When is a Robot a Robot?

How new degree in robotics challenged us to once again define robots

Madsen, Ole; Bak, Thomas; Struijk, Lotte N. S. Andreasen; Moeslund, Thomas B.

Published in:
International Journal of Advanced Robotic Systems

Publication date:
2014

Document Version
Early version, also known as pre-print

INTERNATIONAL JOURNAL OF ADVANCED ROBOTIC SYSTEMS

CELEBRATING 10 YEARS

FR0M THE MANAGING EDIT0R

Dear readers,

In January 2004, NASA successfully landed their Mars Exploration Rovers, Spirit and Opportunity on Mars. Nobody could share the information on Facebook since the latter was only launched in February 2004.
In March 2004, the first IJARS team felt spirited, grabbed the opportunity and published the first paper in the first volume of the International Journal of Advanced Robotic Systems. It was a paper by Dr. Claude F. Touzet on Distributed Lazy Q-learning for Cooperative Mobile Robots.

10 years since IJARS published its first Volume. 10 years of hard work and dedication that lead us to where we are today. In this celebratory feature we have taken a step back to consider what it took to become the first and only Open Access journal in the field of robotics up until today. As much as we are thrilled with the milestones reached in the first decade, we also want to draw your attention to our future goals and share with you where we go from now. I hope you will enjoy the features we have prepared for you.

Our 10th year anniversary is not only a celebration of the journal, but also the celebration of our collaborators whose research and ideas facilitated the development of robotics. They made progress and IJARS possible and this issue is dedicated to them.

Thank you all, it is with great anticipation that we await the next 10 year of IJARS.

Natalia Reinic

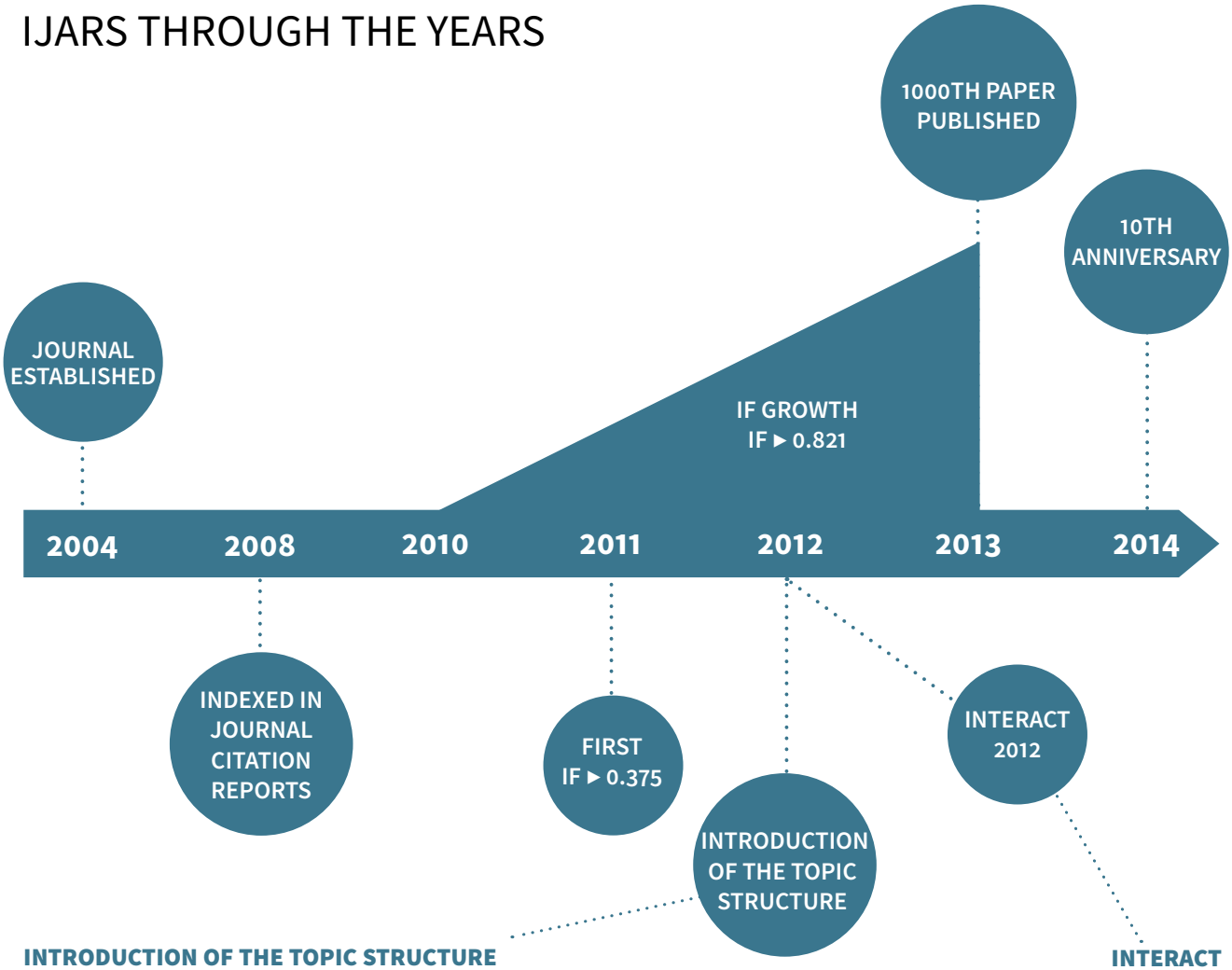
CONTENTS

10 YEARS OF IJARS: OUR PAST AND OUR PRESENT

The International Journal of Advanced Robotic Systems (IJARS) was established in 2004. From the very beginning the journal's mission was to provide the most innovative research and application output in robotics, featuring both established roboticists and younger researchers trying to make a name for themselves. The final goal of the first Editors-in-Chief was to support robotics communities with scientifically relevant content to be read and shared for free. Until then, all robotics journals limited access to knowledge to only those who were able to meet the costs of journal subscriptions.
Being a new journal in the publication landscape, the team behind IJARS had to tackle both the novelty of IJARS as well as the still relatively unknown Open Access model. Gradually attracting the attention of major robotics labs, institutions and research groups looking for further ways to increase the visibility of their work, IJARS provided these with a double blind peer-reviewed journal that also allowed all published articles to be read, downloaded and shared online for free. With such a publishing model in place, the journal successfully evolved into an online robotics platform for roboticists to publish their latest research efforts and for readers and libraries to access all articles at no cost.

THIS LEAD TO IJARS BECOMING THE FIRST AND ONLY OPEN ACCESS JOURNAL IN THE FIELD OF ROBOTICS UP UNTIL TODAY.

