IAS-13 Foreword

For the second time the International Conference on Intelligent Autonomous Systems (IAS) is held in Italy and organized by the University of Padova. Many years have passed since the 6th IAS Conference was held in Venice in 2000 and in those fourteen years, IAS Conferences have evolved to reflect the tremendous technological advancement of the field of Robotics.

This year the 13th IAS is held in Padova from July 15 to July 18, 2014 at Centro Congressi Padova with the goal of bringing together researchers and engineers from around the world to present their latest research accomplishments, innovations and visions in the field of robotics and artificial intelligence.

This year we have a special motto: "Bringing autonomous robots into industrial production", in order to highlight the most recent results of autonomous robots and intelligent systems which are now sufficiently mature and robust to operate in industrial production. Therefore, co-located with IAS-13 we have Industrial Workshops, an Industrial Forum focused on Horizon 2020, and a technological and scientific exhibit.

From the 159 papers submitted to IAS-13 from all over the world, 83 papers have been selected for oral presentation and 39 for poster presentation after going through a rigorous peer-review process. The scientific program consists of 7 technical sessions in 4 tracks and 2 poster sections, running over three days in comfortable slots of 25 min. to have room for fruitful discussions. In addition, there will be 16 workshops, 6 tutorials, and an Industrial Forum over the three day period. The Conference program is enriched by six keynote talks from Gary Bradski, Eugenio Guglielmelli, Koh Hosoda, Jan Peters, José del R. Millán, and Cyrill Stachniss.

Moreover, a Workshop on New Research Frontiers in Intelligent Autonomous Systems celebrating the 20th Anniversary of the International Society for Intelligent Autonomous Systems (IAS-Society) is held as a Post-Conference meeting in Venice at the Telecom Future Centre on July 19, 2014. The workshop consists of six Invited Talks delivered by Hajime Asama, Ruediger Dilmann, Frans Groen, Oussama Khatib, Sukhan Lee, and Lynne Parker, all world-wide leaders in Intelligent Autonomous Systems research, and by ten peer-reviewed position papers to present exciting and visionary ideas to galvanize the research community and spur novel research directions. We wish to thank the organizing committee members for their commitment and great effort, the over 100 program committee members, the local staff and student volunteers. We would also like to thank the authors, the conference participants, the sponsors and the exhibitors for making IAS-13 a great success and a unique opportunity for scientists.

We hope that these proceedings, and especially the participation in the IAS-13 Conference and its related events, will inspire new ideas, foster new research, and create new friendships which can grow into fruitful collaborations.
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Yande Liang
Yi-li Fu
Yuichi Kobayashi
Yusuke Maeda
Zheng Liu

Workshop/Tutorial Organizers

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Thomas Wiemann
Tiziana D’Orazio
Ulrich Reiser
Yuichiro Yoshikawa
Conference and Workshops Venues

The conference will take place at the Centro Congressi Padova, which can host up to 500 people. There will be five rooms for five parallel tracks and for five simultaneous pre- and post-conference workshops and tutorials. Two more meeting rooms and a large main room for the plenary talks will also be available. A large green area will also be available for lunch and recreation during the conference.

Other locations will host our special events: some plenary talks will be held at the University of Padova “Aula Magna” at “Palazzo del Bo” and the IAS Banquet will be held at the nice ancient “Villa dei Vescovi”.

The post-conference event to celebrate the 20th anniversary of the IAS Society will be held in Venice at Telecom Italia Future Center during the Annual Venetian “Feast of the Redeemer”.

Centro Congressi Padova – Conference Main Venue

Tuesday, July 15 to Friday, July 18
Via Forcellini 170/A - 35128 Padova
The University of Padova was established in 1222, after a group of students and teachers decided to come here from Bologna. They set up a free body of scholars, who were grouped according to their place of origin into nations, in which students approved statutes, elected the rettorre (rector, or chancellor) and chose their teachers, who were paid with money the students collected. Defending freedom of thought in study and teaching became a distinctive feature which today lives on in the University motto: Universa Universitatis Paduana Libertas. The introduction of empirical and experimental methods together with the teaching of theory marked the dawn of a golden age. In the 18th and 17th centuries, Padova became a workshop of ideas and the home to figures who changed the cultural and scientific history of humanity. They included Andrea Vesalius, who founded modern anatomy, as well as the astronomer Copernicus, and Galileo, who observed the skies here. Padova also vaunts the world’s first university botanical garden and a permanent anatomical theatre, which was built by Girolamo Fabrici d’Acquapendente. William Harvey, who became famous for describing the circulation of the blood, studied in Padova, and in 1678 Elena Lucrezia Cornaro Piscopia became the first woman in the world to be awarded a university degree. The fall of the Serenissima Republic of Venice in 1797 marked the beginning of a dark age. Padova fell under the rule of first the French and then the Austrians, passing through Italy’s tumultuous Risorgimento, which also affected the University.
Between the late 19th and early 20th centuries, the University expanded to include the faculties of Engineering, Pharmacy, and Political Sciences together with its traditional faculties of Law, Medicine, Arts and Philosophy, and Sciences. The advent of Fascism curtailed the University’s values of free thought and cultural independence. Its professors swore allegiance to the regime, after which the approval of Italy’s racial laws and the expulsion of Jewish professors opened one of the darkest periods in the University’s history. Chancellor Concetto Marchesi shook the University from its slumber and, at the height of the German occupation made a courageous appeal to the students to fight for the freedom of Italy. For its sacrifices in the name of Liberation, the University of Padova was awarded a gold medal for military valour, the only university to receive such an honour. During the post-war period, the University opened faculties of Education, Agricultural Sciences, and Psychology and, in the 1990s, faculties of Veterinary Medicine, and Economics and Business Administration. In the 20th century, the University of Padova produced great literary figures such as Diego Valeri and Concetto Marchesi; engineers of the stature of Giuseppe Colombo, the “master of celestial mechanics”; mathematicians such as Tullio Levi Civita; jurists Alfredo Rocco and Livio Paladin; philosophers Luigi Stefanini and Enrico Opocher; and doctors like Vincenzo Gallucci, who carried out the first heart transplant in Italy. The new millennium opened with some important new discoveries, particularly in medicine, biomedicine, engineering and aerospace technology.

