

The 10th Edition of the International Workshop of Robot Motion and Control (RoMoCo)

The tenth (jubilee) edition of the International Workshop of Robot Motion and Control (RoMoCo) was held in Poznan, Poland, on July 6–8, 2015. It was dedicated to Dr. Antal (Tony) K. Bejczy, who passed away peacefully in Los Angeles, California, on June 25, 2015 after several months of illness. His passing is a great loss for the organizers of RoMoCo and for the whole community. Tony was one of the founders of RoMoCo and its first keynote speaker in 1999. He has continuously supported the workshop since 1998, when the idea originated. All participants offered Dr. Bejczy a minute of silence during the opening ceremony to memorialize his death.

Previous RoMoCo meetings were held in 1999, 2001, 2002, 2004, 2005, 2007, 2009, 2011, and 2013, and the next will be in 2017. RoMoCo, an internationally recognized event, is technically cosponsored by the IEEE Robotics and Automation Society; Polish Chapter IEEE Robotics and Automation Society; IEEE Polish Section; IEEE Control Systems Society; IFAC Technical Committees TC 4.3 Robotics and TC 2.1. Control Design; and the Polish Society for Measurement, Automatic Control, and Robotics (POLSPAR), the Polish national member organization of IFAC. The workshop is organized under the auspices of the chair of Control and Systems Engineering of the Poznan University of Technology, Poland. Interest and progress in robot motion and control has increased significantly in recent years.



The opening ceremony (from left): Prof. Jerzy Nawrocki, dean of the Faculty of Computing; Prof. Tomasz Łodygowski, rector of the Poznan University of Technology; and Prof. Krzysztof Kozłowski, general chair of RoMoCo.



Prof. Oussama Khatib.



Prof. Zhong-Ping Jiang.



Prof. Mark Spong.



Prof. Pascal Morin.



Prof. Zhiqiang Gao.



Prof. Kozlowski summarizing the history of RoMoCo workshops during the banquet.



The Young Author Best Paper Award is presented to the winner, Igor Zubrycki.



The banquet in City Hall.



Workshop participants.

This includes the development of novel solutions to complex mechanical problems, such as developing industrial robots, mobile robots, walking robots, multiagent systems, and localization and mapping sensor systems. In this year's workshop, topics such as grasping and hand-gesture planning, skid-steering motion control, motion planning for nonholonomic systems, space robotics, and intelligent measurement techniques in robotic systems appeared to be of the highest interest. The RoMoCo workshop

continues to lead to new ideas in control technologies and path-planning algorithms that are currently used in research laboratories and in industrial applications. The main objective of RoMoCo is to present the most recent results concerning robot motion and control to the robotics community.

A total of 64 papers submissions were received from 13 countries, and 46 original works were selected (with an acceptance rate of 71.9%) for oral presentation at RoMoCo. On average, each paper received three

reviews, and, based on the comments, all of the accepted papers were corrected and published in *IEEE Xplore*. Accepted contributed papers and plenary papers were from ten countries. A total of 69 participants took part in the workshop, of which 19 were students and nine were female.

The year 2015 was the inaugural year of the Young Author Best Paper Award at RoMoCo, which honors an excellent paper presented at the workshop that is distinguished by its

originality, importance of the topic, and the quality of presentation. Winner selection is based on the reviews of the paper, comprising both the content and its delivery during workshop. Krzysztof Kozłowski and Cezary Zieliński organized a special session this year on exploration and rescue robots. The aim of this special session was to gather researchers and practitioners to report on their recent achievements in the development of this type of robot, in particular how they have handled real-world problems. Both of these new initiatives were well received by RoMoCo participants.

SUMMARY OF INVITED PRESENTATIONS

The scientific contribution of the workshop was strengthened by five plenary presentations given by internationally recognized scientists in the field of robotics and automation.

Prof. Oussama Khatib, Stanford University, United States, presented an overview of the new generation of robots developed for real-time collaboration with humans while interacting with environment. These robots are assumed to provide support in services, health care, manufacturing, entertainment, education, assistance, and interventions. The presentation focused on robot design concepts, perception and control architectures based on the operational space approach, and task planning that takes human modeling and skill understanding into account. These ideas were deployed to create a concept of a novel underwater robot proposed recently by Stanford, Meka Robotics, and KAUST. The properties of this robot and its control architecture were presented based on animations.

Prof. Mark Spong, The University of Texas in Dallas, United States, considered time-optimal velocity control

designed for unicycle robots subjected to nonholonomic constraints. He recalled that most recent problems defined for multiagent systems such as consensus, flocking, or formation control are based on simple linear models. Hence, the application of these techniques to nonholonomic systems becomes a nontrivial task. Prof. Spong discussed how the time-optimal velocity control problem can be solved for a unicycle robot using Pontryagin's maximum principle. He investigated the details of an optimal control solution to find minimum-time trajectories in the presence of bounded torque inputs. The performance of the designed control algorithm was illustrated based on simulation results.

Prof. Zhong-Ping Jiang, Polytechnic School on Engineering, New York, United States, presented distributed control based on a small-gain approach. The fundamental concepts of stability analysis using classic Lyapunov theory were discussed. It was shown that the application of small-gain techniques is very useful to control distributed network dynamic systems. Next, the considered approach was used for formation control of nonholonomic agents assuming that no global position measurements are available. Extensions of the presented approach to systems with flexible topologies and distributed output feedback control were discussed. Moreover, the robustness of the presented strategies to information uncertainties was investigated.

Prof. Pascal Morin, Sorbonne University, UPMC University, Paris, France, discussed a new class of vertical take-off and landing (VTOL) vehicles equipped with wings known as convertible micro air vehicles (MAV). He made a survey of existing VTOLs and considered fundamental dynamic models of MAVs

with different mechanical structures. The description of the aerodynamic models discussed was supported by experimental validation. Next, flight control issues dedicated for the given class of vehicles were investigated. Prof. Morin presented different control feedback strategies developed for MAVs with various mechanical structures. Finally, flight tests illustrating performance of the developed control systems were presented.

Prof. Zhiqiang Gao, Center for Advanced Control Technologies, Washkewicz College of Engineering, Cleveland, United States, considered the idea of disturbance rejection for a particular class of dynamic systems. He made a historical survey of control methods taking advantage of a feedback and model-based approach. Next, a control method based on active rejection of disturbances (ADRC) supported by an extended state observer was investigated. Prof. Z. Gao emphasized that ADRC can be seen as a support to a classic proportional-integral-derivative control and considered numerous applications of this technique to control different industrial processes.

SOCIAL EVENTS

As with previous RoMoCo workshops, participants enjoyed social events including an opening reception, a visit to the oldest educational institution in Poznan and a museum, a banquet, and a farewell party. The banquet was organized in the residence of the president of Poznan. During the ceremony, there was a concert by a classical guitar quartet. The participants then thanked Prof. Krzysztof Kozłowski for his continuing effort to organize RoMoCo for 16 years.

Krzysztof Kozłowski
General Chair

Dariusz Pazderski
Program Chair