IJARS THROUGH THE YEARS



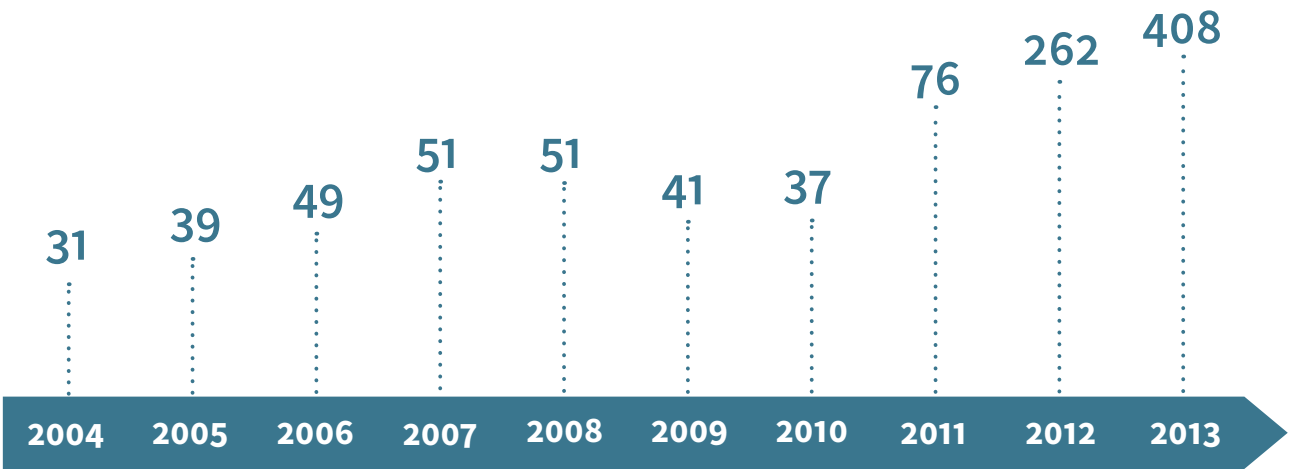
INTRODUCTION OF THE TOPIC STRUCTURE

In 2012, the International Journal of Advanced Robotic Systems lived through several developments that strengthened its scientific impact. The journal's editorial team introduced 42 topics related to distinct areas of research within robotics, united in a single cross-subject journal. This brought onboard Topic Editors specialised in research areas covered by the topic they managed.

INTERACT

Interact was a free-atendance series of workshops organised and sponsored by IJARS that took place on September 3rd, 2012, in Rijeka, Croatia. The principal goal of Interact2012 was to give an overview of the latest and future developments, applications, and frontiers to overcome in the robotics research area of HRI. Professors Hiroshi Ishiguro (University of Osaka), Andrea Bonarini (Politecnico di Milano), and Pericle Salvini (Scuola Superiore Sant'Anna) where the workshops main lecturers.

Such efforts and hard work resulted in the journal's inclusion in ISI Thomson Reuters' database and the allocation of an initial Impact Factor back in 2010. At this point, to provide its readers with an even better journal, the team behind IJARS worked hard with all its scientific collaborators and introduced a topic content structure where each section is managed by a different Topic Editor-in-Chief. Each topic functions as an independent subject domain under the journal's umbrella. 42 robotics topics were presented in 2012 transforming the journal in one of the most comprehensive robotics research publications up until then. In 2013, by merging complementary robotic disciplines together, the topics were grouped into 14. This new model as well as the continual growth in readership, citations and relevance on a global scale, lead to a new Impact Factor of 0.821 allocated in June 2013.



NUMBER OF PAPERS PUBLISHED THROUGHOUT YEARS

In 2014, exactly 10 years from IJARS's start, the journal has grown to be a dynamic publication that regularly features exciting new robotics applications in all sub-areas of robotics research. Furthermore, a new visual identity symbolizing a look into the future has just been introduced and it revamped the journal's brand in celebration of its 10th birthday.

TODAY IJARS HAS A TOTAL OF 13 TOPICS THAT ARE OPEN FOR SUBMISSIONS AND CAN BE ACCESSED ON IJARS'S OFFICIAL HOMEPAGE.

ALL ARTICLES PUBLISHED UNDER EACH TOPIC ARE COMPLETELY FREE TO BE READ ONLINE OR DOWNLOADED AT ANY TIME

TOPICS COVERED IN 2014

ROBOT MANIPULATION AND CONTROL

Topic Editor-in-Chief:
Andrey V. Savkin
University of New South Wales, Australia

FIELD ROBOTICS

Topic Editor-in-Chief:
Yangquan Chen
University of California, Merced, USA

MEDICAL ROBOTICS

Topic Editor-in-Chief:
Arianna Menciassi
Sant'Anna School of Advanced Studies, Italy

SERVICE ROBOTICS

Topic Editor-in-Chief:
Marco Ceccarelli
University of Cassino, Italy

VISION SYSTEMS

Topic Editor-in-Chief:
Antonio Fernández-Caballero
University of Castilla-La Mancha, Spain

MICRO/NANO ROBOTICS

Topic Editor-in-Chief:
Quan Zhou
Aalto University, Finalnd

OPEN ACCESS

BIOINSPIRED ROBOTICS

Topic Editor-in-Chief:
Mohsen Shahinpoor
The University of Maine, USA

HUMAN ROBOT/MACHINE INTERACTION, AI IN ROBOTICS

Topic Editor-in-Chief:
Chrystopher L. Nehaniv
The University of Hertfordshire, UK

HUMANOID ROBOTICS

Topic Editor-in-Chief:
Yoseph Bar Cohen
Jet Propulsion Laboratory/ California Institute of Technology, USA

ROBOT SENSORS

Topic Editor-in-Chief:
Henry Leung
University of Calgary, Canada

CLIMBING AND WALKING ROBOTS

Topic Editor-in-Chief:
Manuel Armada
Spanish Council for Scientific Research (CSIC), Spain

Topic Editor-in-Chief:
Christine Chevallereau
CNRS, Ecole Centrale de Nantes, France

MOBILE ROBOTS AND MULTI-ROBOT SYSTEMS

Topic Editor-in-Chief:
Nak-Young Chong
Japan Advanced Institute of Science and Technology, Japan

Topic Editor-in-Chief:
Pablo Gonzalez-de-Santos
Spanish Council for Scientific Research (CSIC), Spain

IJARS TEAM

NATALIA REINIC
Managing Editor

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

My name is **Natalia Reinic** and I am the International Journal of Advanced Robotic Systems **Managing Editor.** I plan, organize, strategize and keep an eye on all IJARS processes.

WHY DO I LOVE WHAT I DO?

What I love most about my work is the people I work with and the results of our work. The team is simply amazing, starting from my office colleagues to the Topic Editors in Chief, Associate Editors and all other collaborators. They make progress and IJARS possible and I thank them for that.