Telecom Future Centre – NRF Workshop Venue @ Venice
Saturday, July 19
Campo San Salvador, Sestiere di San Marco, 4826 - Venice

In the heart of Venice, a few steps from the Rialto Bridge there is a small square, namely a Campo, called Campo San Salvador. Just beside the Church of San Salvador, inside the Convent lies the Telecom Future Centre. The participants to the NRF workshop will also have the possibility to visit the illustrious Venice conservatory Benedetto Marcello (Palazzo Pisani, Sestiere San Marco, 2810 - Venice) at Friday, July 18 and to listen to a classical music concert. No musician will go up on the stage: a motorized acoustic Gran Piano will be played by computer systems, trained to perform musical scores simulating the expressive nuances of a human musician. The best systems, classified in the Rencon international piano contest, held every two years (http://renconmusic.org), will play a selection of their performances.
Internet / Wireless LAN
1. CENTRO CONGRESSI PADOVA
Conference and workshops participants will be able to access the conference center network. Access credentials are printed and packed in your conference bag; you can use them on up to three devices simultaneously.

2. PADOVA CITY CENTER
Padova, just like a growing number of other cities around the world, has opened up a series of free Wi-Fi hotspots in many parts of the city. Thanks to Padova Wi-Fi Net, conference participants (and also their related) can have free Internet access in all the covered areas, including Palazzo del Bo.

3. VILLA VESCOVI
Even at the Banquet venue you can access to the Internet by using the free Wi-Fi network provided by the Fondo Ambiente Italiano (FAI). Just connect to “Villa Vescovi Public” and you are online.

4. TELECOM FUTURE CENTRE
The access to Telecom Future Centre will be granted to NRF Workshop participants. Access credentials are printed and packed in your conference bag if you are already registered; while it will be provided on site to anyone will join the workshop during the conference.

Help and Emergencies
In case of an emergency at the conference, please call +39 347 090 7797 or +39 334 657 5827. You can also request help from any of the conference volunteers and the concierge at the main entrances of conference buildings. For emergencies at the conference or elsewhere in Italy, please call the emergency number 118.
If you need special assistance to access a building, please contact the conference chair at +39 347 090 7797 or +39 334 657 5827.

Banquet Information
The Banquet is held on Thursday, July 17, at the venue Villa Vescovi, an historical building in the hills around Padova. The villa is located 20 Km from the city center in Via dei Vescovi, 4, Luvigliano di Torreglia (Padova). To get there a private shuttle leaving at 19:30 will be available from the conference venue and from the hotels (cfr. Transport Information) The trip will take about 30 minutes. The way back from Villa Vescovi will be around 23:00.
Transport Information

The transfer from main hotels to the Conference venue and return will be provided to participants of both conference and workshops for free. Two shuttle buses will be set up every morning to bring you on time to the IAS meetings. Just look at bus paths below and find out the nearest to your hotel. An extraordinary shuttle bus will also go from Centro Congressi to Padova city center (Piazza Garibaldi) leaving every 60 minutes from 9:30 to 17:30 and coming back from 10:00 to 17:00.

Changes to the timetable could be applied on Thursday 17 because the Plenary Talks will be located at Palazzo del Bo. The exact time schedule will be provided during the Conference.
The IAS-13 Industrial Forum will put specific emphasis on the technologies and applications of autonomous systems in industry. Smaller lot sizes, a high number of product variants and complex requirements in terms of flexibility require autonomous systems that can quickly adapt to changes and also interact with users. The latter issue is of increasing importance because the costs of flexible automation are very high and the flexibility of human operators will not be replaced by automatic systems in the near future. This requires autonomous systems that interact and cooperate with humans and share activities, where humans deal with the complex parts of the task that are demanding in terms of cognitive abilities or dexterity, while autonomous systems can assist with the more simple parts of the task.

Talks are invited that deal with topics such as mobile platforms, compliant robotics, safety issues in cooperative robotics, human-machine interaction, adaptive robotic systems and assistance systems in general. Examples of concrete applications with potential in the not too distant future are particularly welcome. Also research directions at the European level will be addressed that are currently aimed for in the “Factories of the Future” topics of Horizon 2020.

PROGRAM

08:45 – 09:45 Plenary Talk: Jan Peters (Technische Universität Darmstadt)
Machine Learning of Motor Skills for Robotics

Industrial Session I: Robots & Vision
Chair: Christian Eitzinger

09:45 – 10:10 Ing. Oscar Ferrato (ABB)
ABB Integrated Vision

10:10 – 10:35 Stefano Tonello (IT+Robotics)
Flexible visual inspection

10:35 – 11:00 Fabrizio Romanelli (Comau S.p.A.)
Towards an Industrial Autonomous System: C5G Open meets ROS

11:00 – 11:30 Coffee Break

Industrial Session II: Robots & Assistants
Chair: Reinhard Lafoen

11:30 – 12:00 Dr. Uwe Zimmermann (KUKA)
VALERI - Mobile Manipulator for the Aerospace Industry

12:00 – 12:30 Christian Eitzinger Profactor
Showme – Assistant for assembly processes

12:30 – 12:45 Discussion

12:45 – 14:00 Lunch break

14:00 – 15:00 Plenary Talk: Gary Bradski (OpenCV and Magic Leap)
Perception and Modeling in New Robotic Startup: Efforts Tools, Techniques and Philosophical Implications for Intelligent Systems

Industrial Session III: Robots & Innovation
Chair: Christian Eitzinger

15:00 – 15:25 Dr. Gustaf Winroth (EC DG Research and Innovation)
Research in Robotics for -Manufacturing: Evolution of Partnerships & Opportunities in Horizon 2020

15:25 – 15:40 Manuela Broto (Consorzio Ethics)
The Role of Consorzio Ethics as Private RTD Performer to Boost Innovation

15:40 – 15:55 Massimo Malaguti (Galileo Science Park)
How the industrial design and new materials can improve the IAS

15:55 – 16:10 Roberta D’Orazio (Confindustria)
Support to Italian SMEs for Horizon 2020

16:15 – 16:45 Coffee Break

End of Forum

Industrial BCI Workshop

Thursday 17, 14:00 – 17:00
Room: Tiziano – Centro Congressi

This workshop provided by g.tec will demonstrate for the first time all major concepts for BCI control: motor imagery for cursor control, P300 for spelling and smart home control and SSVEP for robot control. This allows the attendees to see all required hardware and software, the typical training and classifier setup and the achievable accuracies. People from the auditorium will be invited to participate in live demonstrations. The Industrial BCI Workshop will be free of charge for participant to IAS-13 conference, workshops and tutorials.
Jan Peters
Wednesday 16, 8:45 – 9:45
Room: Leonardo – Centro Congressi

