseminate and promote research in this field.

In addition to disseminating challenges and solutions among the academic and responder communities, we were also successful in sparking widespread national media interest with many reporters and TV crews present during the final demo day and positive reports appearing in many major Turkish print, television, and online news agencies. This positive coverage will serve to amplify the interest that this event has sparked among domestic researchers, students, industry, and political leaders, and the wider public. Building on a legacy that spans over 10 years, this event has been successful in disseminating the challenges and best-in-class capabilities in the SSRR community. We hope that this event model will continue in future years, within Turkey and elsewhere, to help push research in this life-saving technology.

We invite the reader to visit the IEEE-RAS SSRR Summer School website, <http://www.ssrsummerschool.org/>, for more information and materials generated at the event.

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