WHAT IS MY FAVORITE ROBOT AND WHY?

Current efforts of Duke's University Walk Again Project are truly remarkable. Seeing a paralyzed teen kicking off the 2014 FIFA World Cup using a mind-controlled exoskeleton will be a glimpse of the future in which wheelchairs may become obsolete. As for fictional robots, my all-time favourite is WALL•E because of his friendly demeanor and positive effect on all robots and humans he meets.

ANJA FILIPOVIĆ
Publishing Process Manager

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

My name is **Anja** and I am the **Publishing Process Manage**r for IJARS. My job is to cover the technical aspects of the process and make sure that everything runs smoothly. I answer all author queries from the moment a manuscript is submitted and enters a review process, until the moment it is published online.

WHY DO I LOVE WHAT I DO?

I enjoy having the opportunity to communicate with all our collaborators. It amasses me how far geographically we can be, but still make such good connections and form a strong team.

WHAT IS MY FAVORITE ROBOT AND WHY?

When it comes to picking out my favorite robot, I will go for a movie, and say Bishop (from Aliens, 1986). An android that helped Ripley and Newt escape Alien Queen (this movie series was one of my favorite). His appearance made an impact and instigated my interest in the topic on robots and emotions.

VIKTORIJA ZGELA
Senior Commissioning Editor

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

My name is **Viktorija Zgela** and I work as a **Senior Commissioning Editor** for IJARS.

WHY DO I LOVE WHAT I DO?

Being part of IJAR'S team has given me an opportunity to cooperate with the robotics community - a community that drives the development in today's world. Having the chance to grasp a bit of the excitement around the scientific research and discovery, being able to closely work with outstanding researchers, knowing that their precious knowledge will be accessible to anyone, anywhere, and to share this experience with great people inside the team is truly a privilege and a pleasure.

WHAT IS MY FAVORITE ROBOT AND WHY?

I believe that there are too many good things in life to opt for just one. The same applies to robots. Among the fictional ones my favorite are Data, Bender, Wall-E, Kryten, C-3PO, R2D2, T-1000, and Maria from Metropolis.
When it comes to real robots, how can one choose among so many useful (yes, you may presume that my number one robot in this section is robovac), technically challenging, and fun (after all) types? The choice is so vast that it bewilders.
However, I must give a head start to medical robots. When people are afflicted with illness or have a disability, the rest of the world can hold still. The opportunities that medical robots offer them are, indeed, amazing.

SAŠA MARCAN
Library & Information Service Coordinator

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

Saša Marcan, Library & Information Service Coordinator. I monitor the journal's perfomance by tracking down citations to it and use that data to (try to) predict its future performance. Besides that, publication and research ethics also fall within my domain so I occasionally help with investigating reported scientific misconducts.

WHY DO I LOVE WHAT I DO?

The tasks I get assigned with are diverse so I rarely get bored with my job, and get to become more and more familiar with different facets of scientific publishing.

WHAT IS MY FAVORITE ROBOT AND WHY?

Google Scholar's crawlers — they do a great job tracking down all sorts of scholarly publications on the web. If we're talking robots with a physical presence, then I'd go with civilian drones. They just seem so fun to play with and I'm sure there are other ways to put them to good use, too.
Fictional robots? Jaegers from Pacific Rim top that category, they're pretty impressive.

ANA NODILO
Marketing Manager

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

I'm **Ana Nodilo** and I'm at the core of the journal's marketing and communications activities.

WHY DO I LOVE WHAT I DO?

What I love about my work is the fast-paced environment and the chance I get to always learn new robotic technology that one day may change the way we live.

WHAT IS MY FAVORITE ROBOT AND WHY?

Currently I'm in love with Keecker as it simplifies one's lifestyle by providing entertainment when you're just too tired to think of something to relax with after a hard day at work.

GORAN ČEKO
Technical support

MY NAME, TITLE, AND WHAT I DO FOR IJARS?

My name is **Goran Čeko** and I provide technical support for all things IJARS (such as updating the journal's website, removing all technical issues related to publishing papers atc.)

WHY DO I LOVE WHAT I DO?

I mostly appreciate the dynamic nature of what I do. There is always something new and exciting coming up. Also, I really enjoy working with the journal's team.

WHAT IS MY FAVORITE ROBOT AND WHY?

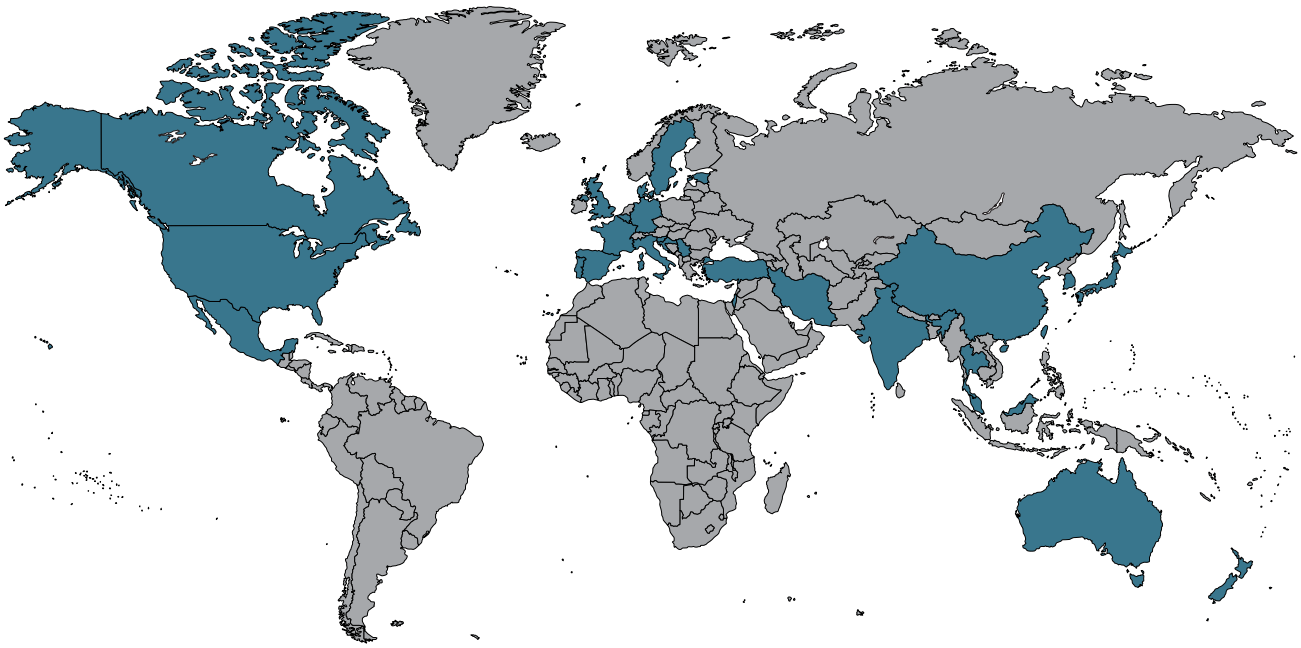
My favorite robot is Marvin Paranoid Android for its GPP (Genuine People Personality) and Data because he's programmed to develop these modules himself.