MACHINE LEARNING OF MOTOR SKILLS FOR ROBOTICS

Autonomous robots that can assist humans in situations of daily life have been a long standing vision of robotics, artificial intelligence, and cognitive sciences. A first step towards this goal is to create robots that can learn tasks triggered by environmental context or higher level instruction. However, learning techniques have yet to live up to this promise as only few methods manage to scale to high-dimensional manipulator or humanoid robots. In this talk, we investigate a general framework suitable for learning motor skills in robotics which is based on the principles behind many analytical robotics approaches. It involves generating a representation of motor skills by parameterized motor primitive policies acting as building blocks of movement generation, and a learned task execution module that transforms these movements into motor commands. We discuss learning on three different levels of abstraction, i.e., learning for accurate control is needed to execute, learning of motor primitives is needed to acquire simple movements, and learning of the task-dependent “hyperparameters” of these motor primitives allows learning complex tasks. We discuss task-appropriate learning approaches for imitation learning, model learning and reinforcement learning for robots with many degrees of freedom. Empirical evaluations on several robot systems illustrate the effectiveness and applicability to learning control on an anthropomorphic robot arm. These robot motor skills range from toy examples (e.g., paddling a ball, ball-in-a-cup) to playing robot table tennis against a human being.

Gary Bradski
Wednesday 16, 14:00 – 15:00
Room: Leonardo – Centro Congressi

PERCEPTION AND MODELING IN NEW ROBOTIC START-UP: EFFORTS, TOOLS, TECHNIQUES AND PHILOSOPHICAL IMPLICATIONS FOR INTELLIGENT SYSTEMS

I’ve taken part in many robotic startup efforts: Stanley, Willow Garage and Industrial Perception. I’ll overview the basic tools (OpenCV) and techniques (physics simulation in 3D world models) and how these enabled the 3 different efforts: An autonomous car, Stanley, that went on to become Streetview and the Google Robot; the PR2 Robot of Willow Garage; and Industrial Perception, robots in logistics. I’ll discuss why the time is right to push the boundaries of what is possible in robotic systems and end with some fun philosophical implications that these efforts in building a robot mind have for our own minds and place in the world. It’s far stranger than you think.
Koh Hosoda  
Thursday 17, 8:45 – 9:45  
Room: Aula Magna – Palazzo del Bo  

BIONIC ROBOTS FOR UNDERSTANDING INTELLIGENCE

Humans and animals exhibit really adaptive behavior in the natural environment. The performance of artificial robots is not comparable to it yet. Since the nature searches optimal solutions for realizing behavior by evolution, we can realize adaptive robots and understand the principle for adaptation by mimicking the nature and by picking up the principles. In the talk, I would like to introduce our trials to realize human/animal like muscular-skeletal robots, Bionic Robots, to understand natural adaptive behavior and to reproduce such behavior by robots.

BIOGRAPHY
Koh Hosoda received his Ph.D. degree in Mechanical Engineering from Kyoto University, Japan in 1993. He was an assistant professor of Mechanical Engineering Department from 1993 to 1997, and an associate professor of Graduate School of Engineering from 1997 to 2010, at Osaka University. From 2010 to 2014, he was a professor of Graduate School of Information Science and Technology, Osaka University. Since 2014, he has been a professor of Graduate School of Engineering Science, Osaka University.

José del R. Millán  
Thursday 17, 9:45 – 10:45  
Room: Aula Magna – Palazzo del Bo  

BRAIN-CONTROLLED ROBOTS

Brain-machine interfaces (BMI) enable users to interact with computers and with physical devices through the voluntary modulation of their brain activity. The central tenet of a BMI is the capability to distinguish different patterns of brain activity in real time, each being associated to a particular intention or mental task. This is a challenging problem due to the limited information carried by brain signals we can measure, no matter the recording modality. How then is it possible to operate complex brain-controlled robots over long periods of time? In this talk I will argue that efficient brain-machine interaction, as the execution of voluntary movements, requires the integration of several parts of the CNS and the external actuators. I will put forward four principles to design neuroprosthetics, which I will illustrate through working prototypes of brain-controlled robots and applications for disabled and able-bodied people alike.

BIOGRAPHY
José del R. Millán is the Deltitech Professor at the Swiss Federal Institute of Technology in Lausanne (EPFL) where he explores the use of brain signals for multimodal interaction and, in particular, the development of non-invasive brain-controlled robots and neuroprostheses. In this multi-disciplinary research effort, Dr. Millán is bringing together his pioneering work on the two fields of brain-computer interfaces and adaptive intelligent robotics. He received his Ph.D. in computer science from the Univ. Politècnica de Catalunya (Barcelona, Spain) in 1992, where he was an assistant professor for three years. He was also a research scientist at the Joint Research Centre of the European Commission in Ispra (Italy), a senior researcher at the Idiap Research Institute in Martigny (Switzerland), and a visiting scholar at the Universities of Stanford and Berkeley as well as at the International Computer Science Institute in Berkeley.
Eugenio Guglielmelli
Friday 18, 8:45 – 9:45
Room: Leonardo – Centro Congressi

REHABILITATION ROBOTICS
Application of robots to rehabilitation has been proposed in the ‘80s, and it came to reality some ten years later. It is expected to be the next major medical domain, after diagnosis and surgery, to which robotics technology will be massively deployed in the short-medium term. The lecture will review basic design principles for rehabilitation robotic systems, which greatly benefit from a typical biomechatronic design approach. Main achievements in the field will be critically analyzed, and a few research case-studies, such as the wearable EVRYON system (www.evron.eu) and the biocooperative MAAT system (hal.umh.es/maat/), will be discussed in more detail so to outline the open challenges for next generation rehabilitation robotic solutions.

BIOGRAPHY
Eugenio Guglielmelli received the Laurea degree in Electronics Engineering and the PhD in Biomedical Robotics from the University of Pisa, Italy, in 1991 and in 1995. He is currently Full Professor of Bioengineering at Campus Bio-Medico University (Roma, Italy) where he serves as the Head of the Laboratory of Biomedical Robotics and Biomicrosystems, that he founded in 2004. From 1991 to 2004 he worked with prof. Paolo Dario at the Advanced Robotics Technology & Systems Laboratory (ARTS Lab) of the Scuola Superiore Sant’Anna (Pisa, Italy). From 2002 to 2004 he served as the Coordinator of the ARTS Lab. His main current research interests are in the fields of human-centred robotics, biomechatronic design and biomorphic control of robotic systems, and in their application to robot-mediated motor therapy, assistive robotics, and neuorobotics.

