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# Advances in Autonomous Robotics

Joint Proceedings of the 13th Annual TAROS Conference  
and the 15th Annual FIRA RoboWorld Congress  
Bristol, UK, August 20-23, 2012

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# Preface

These proceedings contain the papers presented at TAROS and FIRA in August 2012. TAROS 2012 was the 13<sup>th</sup> edition of the conference Towards Autonomous Robotic Systems, while FIRA was the 15<sup>th</sup> Robot World Congress. The joint conference was held in the city of Bristol, in the UK.

The TAROS series was initiated by Ulrich Nehmzow in Manchester in 1997 under the name TIMR (Towards Intelligent Mobile Robots). In 1999, Chris Melhuish and Ulrich formed the conference Steering Committee, which was joined by Mark Witkowski in 2003 when the conference adopted its current name. The Steering Committee has provided a continuity of vision and purpose to the conference over the years as it has moved from center to center in the UK, and under their stewardship TAROS has become the UK's premier annual conference on autonomous robotics, while also attracting an increasing international audience. Sadly, Ulrich died in 2010, but his contribution is commemorated in the form of the TAROS prize named the "Ulrich Nehmzow Best Paper Award."

The Federation of International Robosoccer Association (FIRA) is a non-profit organization that organizes annual robotics competitions and meetings around the world. The Robot Soccer competitions started in 1996 and FIRA was established on June 5, 1997. A new event, the HuroCup competition which focuses on developing full-capability humanoid robots, was added in 2002 in Seoul, South Korea. The Robotics competitions of the FIRA Robot World Cup are aimed at promoting the spirit of adventure and discovery in younger generations of scientists, and the associated FIRA Robot World Congress aims to explore technical developments in the field of robotics, with a robot festival, competitions, technical presentations, and exhibitions. In 2012, the FIRA Robot World Congress was an umbrella for the 9th International Conference on Computational Intelligence, Robotics and Autonomous Systems (CIRAS), the 4th International Conference on Advanced Humanoid Robotics Research (ICAHRR), the 4th International Conference on Entertainment Robotics (ICER), and the Third International Robotics Education Forum (IREF).

Bringing together the TAROS Conference, FIRA Robot World Congress, and the FIRA Robot World Cup created a major robotics event in Bristol, 2012. When we bid to co-host the TAROS and FIRA conferences in Bristol, we soon realized that this presented an opportunity to bring together two groups from the world's robotics community for their mutual benefit, joining two long-recognized conference traditions. This was especially apparent from the feedback we received from many authors who have long been part of both communities; the conferences have also shared members of their Program Committees in previous years, as was again the case in 2012. Therefore, we had the unique chance to organize for 2012 both conferences together with one joint set of proceedings with contents recommended by the two Publication Committees.

Overall both conferences had 77 full paper submissions and another 12 submissions for extended abstracts. Of these submissions 36 papers were recommended, accepted, and published as full papers and 25 as extended abstract: an acceptance rate of 46% for full papers from both FIRA and TAROS submissions.

TAROS was originally intended to be a forum enabling the coming together of UK robotics researchers, with the special remit to give a home to the first papers of PhD students. The conference has grown larger, but is still best served by a simple format to promote communication and cross-fertilization. This focus on simplicity sits well with FIRA, with its focus on being a forum to facilitate the sharing of ideas to inspire younger generations of researchers. In order to satisfy these demands for simplicity, FIRA-TAROS 2012 was a twin-track event, in which the tracks were organized into topics crossing the boundaries between the conferences.

Topical speeches of the joint FIRA-TAROS conferences were held by three world-renowned researchers in robotics. Shuzhi Sam Ge, Chair at the National University of Singapore, and the University of Electronic Science and Technology of China, Chengdu, was the speaker of the IET (Institution of Engineering Technology)-sponsored TAROS IET Robotics Public Lecture on the topic of social robotics. Alois Knoll from the Technical University of Munich, Germany, spoke on human robot interaction and Frank L. Lewis from the University of Texas at Arlington, USA, gave his plenary speech on reinforcement learning in robotic systems.

In support of the TAROS aim to foster a strong and vibrant UK robotics community, it was decided in 2010 to host an Industry-Academia Day to bring together these two groups. We continued with this endeavor in 2012. This year the event was organized together with two strategic partners, UK's Knowledge Transfer Networks (KTN) on Robotics and the British Automation & Robot Association (BARA). The industry day gives companies an opportunity to showcase their products to an international audience and network with clients and partners. Attendees were also invited to talks tailored to provide advice to those wishing to market their research or technology.

The FIRA-TAROS conference was co-hosted by the University of Bristol and the University of the West of England. These institutions are proud to number the Bristol Robotics Laboratory (BRL) among their other collaborations. The BRL is the largest robotics laboratory of its type in the UK, and was officially opened on May 10, 2012 by the Rt. Hon. David Willetts MP, Minister for Universities and Science. We thank the two universities for their support of the FIRA-TAROS conference, and extend especial thanks to our colleagues from the BRL.

We would like to take this opportunity to thank the many people who were involved in making FIRA-TAROS 2012 possible. On the organizational side these included Kim Chang, Julie Coombs, Richard Dewfall, Helen Farmer, Sue Fox, Joanne Fryer, Chris Harper, Khairi Ishak, Alina Jaroszewicz-Czepulkowska, Jane Kelly, Fiona Killard, John McWilliams, Lynette Oakey, Rachel Paterson, Jonathan Rossiter, Thomas Richardson, Xavier Alexis Walter, and Alan Winfield. We would

also like to thank the authors who contributed their work, and the members of the FIRA and TAROS International Program Committees who so kindly volunteered their time to help with the very speedy and efficient process of reviewing the papers.

In particular, we would like to thank our sponsors who kindly financially supported the overall FIRA-TAROS Robotics Events in Bristol 2012: the Institution of Engineering Technology (IET), the Institution of Mechanical Engineers, Maxon Motor UK, the Office of Naval Research (Global), RELAYS (Regional Educational Legacy in Arts and Youth Sport), and Team South West.

We hope that the reader will find within this volume papers which stimulate his interest and further his understanding. If you are starting your career in Robotics research, we hope that you will contribute to future TAROS and FIRA conferences, to continue the process of building the international community and to share our excitement.

June 2012

Guido Herrmann  
Matthew Studley

# Organization

FIRA-TAROS 2012 was organized by the University of Bristol and the University of the West of England, Bristol, working together through the joint venture of the Bristol Robotics Laboratory.

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