OUR COLLABORATORS

The International Journal of Advanced Robotic Systems is a journal managed not only by the editorial team behind its publisher but first and foremost, by all the international collaborators that have jumped on board with the team behind IJARS.

The extended team of Topic Editors in Chief, Editorial Board Members, Reviewers, Technical Editors, Proof Readers and Designers that have worked on this journal throughout the years are as much a vital part to IJARS's growth and success as the journal's core team.

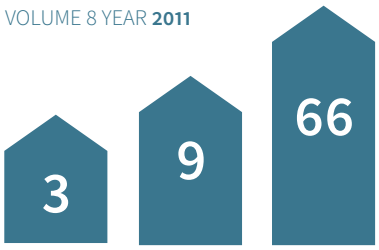
Since 2004, IJARS's team has been joined by international roboticists that actively worked on raising the scientific quality of the journal. **With the journal's expansion in terms of topics covered and published papers, our extended team of collaborators kept growing in number to assure a timely publication timeframe, editorial consistency, quality of the papers and international reach.**



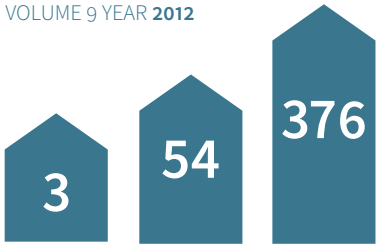
Australia, China, USA, Italy, Japan, Germany, United Kingdom, France, Malaysia, Portugal, Taiwan, Denmark, Mexico, Belgium, Canada, Estonia, India, Iran, Israel, Kingdom of Bahrein, Korea, New Zealand, Serbia, Singapore, Slovenia, Spain, Sweden, Thailand, Turkey.

EXPANSION OF THE EDITORIAL BOARD

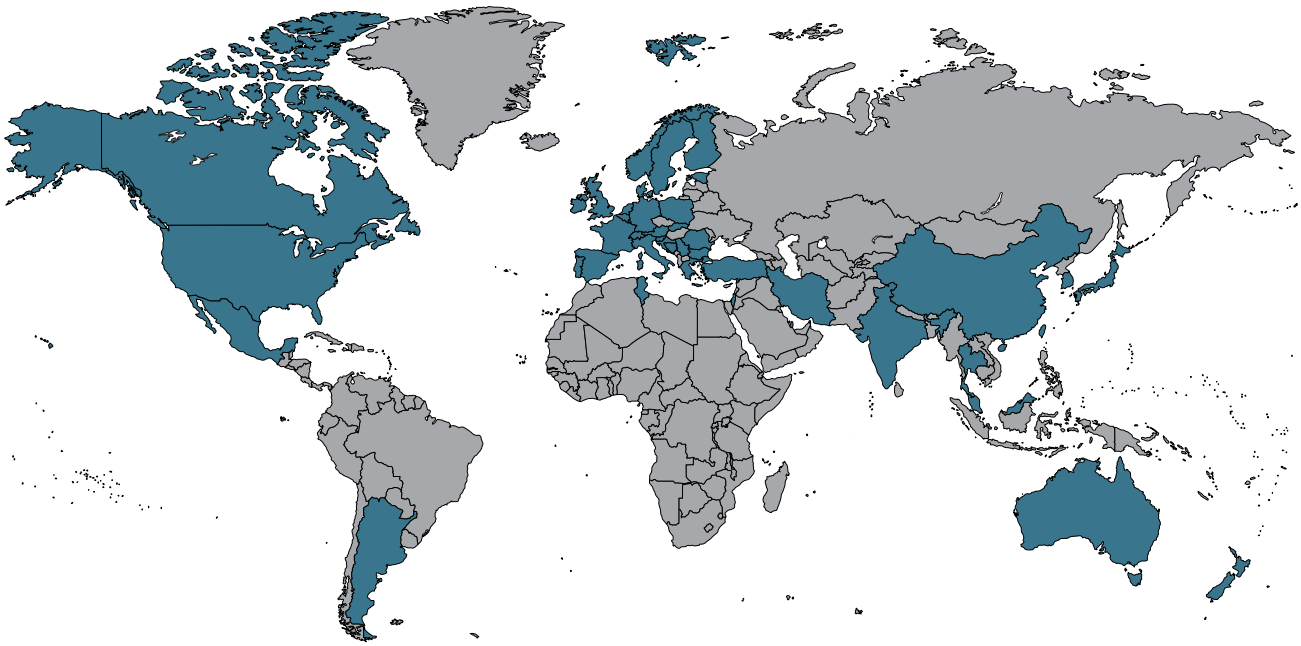
VOLUME 8 YEAR **2011**



VOLUME 9 YEAR **2012**



With the growth of the journal's Editorial Board throughout the years, IJARS became an authoritative publication in the field of robotics that not only publishes research articles but spots and highlights trends that lead to novel applications widening robotics research areas.



2014

303 BOARD MEMBERS

41 DIFFERENT COUNTRIES

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TOPIC EDITORS IN CHIEF FOR THE YEAR 2012 ARE THE ONES WHO TRULY SUPPORTED THE JOURNAL'S EXPANSION AT THE TIME. WE WANT TO THANK THEM ALL:

Dr. Jorge Pomares, University of Alicante, Spain
Prof. Manolya Kavakli-Thorne, Macquarie University, Australia
Dr. Patricia Melin, Tijuana Institute of Technology, Mexico
Prof. Maki Habib, The American University in Cairo, Egypt
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Dr. Lazaros Nalpantidis, KTH Royal Institute of Technology, Sweden
Dr. Alejandra Barrera, Autonomous Institute of Technology, Mexico
Dr. Andon V. Topalov, Technical University of Sofia, Bulgaria

Dr. Pedro U. Lima, Institute for Systems and Robotics, Portugal

The International Journal of Advanced Robotic Systems (IJARS) is celebrating its 10th anniversary and I was a collaborator from the very beginning in this new publishing adventure. I still have the e-mail Mr. Aleksandar Lazinica, then a PhD student at Vienna University of Technology, sent me back in December 2003, inviting me to submit a paper with my students to this new journal. I must confess that at first I was not sure whether an initiative of publishing a scientific journal coming from non-professionals, namely mostly PhD students maturing their knowledge in the field would be as serious as I would like to. But then I started getting the enthusiasm transmitted by Aleksandar and his colleagues, and found this to be a very refreshing initiative. After being invited and becoming member of IJARS'S Editorial Board, I also had the pleasure to notice that worldwide prestige colleagues in Robotics were there, and all these facts lead me to wholeheartedly engage with the journal.