Cyrill Stachniss
Friday 18, 13:45 – 14:45
Room: Leonardo – Centro Congressi

FLEXIBLE LONGTERM NAVIGATION FOR MOBILE ROBOTS OPERATING IN THE REAL WORLD

Autonomous robots need the ability to perceive and model their environment and to make appropriate decisions in complex situations on their own. The complexity results from the high-dimensional perceptions, the large number of possible actions and the uncertainty about the state of the world. Probabilistic approaches offer ways for addressing these problems since they allow for explicitly modeling noise, for making decisions under uncertainty, and thus for acting robustly. In this talk, I will present innovative techniques for solving different problems in the context of robot navigation and will point out challenges to address in order to build more flexible systems. This includes techniques for building large-scale maps of the environment, relating built models with existing information sources, and for maintaining the acquired models. These are important capabilities for robots to robustly navigate in dynamic environments and crowded city scenes.

BIOGRAPHY
I have joined the University of Bonn as the successor of Wolfgang Förstner as the chair for photogrammetry. Before that, I was lecturer at the University of Freiburg. Until September 2010, I had a 1-year deputyship (W3-Vertretung) of Wolfram Burgard and also finished my habilitation in November 2009. Before that, I was working as an academic advisor in the Lab for Autonomous Intelligent Systems at the University of Freiburg. In my research, I focus on probabilistic techniques in the context of mobile robotics and sensor data interpretation. A main area of my research is autonomous navigation and exploration in combination with solutions to the simultaneous localization and mapping (SLAM) problem. I am also interested in classification and learning approaches, as well as in computer controlled cars, computer vision, navigation techniques, and scene analysis. See my publication list and research page for further details.
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<td>20:00</td>
<td>Shuttle from Centro Congressi to Hotels</td>
<td>3 hours</td>
<td>Conference Banquet</td>
<td>55 mins</td>
<td>Cyril Stachniss</td>
</tr>
<tr>
<td>21:00</td>
<td>2 hours</td>
<td>Welcome Reception</td>
<td>Welcome Reception</td>
<td>Welcome Reception</td>
<td>Cyril Stachniss</td>
</tr>
<tr>
<td>22:00</td>
<td></td>
<td></td>
<td>with Public Fireworks for the “Feast of Redeemer”</td>
<td></td>
<td>Cyril Stachniss</td>
</tr>
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<td></td>
<td>Cyril Stachniss</td>
</tr>
</tbody>
</table>
## Workshops & Tutorials

**Full day (8:45 - 18:00) - Tuesday 15**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTu1</td>
<td>Leonardo</td>
<td>Intelligent Robot Assistants: from Household Chores to Industrial Applications. (IRAS)</td>
<td>Dimitrios Chrysostomou, Simon Boghi, Rajeev Uppal, Erina Giannaccini</td>
</tr>
<tr>
<td>Ttu5</td>
<td>Michelangelo</td>
<td>Data Structures for Large-Scale 3D Point Cloud Processing</td>
<td>Andreas Nüchter, Thomas Wiewmann</td>
</tr>
</tbody>
</table>

**Half day - Morning Session (8:45 - 12:45) - Tuesday 15**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ttu2</td>
<td>Tiziano</td>
<td>Robot Consciousness</td>
<td>Antonio Chella, Riccardo Manzotti</td>
</tr>
<tr>
<td>WTu4</td>
<td>Cimabue</td>
<td>3D Robot Perception with Point Cloud Library</td>
<td>Matteo Munaro, Radu Bogdan Rusu</td>
</tr>
<tr>
<td>WTu6</td>
<td>Raffaello</td>
<td>Brain-Machine Interface</td>
<td>José del R. Millán, Luca Tonin</td>
</tr>
<tr>
<td>WTu5</td>
<td>Giotto</td>
<td>ROS Industrial in European Research Projects</td>
<td>Ulrich Reiser, Stefano Micheletto</td>
</tr>
<tr>
<td>WTu8</td>
<td>Donatello</td>
<td>Connected Service Robotics for Telecommunications Operators</td>
<td>Marco Gaspardone, Basilio Bona</td>
</tr>
</tbody>
</table>

**Half day - Afternoon Session (14:00 - 18:00) - Tuesday 15**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ttu7</td>
<td>Donatello</td>
<td>GPU based Voxel-Collision-Detection for Robot Motion Planning</td>
<td>Andreas Herrmann, Florian Drews</td>
</tr>
<tr>
<td>WTu9</td>
<td>Cimabue</td>
<td>Advances in Marine Robotics Applications</td>
<td>Giovanni Indiveri</td>
</tr>
<tr>
<td>WTu10</td>
<td>Raffaello</td>
<td>Real Time Gesture Recognition for Human-Robot Interaction</td>
<td>Tiziana D’Orazio, Grazia Cicirelli</td>
</tr>
<tr>
<td>WTu11</td>
<td>Giotto</td>
<td>ARP – Robots for Assistance of Post-Production and other Auxiliary Processes</td>
<td>Reinhard Lafrenz, Stefano Ghidoni</td>
</tr>
<tr>
<td>Ttu12</td>
<td>Tiziano</td>
<td>Point Cloud Library Tutorial</td>
<td>Matteo Munaro, Radu Bogdan Rusu</td>
</tr>
</tbody>
</table>

**Full day (9:45 - 17:45) - Friday 18**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFr1</td>
<td>Tiziano</td>
<td>4th TRTWR &amp; RIE 2014 – 4th International Workshop “Teaching Robotics &amp; Teaching with Robotics” &amp; International Conference “Robotics in Education” 2014</td>
<td>Dimitris Alimisis, Grzegorz Granosik, Michele Moro</td>
</tr>
<tr>
<td>WFr2</td>
<td>Raffaello</td>
<td>Intelligent Autonomous Unmanned Search and Rescue Tools</td>
<td>Geert De Cubber, Lorenzo Marconi</td>
</tr>
<tr>
<td>WFr3</td>
<td>Leonardo</td>
<td>Evaluating Social Robots</td>
<td>Salvatore Maria Anzalone, Yukhiro Yoshikawa, Sofiane Boucenna, Fabio Dalla Libera</td>
</tr>
<tr>
<td>WFr4</td>
<td>Michelangelo</td>
<td>Neuro-Robotics for Rehabilitation</td>
<td>Massimo Sartori, Dario Farina, Enrico Pagello</td>
</tr>
</tbody>
</table>

**Half day - Morning Session (9:45 - 12:45) - Friday 18**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFr6</td>
<td>Cimabue</td>
<td>Recent Advances in Agricultural Robotics</td>
<td>Peter Biber, Grzegorz Cielniak, Mark Whitty</td>
</tr>
<tr>
<td>TFr7</td>
<td>Giotto</td>
<td>Compliant Control for Physical Human-Robot Interaction</td>
<td>Andrea Calanca, Nevo Luig Tagliamonte, Paolo Fioroni, Fabrizio Sergi, Riccardo Muradore</td>
</tr>
</tbody>
</table>