It is now clear that IJARS became a successful initiative, being listed in ISI with an interesting impact factor for this field, and having in its Editorial Board an extended list of roboticists from all over the world who are paving the way for the new generation of robots. This is certainly something the journal founders should be proud of, and that INTECH'S editorial team, who takes care of the journal, should also be praised for!

So, congratulations IJARS, and let's make sure this initiative keeps its steady progress towards becoming a distinguished journal in one of the most important scientific and technological areas of the XXI Century: robotics!

Pedro Lima
Researcher at the Institute for Systems and Robotics / LARSyS, Portugal
IJARS Multi-Robot Systems Topic Editor for year 2012

Professor Guangming Xie, College of Engineering, Peking University, China

IJARS Humanoid Topic Editor for year 2012

Quick and easy accessibilities to new and important developments in robotics are of prime importance to trigger new ideas that will help propulsing such field in new directions. Over the last ten years, the model of IJARS proved to be a credible platform to emphasize such a concept. When you are still so young, the future is ahead with more opportunities to continue what IJARS have done so well already. Best wishes with at least another 10 years of exciting publications.

Dr. Enzo Mumolo, University of Trieste, Italy
Dr. Houxiang Zhang, Aalesund University College, Norway
Dr. Shengyong Chen, Zhejiang University of Technology, China
Dr. Fadi Dornaika, University of the Basque Country, Spain
Dr. Yin-Tien Wang, Tamkang University, Taiwan
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Dr. Antonio Visioli, Università degli Studi di Brescia, Italy
Prof. Maki Habib, The American University in Cairo, Egypt
Prof. Keigo Watanabe, School of Natural Science and Technology Okayama, Japan
Prof. Jong-Hwan Kim, National Center for Robot Intelligence Technology, Korea
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Prof. Bruno Siciliano, University of Napoli, Italy
Prof. Pierre Bonnal, CERN, Switzerland
Prof. Chieh-Chih (Bob) Wang, National Taiwan University, Taiwan

SOME OF OUR COLLABORATORS HAVE BEEN WITH US SINCE THE VERY FIRST VOLUME AND HAVE BEEN SO KIND TO SHARE THEIR INPUT ON HOW THEIR RESEARCH DEVELOPED IN THE PAST 10 YEARS:

"Robotics is constantly changing the field and the research generally indicates the new directions. In addition to the amazing benefits it enjoys from the IT and hardware technologies, there is a new direction where robotics will benefit from the fast growing area of Biomedical Engineering. I congratulate the International Journal of Advanced Robotic Systems for its service to robotics research over the past decade. The next decade will be even more interesting and exciting and the journal has a crucial role to play."

Prof. Saman K. Halgamuge
Department of Mechanical Engineering
The University of Melbourne, Australia
Member of the first IJARS Editorial Board in 2004

I am proud to serve as an Editorial Board Member of this journal. For the past 10 years I found the job of being in IJARS'S editorial extremely interesting. The quality of papers submitted is continuously increasing. I support the fact that IJARS is open and puts its mission to disseminate robotics knowledge as much as possible. I truly believe that knowledge should be open and freely available to anyone. I would like to use this opportunity to congratulate the journal for its achievements over the past 10 years, and I am happy to take part to these achievements.

Amir Shapiro, Ph.D., Senior Lecturer
Director, Robotics Laboratory
Department of Mechanical Engineering
Ben Gurion University of the Negev, Israel
IJARS Editorial Board Member from Volume 1 up until today

I would like to congratulate the Managing Editor and the staff of the International Journal of Advanced Robotic Systems for this important anniversary. I thank them for their precious work that, in these 10 years, has made IJARS an important and open reference for all the scientists and researchers involved in the study of robotic systems.

Nicola Ivan Giannoccaro
Department of Innovation Engineering
University of Salento, Italy
IJARS Author

First of all, congratulations to the International Journal of Advanced Robotic Systems and all its staff on its 10th anniversary! I have had the chance to work with the team both during paper submission and outreach activities and it was a pleasure to interact with all of them. Generally it is great to see that Open Access publications are also thriving in the robotics sector, that is very good news especially for the people working on open source and open hardware robotics.
Again, happy birthday and I am looking forward to contributing to IJARS in the future and collaborating with the people at InTech!

Juxi Leitner
IDSIA Robotics
Dalle Molle Institute for Artificial Intelligence (IDSIA)
Lugano, Switzerland
IJARS Author

I still remember the excitement of publishing my first paper in the first volume of IJARS exactly 10 years ago, when I was a graduate student working on RoboCup robots at Philips in Netherlands. Now after 10 years, I show that paper to my students at National Taipei University in Taiwan in my robotics classes at undergraduate and at graduate level and introduce this journal as a wonderful source for exploring multiple topics in robotics. The field of robotics is extremely challenging, exciting and interesting and I would like to congratulate IJARS and show my appreciation for the support provided to robotics communities by granting us an openly accessible, high quality publication. IJARS has helped us manage, collect, connect, distribute and share internationally the latest advances in the domain of robotic systems in a professional manner through a unique platform. Thank you IJARS and happy birthday!!!

Hooman Samani
Department of Electrical Engineering
College of Electrical Engineering and Computer Science
National Taipei University, Taiwan
IJARS Author

Best wishes to IJARS! Besides the scientific quality, I appreciated very much the approach of this journal, as well as the positive and kind attitude of its staff. I wish IJARS many more years of prosperity and good service as a forum for researchers in the field of robotics.

Alesandro Gasparetto
University of Udine, Italy
IJARS Author

IJARS has become an important tool for the dissemination of my research work around the world. Congratulations on this anniversary to the editorial staff for the good job and kind treatment of the authors. The journal improves every volume with better quality papers.

Dr. Eduardo Gamaliel Hernandez-Martinez
Universidad Iberoamericana, Mexico City, Mexico.
IJARS Author

Happy birthday, its great to see IJARS reach a decade of publication. Robotics research continues to grow and deployment of robotics in many commercial areas is increasing. The next decade should be as productive and important as the last.

Bruce MacDonald
Department of Electrical and Computer Engineering
The University of Auckland
Australia
Member of the first IJARS Editorial Board in 2004

I learned about the journal a few years ago thanks to an invitation from the publisher to submit an article. I enjoyed the competence and efficiency of both the reviewers and the Editor. I also appreciate the quality of the journal and of the published papers in my field of expertise. Happy tenth birthday!