**Half day - Afternoon Session (14:45 - 17:45) - Friday 18**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFr8</td>
<td>Cimabue</td>
<td>From Social Robots Towards Android Robots as Life-long Empathic Companions</td>
<td>Antonio Chella, Rosario Sorbello, Shuchi Nishio, Hiroshi Ishiguro</td>
</tr>
<tr>
<td>TFr9</td>
<td>Giotto</td>
<td>Robust Motion Detection for Body Motion Recognition</td>
<td>Estel Martinez-Martin, Angel P. del Pobil</td>
</tr>
</tbody>
</table>

**Half day - Morning Session (09:00 - 13:00) - Saturday 19**

<table>
<thead>
<tr>
<th>ID</th>
<th>Room</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wsa1</td>
<td>Sala De’ Barbari</td>
<td>Workshop on Computational and Robotic Systems for Automatic Music Performance</td>
<td>Antonio Rodà, Sergio Canaanza</td>
</tr>
</tbody>
</table>
### Session I - Wednesday 16

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:45</td>
<td>A Weak Generalized Inverse Applied to Redundancy Solving of Serial Chain Robots</td>
<td>Bertrand Torru</td>
</tr>
<tr>
<td>10:00</td>
<td>Collision Avoidance with Task Constraints and Kinematic Limitations for Dual Arm Robots</td>
<td>Nicola Ceriani, Andrea Zanchettin, Paolo Rocco</td>
</tr>
<tr>
<td>10:35</td>
<td>Autonomous Construction with Compliant Building Material</td>
<td>Young Sokeymami, Wto Tien, Michael Bonani, Francesco Mondada, Marco Cipriano</td>
</tr>
</tbody>
</table>

### Session II - Wednesday 16

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30</td>
<td>Splash-OPTIMIZE: Optimized Linear Carangiform Swimming Motion</td>
<td>Richard James Clapham, Huosheng Hu</td>
</tr>
<tr>
<td>11:55</td>
<td>Control of a Four-legged Steering Walker – Design of Virtual Mechanical Elements Based on Desired Motions</td>
<td>Hiroshi Yamaguchi, Ryosuke Takahashi, Atsushi Kawajirami</td>
</tr>
<tr>
<td>12:20</td>
<td>Parametric Continuous Curvature Path for Smooth Steering with Car-like Vehicles</td>
<td>Shuhyun Gm, Lounis Addouane, Sukheen Lee, Jean-Pierre Derutin</td>
</tr>
</tbody>
</table>

### Session III - Wednesday 16

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:00</td>
<td>Stereo Graph-SLAM for Autonomous Underwater Vehicles</td>
<td>Pep Lluis Negre Carrasco, Francesco Monfort, Gabriel Oliver Codina</td>
</tr>
<tr>
<td>15:25</td>
<td>Robust Onboard Visual SLAM for Autonomous MAVs</td>
<td>Shaowu Yang, Sebastian Scherer, Andreas Zell</td>
</tr>
<tr>
<td>15:00</td>
<td>Micro Air Vehicles</td>
<td>Toma Morisawa, Ikuo Mizuuchi, Antoine Toma, Stefano Rosso, Roberto Antonini</td>
</tr>
<tr>
<td>15:25</td>
<td>Robust Onboard Visual SLAM for Autonomous MAVs</td>
<td>Shaowu Yang, Sebastian Scherer, Andreas Zell</td>
</tr>
<tr>
<td>15:00</td>
<td>Multi-robot Systems I</td>
<td>Roberto Capobianco, Guglielmo Gemignani, Domenico Bissi, Daniele Serio, Luca Zucca, Andrea Zell</td>
</tr>
<tr>
<td>15:25</td>
<td>Robust Onboard Visual SLAM for Autonomous MAVs</td>
<td>Shaowu Yang, Sebastian Scherer, Andreas Zell</td>
</tr>
</tbody>
</table>
## Session IV - Wednesday 16

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Organizer</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:45</td>
<td>A Kinetic-based Front-end for Graph-SLAM Using Plane Matching in Planar Indoor Environments</td>
<td>Leonardo Cimabue</td>
<td>Padova</td>
</tr>
<tr>
<td>17:10</td>
<td>Landmark Rating and Selection for SLAM in Dynamic Environments</td>
<td>Radim Luza, Vitezslav Beranv, Khelifa Baizid, Ryad Chellali, Filippo Arrichiello</td>
<td>Padova</td>
</tr>
<tr>
<td>17:35</td>
<td>Local Multi-Resolution Surfel Grids for MAV Motion Estimation and 3D Mapping</td>
<td>Daniel Saur, Kurt Geihs</td>
<td>Padova</td>
</tr>
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</table>

## Session V - Thursday 17

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Organizer</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:45</td>
<td>Design of a Low-Cost Vision System for Laser Profilometry Aiding Smart Vehicles Movement</td>
<td>Leonardo Cimabue</td>
<td>Padova</td>
</tr>
<tr>
<td>12:10</td>
<td>Prophet MARS: Reactive Planning Engine For Multi-agent systems</td>
<td>Marco Langerwisch, Marc Steven Krämer, Claudia Krämer</td>
<td>Padova</td>
</tr>
<tr>
<td>12:35</td>
<td>A Knowledge-based Approach to Crack Detection in Thermographic Images</td>
<td>Emanuele Menegatti, Davide Antonio Cucci, Andrea Baroni, Matteo Munaro</td>
<td>Padova</td>
</tr>
</tbody>
</table>

## Session VI - Thursday 17

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Organizer</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00</td>
<td>On-Road Trajectory Planning for General Autonomous Driving with Enhanced Tunability</td>
<td>Leonardo Cimabue</td>
<td>Padova</td>
</tr>
<tr>
<td>14:25</td>
<td>Curve-Graph-skimmetry: Removing the orientation in loop closure optimisation problems</td>
<td>J.J. Guerra, Leonardo Cimabue</td>
<td>Padova</td>
</tr>
<tr>
<td>14:50</td>
<td>RRS: Rapidly-exploring Random Snakes a New Method for Mobile Robot Path Planning</td>
<td>Filippo Arrichiello, Riccardo Mencarelli</td>
<td>Padova</td>
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</tbody>
</table>
# Technical Program