Rocco Furferi
Department of Industrial Engineering
University of Florence, Italy
IJARS Author

Congratulations on 10 years in academic communication! I'm glad to work with you. Keep up all the good work and never stop inspiring!

Sylvain Martel
Director, NanoRobotics Laboratory
Deptartment of Computer and Software Engineering
Polytechnique Montréal
Montréal, Canada
IJARS Author

OUR COLLABORATORS AND THEIR RESEARCH IN THE PAST 10 YEARS

Professor Fengfeng (Jeff) Xi
Ryerson Research Chair
Department of Aerospace Engineering
Ryerson University, Canada

Reconfigurable Robots: Past, Current and Future Research

As a past Editorial Board Member, I would like to offer my warmest congratulations to the journal on the celebration of its tenth anniversary. To me, this journal is distinct in its effort to focus on the emerging technologies for the development of advanced robots. Indeed, robots have evolved to become more and more intelligent. I have been following this trend by developing three frameworks for modular reconfigurable robots. In my view, reconfigurable robots represent the highest level of intelligent robots because they are capable of changing the structures to promptly adapt to new circumstances and perform new tasks, and even recover from damage.

My first framework created a module-based method for design, modeling and control of modular reconfigurable serial robots. The concept of zero reference plane (ZRP) was developed to describe the coordinates of all modules only using a single coordinate frame, i.e. the base frame. This allowed the designer or the operator to easily define the configurations required for the robot to reconfigure, while leaving the software we developed using a linear graph method to handle the automatic generation of robot kinematics and dynamics equations upon reconfiguration. My second framework resulted in a module-based method for modular reconfigurable parallel robots. By recognizing the modularity inherent in the parallel robot, a 6 degrees-of-freedom (DOF) reconfigurable parallel robot was developed that consisted of two 3-DOF parallel robots: one called the sliding tripod made of three linear actuators fixed to the base, and another called the swing tripod made of three rotary actuators detachable for reconfiguration. As shown in Figure 1, the swing tripod can have one rotary branch detached, forming a 5 DOF parallel robot along with a 2 DOF serial arm, suitable for applications such as self tool change on the robot's end-effector. It can also have two or three rotary branches detached for other applications, such as pick-and-place of a part before and after machining or part assembly.

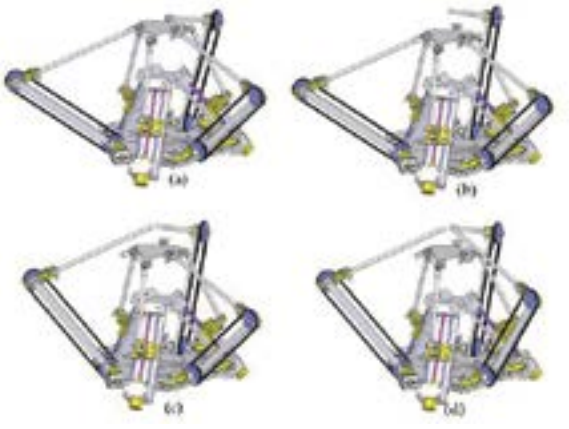

Figure 1: Reconfigurable parallel robot

My current framework is to develop a module-based method for structural shape morphing, such as aircraft morphing wings. The principle of variable geometry truss manipulator (VGTM) is adopted, but further research is needed in order to tackle the problem of distributed motions and loads over a continuous morphing shape. To minimize the use of actuators in turn the weight, a new under-actuation method is put forward, based on which a variable length rectangular structure is designed called variable geometry wing box (VGWB). A two-module VGWB is built and tested against the motion and load requirement. A patent has been filed by Bombardier, our industrial collaborator. Figure 2 shows this prototype going through three morphing stages, capable of morphing in span (linear motion), cant, sweep and twist (three rotations). The ongoing research is to develop morphing skins to cover the VGWB, thereby forming a complete structural shape morphing system. Three types of morphing skins are under our investigation: flexible skin, sliding skin and hybrid skin that combines the first two. Our dream is that one day the airplane could be equipped with the morphing wings that can adapt to various flight regimes such as take-off, cruise and landing,

to achieve optimal aerodynamic performance for fuel saving and noise reduction.
Finally, I would like to thank the current Journal Editor for providing me this opportunity to share my research. I hope that my summary sheds some lights on the emerging technologies for reconfigurable robot research.

Figure 2: Variable geometry wing box (VGWB)

Amir Shapiro, Ph.D., Senior Lecturer
Director, Robotics Laboratory
Department of Mechanical Engineering
Ben Gurion University of the Negev, Israel

On Robot Walking, Climbing, and Grasping

I am proud to serve as an Editorial Board Member of the International Journal of Advanced Robotics Systems. For the past 10 years I found the job of being in IJARS's editorial team extremely interesting. The quality of papers submitted is continuously increasing. I strongly support the fact that IJARS is open and wants to disseminate the robotics knowledge as much as possible. I truly believe that knowledge should be open and freely available to anyone. I would like to use this opportunity to congratulate the journal for its achievements over the past 10 years, and I am happy to take part to these achievements.

During this period my own career as a robotics researcher has also developed. I concentrated on various kinds of robot locomotion, but in particular on walking robot motion planning and control. Specifically we developed quasi-static walking algorithms for spider-like robot, quadruped robot, and for humanoids. I developed a spider-like robot for motion in tunnel environments. I modeled the non-linear dynamic interaction between the robot and the environment based on Hertz and Mindlin compliant contact model. I developed a feedback control law for the robot and established the system's stability. Since the system is asymmetric, I developed an analytic tool for analyzing the stability of second order linear systems. I developed a convex-optimization based motion planning algorithm for the spider-like robot that guarantees minimal number of steps. Another spider-like robot that we developed is the SpiderBot which is a cable suspended robot capable of shooting arrows to the ceiling and walking on the web. This work also uses convex optimization as a motion planning tool which minimizes the cables tension. We also developed a quadruped walking robot including its non-linear control and motion planning algorithms. The motion planning is based on a combined potential function and graph search approach. The big quadruped robot is pneumatically driven using pneumatic cylinders. The servo control of the pneumatic cylinders is based on the nonlinear backstepping approach. Recently we started working on humanoid locomotion and dexterity as part of the ROBIL team participated in the DARPA robotics challenge. Since I am interested in walking robots, I am also interested in better understanding human walking and balance control. We developed a system for balance training for the elderly and we are now investigating human balance reactions.