## Session VII - Thursday 17

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:45</td>
<td>Layered Mission and Path Planning for MAV Navigation with Partial Environment Knowledge</td>
<td>Matteo Neuenhausen, Sven Benike</td>
</tr>
<tr>
<td></td>
<td>Multi-Vehicle Adaptive Planning with Online Estimated Cost due to Disturbances</td>
<td>Vishnu Desanjoo, Lantao Liu, Nathan Michael</td>
</tr>
<tr>
<td>16:10</td>
<td>Kinematic analysis of a 3D printed 4-DOF desktop robot actuated exclusively by revolute pairs</td>
<td>Fabio Della Libera, Christian Pirlozzi, Vittorio Yarjoo, Kimiko Ishiguro</td>
</tr>
<tr>
<td>16:35</td>
<td>I am Alone: the autonomous wheelchair at your service</td>
<td>Adalberto Liverani, Raul Rojas</td>
</tr>
</tbody>
</table>

## Poster Session I - Friday 18

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:45</td>
<td>Communication Aware Route Selection in Wireless Sensor Networks</td>
<td>Adnan Rida, Pham Duc Hung, Nor Jaidi Tuah, Trung Dung Ngo</td>
</tr>
<tr>
<td></td>
<td>Considerate Behavior of Robots based on Individual Preference</td>
<td>Jeonguhn Baek, Juntau Maouchi</td>
</tr>
<tr>
<td></td>
<td>Dynamic simulation of robotic devices using the biomechanical simulator</td>
<td>Pablo-Diego Conde, Enrico Pagello</td>
</tr>
<tr>
<td></td>
<td>A tag-based recommender system</td>
<td>Pietro De Caro, Maria Silvia Pini, Francesco Sambo</td>
</tr>
<tr>
<td></td>
<td>Interaction of two oscillator aggregations</td>
<td>Sho Yamachi, Hidekazu Kawamura, Kaji Suzuki</td>
</tr>
<tr>
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<tr>
<td>14:45</td>
<td>Towards Localizing Both Static and Non-static RFID Tags with a Mobile Robot</td>
<td>Pan Liu, Andreas Zell</td>
</tr>
<tr>
<td></td>
<td>Fast Active SLAM for accurate and complete mapping</td>
<td>Ikuo Mizuuchi, Sho Yamauchi, Hidenori Kawamura</td>
</tr>
<tr>
<td></td>
<td>3D Object Recognition using Convolutional Neural Networks with Transfer Learning between Input Channels</td>
<td>Luis A. Alexandre</td>
</tr>
<tr>
<td></td>
<td>Self-learning PRT* Algorithm for Mobile Robot Motion Planning in Complex Environments</td>
<td>Fabio Lettice, Christian Bagler, Joerg Frankie</td>
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</tbody>
</table>

## Poster Session II - Friday 18

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:45</td>
<td>Cognitive Recognition under Occlusion for a Visually Guided Robotic Errand Service</td>
<td>Ahmed Najaib, Xi Chen, Suhyan Lee</td>
</tr>
<tr>
<td></td>
<td>Automatic Detection and Feature Estimation of Windows from Mobile Terrestrial LiDAR Data</td>
<td>Hoon-Ki Kwon, K.S. Kim, Jiang-Myang Lee, Min Cheol Lee</td>
</tr>
<tr>
<td></td>
<td>3D Mapping by a Robotic Fish with Two Mechanical Scanning Sonars</td>
<td>Krutu Lesnic, Andrei Kitanov, Marija Marozovic, Marija Marozovic, Ivan Petrov</td>
</tr>
<tr>
<td></td>
<td>Construction of Roadmaps Maps for Mobile Robots’ Navigation Using RGB-D Camera</td>
<td>Jesus Savage, Luis Contreras</td>
</tr>
<tr>
<td></td>
<td>An Application of Laser-Based Autonomous Navigation for Data-Collector Monitoring</td>
<td>Stefano Risso, Luccio Orlando Russo, Giuseppe Airo Fasola, Luca Cardone, Roberto Antonio, Marco Gasparinone, Basilio Bona</td>
</tr>
<tr>
<td></td>
<td>Construction of Laser-Based Autonomous Navigation for Data-Collector Monitoring</td>
<td>Stefano Risso, Luccio Orlando Russo, Giuseppe Airo Fasola, Luca Cardone, Roberto Antonio, Marco Gasparinone, Basilio Bona</td>
</tr>
</tbody>
</table>

## Other Session Notes

- **Path Planning II**
  - **Robot Design II**
  - **Sensing for Navigation II**
  - **Object Detection and Tracking II**

- **Posters**
  - **Robotics**
  - **Perception**

- **Technical Program**
  - **Arcimboldo**
  - **Michelangelo**
  - **Raffaello**

- **Technical Program**
  - **Leonardo**
  - **Cimabue**
Oussama Khatib

WORKING WITH THE NEW ROBOTS

Exploring, working, and interacting with humans, the new generation of robots being developed will increasingly touch people and their lives, in homes and workplaces, in challenging field domains and new production systems. These emerging robots will provide support in services, health care, manufacturing, entertainment, education, assistance, and intervention. While full autonomy for the performance of advanced tasks in complex environments remains challenging, the simple intervention of a human would tremendously facilitate reliable real-time robot operations. Two basic modalities of haptically mediated interaction and direct physical contact are being conceived. Human-robot interaction greatly benefits from combining the experience and cognitive abilities of the human with the strength, dependability, competence, reach, and endurance of robots. Moving beyond conventional teleoperation, the new paradigm places the human at the highest level of task abstraction, relying on highly skilled robots with the requisite competence for advanced task behavior capabilities. The discussion focuses on robot design concepts, robot perception and control architectures, and task strategies that bring human modeling, motion, and skill understanding to the development of safe, easy to use, and competent robotic systems. The presentation will include live hands-on illustrative instance of human-robot interactions in various robotic applications. In particular, it will highlight interactions with a novel underwater robot, being developed jointly in collaboration between Stanford, Meka Robotics, and KAUST. The motivation for this robot is to help marine biologists to safely explore the Red Sea’s fragile and previously inaccessible underwater environment. Live interactions will illustrate how bimanual haptic devices can be used to interact with the entire robot. A 3D graphic and haptic interface allows non-expert users to intuitively operate the robot while feeling contact forces when performing dexterous tasks. While the operator can fully focus on the robot’s task, the robot controller autonomously handles constraints, multiple contacts, disturbances, obstacles, and robot posture, so that the robot task can be optimally performed in the deep sea. This robot illustrates the new emerging paradigm in other challenging areas of underwater robotics, such as archeology, inspection, and maintenance of pipelines and other structures. Connecting humans to increasingly competent robots will certainly fuel a wide range of new robotic applications in challenging environments.