We also developed four types of wall climbing robots that defer by the attachment method they use. The first is a snail-inspired climbing robot that uses hot melt adhesive. The second is a four legged cat-inspired robot that uses claws. The third is a four wheeled robot that uses sticky wheels with a tail mounted on pendulum to provide counter gravity torque. The fourth is a magnetic climber that uses compliant magnetic wheels to climb on ferromagnetic surfaces such as ship hulls.
In robot grasping and control we modeled the grasping arrangement including the asymmetric contact model, and developed a grasp stability criterion. We investigated the set of external forces and torque a passive compliant

grasp can resist. For the car manufacturer GM, we developed algorithms for automatically design robot end effectors which can grasp set of object. This algorithm will allow GM to manufacture various car models in the same production line.

Finally, I would like to thank the journal's Editors-in-Chief for providing me with the opportunity to share my research. I hope that my summary sheds some lights on our research on walking, climbing, and grasping technologies.

Figure 1: Spider like robot for motion in tunnels environment, and SpiderBot a cable suspended robot that walks on cables.

Figure 2: Two types of quadruped robots, a small electric robot, and a large pneumatically driven robot.

Figure 3: Four types of wall climbing robots: a magnetic robot for inspection of ship hull, a hot melt glue based climber for climbing on walls, a robot with sticky wheels for climbing on smooth surfaces, and a claw based climber for climbing on rough terrain

OVERVIEW

WHEN IS A ROB0T A ROBOT? HOW A NEW DEGREE IN ROBOTICS CHALLENGED US TO ONCE AGAIN DEFINE ROB0TS

By Ole Madsen, Thomas Bak, Lotte N.S. Andreasen Struijk and Thomas B. Moeslund, Aalborg University, Denmark

Thomas B. Moeslund from Aalborg University, Denmark has been with the International Journal of Advanced Robotic Systems for 10 years now. It is always nice to see such commitment to a project.

In 2014 his university is introducing a new Bachelor of Science degree in Robotics. We are sure that the collaboration with IJARS and the use of Open Access research we publish will help assist their development.

Robots no longer live only in the minds of science fiction writers and Hollywood producers; today they also play a significant role in manufacturing and are an integral part of society. According to the International Federation of Robotics, industrial robot sales grew by 7% per year between 2008 and 2012 – and this will only be the beginning. In recent years robots have also started to emerge in other parts of society – from private homes, in the form of lawnmowers and toys, to hospitals and nursing homes, in the form of surgery, therapeutic, and rehabilitation devices. Robots also take part in space missions, help mine minerals, undertake underwater surveillance activities, and teach in schools. Given that robots will take on an even greater role in future society, Denmark's Aalborg University decided in 2013 to establish a new Bachelor of Science degree in Robotics. The new degree program will begin running this summer. In the process of defining a timely and appropriate curriculum, we started out by searching for a definition of what, exactly, makes a robot. When looking at all the very different machines that people call robots, however, we realized that it is actually quite a challenge to identify what they all have in common and to come up with the perfect definition. Thus, we initiated a discussion on the matter and this text is the outcome.

Definitions of a robot

To come up with a solid definition of a robot one can naturally follow the clever approach of Joseph Engelberger, the developer of the first industrial robot. "I can't define what a robot is, but I know one when I see one," he said. Alternatively one may start with the definition of the term "robot", which originates from a play by the Czech writer Karel Capek. He sets his play in the early 1920s: R.U.R. (Rossum's Universal Robots) where artificial people were created to replace the human workforce. Karel Capek referred to these entities as "robots", which comes from the Czech word "robota" meaning slave or servant. However, since few robots actually act like humans this definition is not valid. While Capek's robots represented an anxiety about industrial progress, science fiction writer Isaac Asimov suggested a kinder version of robots that are constrained by the way they are programmed; this may better describe the robots we see today. A number of formal definitions have been suggested by different organizations; for example, the International Organization for Standardization (ISO) have defined a number of different categories of robot, such as industrial and service robots, but they lack a solid description of what exactly makes a robot a robot. When examining different definitions it seems that the only thing all agree on is to disagree!

TO COME UP WITH A SOLID DEFINITION OF A ROBOT ONE CAN NATURALLY FOLLOW THE CLEVER APPROACH OF JOSEPH ENGELBERGER, THE DEVELOPER OF THE FIRST INDUSTRIAL ROBOT.

A pragmatic definition

Since robots come in so many different forms and can be used in so many different contexts AND since the field of robotics is still evolving in so many different directions, we must conclude that it may not yet be possible to provide a clear cut definition of a robot. It may not be possible at all to find a common definition that encapsulates the whole domain. Maybe we will have to invent a number of new terms and definition? Or perhaps one needs to delay the wording of such a definition until the field has matured further? Until then, we feel a better approach to this task is to be pragmatic and describe a robot as an entity possessing four different parameters or characteristics:

- **A robot is a physical device**
- **A robot can sense the world**
- **A robot is autonomous**
- **A robot is multi-functional**

A physical device

First, we think that a robot must be a physical device that can interact with physical objects in its environment. Industrial robots and vacuum robots are good examples of this. We do not think, however, that virtual opponents, against which little children play in their computer games, are real robots (we think they call these bots nowadays).

Senses

Second, a robot must have the ability to sense. It must, by means of sensors, be able to collect information about itself and its environment and be able to use this information to control the physical part of the robot.

Autonomy

Third, we believe that a robot must somehow be self-governing but that it need not be completely autonomous. Industrial robots, for example, must be programmed before they can run automatically. A surgical Da Vinci robot is tele-operated by a surgeon who controls the robot's operation tools. The surgeon, however, does not control all the robot's degrees of freedom, nor does he/she ensure that the tools are only concerned about the hole where they enter the body. The robot does this by itself. The notion of autonomy is also challenged in for example rehabilitation robotics, where human nerves that previously controlled an amputated arm control a robotic arm instead.

Multi-functional

Fourth, a robot has to be multi-functional. It should be used for different purposes in different contexts. An elevator, for example, possesses the first three characteristics above but it is not multi-functional. It can move objects between different predefined locations but much more than that it cannot do, so it cannot be called a robot. A vacuum cleaner robot, which many of us have at home, cannot only vacuum but is able to adapt (at least to some extent) to the various tasks required of it; for example, it can avoid walls, bypass chairs, etc.

Must have all four features

So one answer to "when is a robot a robot?" could be "it is if it can physically interact with its environment; if it senses that and use this to control itself; if it is perceived at least partly autonomous; and if it is multifunctional." If you have a robot, see whether it meets all of these requirements.

A Bachelor of Science in Robotics curriculum

Our reflection on robotics was just the beginning of our process of creating a new Bachelor of Science in Robotics curriculum at Aalborg University. We have developed a curriculum that builds on two principles: the value of experimentation and problem based learning, which lends itself nicely to robotics as students will spend half of their time on robotics projects. Applications involving robotics motivate learning and convey a sense of usefulness to whatever the students work on. They will spend the other half of their time on courses based on the second principle, which reflects the pragmatic approach outlined above. When students begin the program, they will focus on basic programming knowledge, math, etc. but they will also be given insight into the diversity and multi-functionality of robotics. Subsequent semesters will focus on interaction, sensing, and autonomy, in that order. This step-by-step refinement of their robotic skills will allow students to address in their final semester a specific application, such as factory automation or rehabilitation, or an area of theory, such as navigation, motion planning, control, computer vision or advanced human-robot interaction – topics that are all relevant to robotics.