BIOGRAPHY

Oussama Khatib received his Doctorate degree in Electrical Engineering from Sup’Aero, Toulouse, France, in 1980. He is Professor of Computer Science at Stanford University. His work on advanced robotics focuses on methodologies and technologies in human-centered robotics, including human-robot interaction, robotics in human habitats, and human-robot interaction. His research includes the Springer Handbook of Robotics, which received the PROSE Award. He is a Fellow of IEEE and has served as a Distinguished Lecturer. He is the President of the International Federation of Robotics Research (IFRR). Professor Khatib is a recipient of the Japan Robot Association (JARA) Award in Research and Development. In 2010 he received the IEEE RAS Pioneer Award in Robotics and Automation for his fundamental pioneering contributions in robotics research, visionary leadership, and life-long commitment to the field. Professor Khatib received the 2013 IEEE RAS Distinguished Service Award in recognition of his vision and leadership for the Robotics and Automation Society, in establishing and sustaining conferences in robotics and related areas, publishing influential monographs and handbooks and training and mentoring the next generation of leaders in robotics education and research. In 2014, Professor Khatib received the 2014 IEEE RAS George Saridis Leadership Award in Robotics and Automation.

Lynne Parker

DISTRIBUTED ROBOT SYSTEMS: ACCOMPLISHMENTS, UNIFYING THEMES, AND FUTURE DIRECTIONS

Distributed robot systems have been a topic of study for more than two decades. Many important advances have been made in the field, yet few multi-robot systems are in practical use today. This talk explores many accomplishments in the field of distributed robotics, as well as potential reasons these systems have not yet been widely deployed in real applications. In addition, given the multitude of research activities worldwide that involve multiple robots, it is also important to determine what the fundamental questions are that unify these various studies, other than the fact that they employ more than one robot. This talk will conclude with a discussion of open research challenges that may help lead toward new frontiers in distributed robot systems.

BIOGRAPHY

Dr. Lynne Parker is Professor and Associate Head in the Department of Electrical Engineering and Computer Science at the University of Tennessee, Knoxville, where she directs the research of the Distributed Intelligence Laboratory. Additionally, she holds an appointment as Adjunct Distinguished Research and Development Staff Member at Oak Ridge National Laboratory (ORNL), where she worked as a full time researcher for several years. Dr. Parker received her Ph.D. degree from the Massachusetts Institute of Technology (MIT), performing her research in MIT’s Artificial Intelligence Laboratory, with a minor in brain and cognitive science. Dr. Parker conducts research in the areas of distributed robotics, human-robot interaction, sensor networks, and machine learning, and has published over 150 articles in these areas. For this research, she was awarded the PECASE (U.S. Presidential Early Career Award for Scientists and Engineers), For 3 years, she served as the Editor-in-Chief of the IEEE Robotics and Automation Society Conference Editorial Board, and served for several years as a senior Editor of IEEE Transactions on Robotics. She is serving as the Program Chair for ICRA 2014, and the General Chair for ICRA 2015. She is a Fellow of IEEE.
Hajime Asama

HUMAN INTERFACE FOR DISASTER RESPONSE ROBOTS

The Great Eastern Japan Earthquake and Tsunami occurred in March 11, 2011, and as a result, the accident of Fukushima Daiichi Nuclear Power Plant occurred. Utilization of remote-controlled machine technology including robot technology (RT) was essential for the response against the accident to accomplish various tasks in the high-radiation environment. In this presentation, it is introduced how the technology has been utilized in the emergent situation of the accident, and what kind of technology is still demanded for decommissioning. In operation of remote-controlled machines, human interface plays very important role. In this presentation, human interface design taking account of human characteristics on sense of agency is suggested, and human interface using various viewpoint image visualization to facilitate the operation is introduced. Finally, issues are discussed how we should prepare for the future possible disasters and accidents in future.

BIOGRAPHY

Hajime Asama received his B. S., M. S., and Dr. Eng. from the University of Tokyo, in 1982, 1984 and 1989, respectively. He worked in The Institute of Physical and Chemical Research from 1986 to 2002. He became a professor of Research into Artifacts, Center for Engineering, the University of Tokyo in 2002, and a professor of School of Engineering, the University of Tokyo since 2009. He received JSME Robotics and Mechatronics Award in 2009, RSJ Distinguished Service Award in 2013, etc. He is the vice-president of RSJ in 2011-2012. He was an AdCom member of IEEE Robotics and Automation Society from 2007 to 2009, the president-elect of Intelligent Autonomous Systems Society from 2012, an associate editor of Control Engineering Practice, Journal of Robotics and Autonomous Systems, Journal of Field Robotics, etc. He played the director of the Mobiligence Emergence of adaptive motor function through the body, brain and environment program in the MEXT Grant-in-Aid for Scientific Research on Priority Areas from 2005 to 2009. He is a Fellow of JSME and RSJ. Currently, he is the chairman of the Task Force for Remote Control Technology of the council for decommissioning of the Fukushima Daiichi Nuclear Power Plant, the leader of Project on Disaster Response Robots and of Council on Competitiveness-Japan, and the chairman of Robotics Task Force for Anti-Disaster. His main research interests are distributed autonomous robotic systems, smart spaces, service engineering, Mobiligence, and service robotics.

Rüdiger Dillmann

STATUS AND RECENT PROGRESS TOWARDS INTERACTIVE AUTONOMOUS ROBOT SYSTEMS

Today in the golden age of autonomous robot systems powerful methods and system architectures are available which enable a robot to interact with its environment including humans and being adaptive to dynamic situations and changing contexts. Some systems are announced considering the user’s preferences and even its needs. Currently, an encouraging spectrum of methods are propose which allow the design and integration of cognitive system capabilities including vision, speech, learning, decision making, planning and motor control. Nevertheless, the focus of most today’s autonomous systems is related to high performance activities in well defined, narrow domains. The successful attempts in building autonomous robot systems with cognitive capabilities are still restricted to systems designed for missions with limited and well defined scope and performing simple tasks. The transfer of these skills and abilities to master changing contexts and tasks without costly redesign of specific, ad hoc solutions is still cumbersome. A break-through in understanding, modelling and integration of generative system capabilities into an autonomous system requires an extensive utilization of search-based planning techniques as the fundamental representation being part of a powerful AI framework to tackle flexible task adaptation. Instead of trying to use a single unified planning representation, both discrete, symbolic and continuous, sub-symbolic motion planning can be applied. The task planning representation can be generated by PbD techniques, which has been proven to be sufficiently flexible and powerful. The representation gap between constraint-based motion planning and symbolic task planning can be bridged by utilizing a triplet of manipulation strategy representations, scene context models and semantic task annotations. Manipulation strategy graphs ground complex, flexible robot motions, instantiated in a specific situation by motion planning, in sequences of discrete segments with precise pre- and post-conditions. Scene context models ground the strategy graph task frames in real-world scene object properties as provided by robot perception. Thus, pre- and post-conditions can be attached to distinct objects or corresponding properties. Finally, semantic task annotations provide a discrete, symbolic grounding of complex motion constraint properties. Such grounding can be acquired from human natural language task demonstration comments. By applying this triplet together, complex manipulation tasks, executed by motion planning, can be tightly linked to parts of a symbolic planning domain instance. Then both aspects can be planned and executed together. Providing this technology more complex robot tasks can be learned naturally from humans and executed autonomously. For this purpose, a framework is beneficial which allows the combination of multiple forms of learning and context-dependent switching between such forms of learning accelerates considerably the acquisition of new skills. A survey on recent work on learning supporting autonomous robots and the related representations as well as some applications are to be presented.

BIOGRAPHY

Rüdiger Dillmann received his Ph. D. from University of Karlsruhe in 1980. Since 1987 he has been Professor of the Department of Computer Science and is Director of the Research Lab. Humanoids and Intelligence Systems at KIT. 2002 he became director of an innovation lab at the Research Center for Information Science (FZI), Karlsruhe. Since 2009 he is spokesman of the Institute of Anthropomatics at the Karlsruhe Institute of Technology and founder of the KIT – Focus Anthropomatics and Robotics. His research interest is in the areas of humanoid robotics with special emphasis on intelligent, autonomous and interactive robot behaviour based on machine learning methods and programming by demonstration (PbD). Other research interests include machine vision for mobile systems, man-machine interaction, computer supported intervention in surgery and related simulation techniques. He is author/co-author of more than 700 scientific publications, conference papers, several books and book contributions. He was Coordinator of the German Collaborative Research Center “Humanoid Robots”, SFB 588 and several European IPs. He is Editor-in-Chief of the journal “Robotics and Autonomous Systems”, Elsevier, and Editor in Chief of the book series COSMOS, Springer. He is IEEE Fellow.
Frans Groen

ACTOR-AGENT COMMUNITIES, DECISION MAKING AND INFORMATION FUSION

Human beings are the oldest intelligent actors we know and form an essential part of complex intelligent systems. Despite all the information and communication available in our current society, a close cooperation between human beings and intelligent agents is often not really present. Systems are distributed and information is not optimally shared. The challenge is to design distributed systems where both human beings and intelligent agents use the same underlying world model and interact with it. The system must ensure that information of human beings is merged with sensory information of the intelligent agents and that information can be easily retrieved. An example may be a relief worker with a smart phone and sensory data of a sensor network in an emergency situation. Different types of information, delivered by sensors and human beings have to be merged. Bayesian networks can be used for that. In a Bayesian network the relationship is represented between the involved variables. They also form the statistical framework to determine the probabilities of the values of the variables and to fuse information. Issues are among others, which variables and relations between variables are essential, in particular when complex networks are merged together from sub networks, and how to determine the utility of information compared to the cost of that information. The interaction with the human being is another important aspect. The question is not only how to merge information, but also what are the best questions to ask on a smart phone. For instance the human is good in smell, but less good in the determination of scents. Associations work much better. Another challenge is that the system, for example, in crisis situations, is not closed but open. Each crisis situation is different with regard to essential and unforeseen information which must be included in the world model. The system must have such a structure that this new information can be recorded and tracked in the world model. We will illustrate this with a project in the field of Environmental Crisis Management in the industrial Rotterdam area. If a gas in that region escapes, people begin to call DCMR (the Environmental Department Richmond) and several types of gas sensors give an alarm. If there are many phone calls coming in, they cannot all be manually processed. You would like to have an automated system, which can handle calls and merge information incorporating existing knowledge. Also social media like twitter form an important source of information.

Sukhan Lee

COGNITIVE VISION AND INTERACTION FOR INTELLIGENT SERVICE ROBOTS

The future generation of service robots for personal/domestic use should be able to provide with such physical services as errands in an unstructured, naturally cluttered, home environment. The key for robots to carry out such an errand service is their capability of dependable search, recognition and pose estimation of the objects of interest as well as of natural and sociable interaction with a service requester. This talk presents an approach to “cognitive vision” as a means of accomplishing dependable search, recognition/pose estimation of a target object as well as natural and sociable interaction in an unstructured, naturally cluttered, home environment. The approach emphasizes the integration of cognitive behaviors associated with object search, recognition/pose estimation as well as human-robot interaction with conventional approaches as a solution. The cognitive behaviors included are the selection of the features optimal for environmental variations, the proactive collection of evidences sufficient for reliable decision, the probabilistic reasoning with multiple hypotheses, as well as the use of context knowledge. A home service robot, “HomeMate,” capable of an errand service with the above “cognitive vision” fully implemented for dependable search, recognition/pose estimation as well as human-robot interaction for an errand service is introduced. In particular, this talk entertains the audiences with a number of video clips that demonstrate the capability of “HomeMate” carrying out visually guided yet dependable errand services with smart-phone, menu-driven avatar and gesture based human-robot interactions. User studies performed in Korea and US are also introduced.

Biography

Prof. Sukhan Lee is currently Haegdian Chair Professor of Information and Communication Engineering and the Director of the Intelligent Systems Research Institute at Sungkyunkwan University. He served as the Dean of the Graduate School from 2011 to 2013 and the WCU professor of Interaction Science from 2008 to 2013. From 1998 to 2003, he was with the Samsung Advanced Institute of Technology as an Executive Vice President and a Chief Research Officer. From 1990 to 1997, he worked for the Jet Propulsion Laboratory/NASA, Califoria Institute of Technology, as a Senior Member of Technical Staff. From 1983 to 1997, he was with the Department of Electrical Engineering and Computer Science at the University of Southern California as a Professor. Prof. Sukhan Lee received his Ph.D. degree in Electrical Engineering from Purdue University, West Lafayette in 1982, and his M.S. and B.S. degrees in Electrical Engineering from Seoul National University in 1974 and 1972, respectively. Prof. Sukhan Lee is a fellow of IEEE since 1998 and a fellow of Korean National Academy of Science and Technology since 1999. He has his current research interest in the areas of Cognitive Robotics and Intelligent Systems.
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