APPLICATIONS INVOLVING ROBOTICS MOTIVATE LEARNING AND CONVEY A SENSE OF USEFULNESS TO WHATEVER THE STUDENTS WORK ON.

IJARS EDITORIAL BOARD 2014 ACKNOWLEDGEMENTS

In view of the International Journal of Advanced Robotic Systems' 10th year anniversary, I would like to congratulate the team behind the journal for this important milestone. Throughout this 10 years, IJARS has grown to be the only Open Access robotics journal in the field that is ISI indexed, and a valuable resource for all things robotics to science communities on a global scale.

In particular, with the introduction of specific topics and Topic Editors-in-Chief, IJARS has become the most comprehensive robotics journal available to be read online these days. As one of the Topic Editors-in-Chief, I would like to personally congratulate the editorial team for making this journal successful and I am looking forward to keep working on this journal in the years to come.

Mohsen Shahinpoor
The University of Maine, USA

IJARS Bioinspired Robotics Topic Editor-in-Chief

As the Topic Editor-in-Chief of Field Robotics, I would like to congratulate the journal's team for all the work done to make this journal such a successful publication. In this past 10 years the International Journal of Advanced Robotic Systems grew from being a novel journal to a well-established and widely read robotics resource for both students and professionals in robotics.

I am happy to be part of the team at this time when we celebrate the journal's 10th year anniversary and I am looking forward to many more important milestones in the upcoming years.

Yangquan Chen
University of California, Merced, USA

IJARS Field Robotics Topic Editor-in-Chief

It is my pleasure to congratulate IJARS on its 10th birthday. IJARS is an outstanding Open Access journal, and in my opinion the best one among all robotics journals currently published. This must be credited to its proactive editorial team I have had the honor to work with since last year. I sincerely look forward to see IJARS grow further in the next decade, just to become a core publication in robotics to be read by all of stakeholders with an interest in this dynamic field of research.

Quan Zhou
Aalto University, Finland

IJARS Micro/Nano Robotics Topic Editor-in-Chief

I would like to congratulate the International Journal of Advanced Robotic Systems on its 10th anniversary.

I have had the chance to be a member of the journal's Advisory Board since its first year and it's been a pleasure seeing how this openly accessible robotics publication has grown into a truly valuable resource of research articles on the latest developments and applications in all subareas of robotics.

I am looking forward to further work with the journal's team in the foreseeable future and I salute the efforts to continually looking for new ways to bring significant visibility to the editors and authors' research activities while assuring and maintaining high quality of the journal content.

Yoseph Bar Cohen
Jet Propulsion Laboratory/California Institute of Technology, USA

IJARS Humanoid Robotics Topic Editor-in-Chief

It is a real pleasure to wish "Happy Birthday!" to the International Journal of Advanced Robotic Systems where I have the honor to serve as Topic Editor. IJARS is growing up as a vibrant journal, collecting novel technologies, applications, components and systems in robotics and it is already a reference for scientists in the field.
I hope to also enjoy the future years with IJARS!

Arianna Menciassi
Sant'Anna School of Advanced Studies, Italy

IJARS Medical Robotics Topic Editor-in-Chief

I am so glad for IJARS and for the amazing work carried out in the past decade. Warmest congratulations on ten years of outstanding contribution to disseminating scientific and technological breakthroughs among robotics communities!
I am quite sure that a tremendous amount of effort has been put into making IJARS more visible and frequently cited. Wishing the best to the entire IJARS team and looking forward to many more years of collaboration. I am honored to be part of this big celebration. May it continue as long as possible!

Nak-Young Chong
Japan Advanced Institute of Science and Technology, Japan

IJARS Mobile Robots and Multi-Robot Systems Topic Editor-in-Chief

I'm pleased to wish a "Happy Birthday" to the International Journal of Advanced Robotic Systems on its 10th anniversary.

I would like to thank the Editorial Board for its effort to improve the visibility of the studies presented in this Open Access journal, and the authors for proposing their high quality research papers in various areas of Robotics.

Christine Chevallereau
National Center for Scientific Research (CNRS), France

IJARS Climbing and Walking Robots Topic Editor-in-Chief

It is a great pleasure to congratulate the International Journal of Advanced Robotics Systems on its tenth year anniversary.
Through 10 years of its existence, the journal has been steadily increasing the quality of published articles. I believe that IJARS is now one of the most significant international journals in the field of robotics. In my opinion, the most attractive feature of the journal is a rare mixture of deep theoretical analysis with real world engineering applications.

I am honoured to serve as a Topic Editor for IJARS and I wish to congratulate all the authors, Editors, editorial staff, reviewers and the publisher with their common success.

Andrey V. Savkin
School of Electrical Engineering and Telecommunications
The University of New South Wales, Australia

IJARS Robot Manipulation and Control Topic Editor-in-Chief

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CELEBRATING
10
YEARS

INTERVIEW
DR. DANICA KRAGIC:
10 YEARS OF PR0FESSI0NAL SUCCESS SINCE THE FIRST PAPER PUBLISHED IN IJARS

Dr. Danica Kragic is a Professor at the School of Computer Science and Communication at the Royal Institute of Technology, KTH. She is also the Director of the Centre for Autonomous Systems (CAS) and Head of the Computer Vision and Active Perception Lab.

IJARS's team: In 2004, you have published a paper titled "Modelling, Specification and Robustness Issues for Robotic Manipulation Tasks" in the International Journal of Advanced Robotic Systems. It has been 10 years since then and your research has lead to the achievement of many milestones in robotics' developments. When you look back and think about the above-mentioned paper, how relevant and/or related was it to your current robotics projects?

Dr. Kragic: During the past 10 years, lots of contributions have been made to the field of robotics grasping and manipulation. However, there are still many open questions left and some of the problems raised in my journal article are still relevant. One aspect is, for example, dealing with unknown objects in natural science, handling occlusion and noise. Another open problem is task related grasping and manipulation – that is, how to grasp objects dependent on what a robot is supposed to do with them posterior to grasping.

IJARS's team: Since your early work and research in the fields of computer vision, machine learning and human-robot interaction, what have been the turning points in basic research that led to major new application-based developments?

Dr. Kragic: One aspect is the development of new and better sensory modalities – today, it is common to realy on 3D vision something that was not straightforward to do 10 years ago.

IJARS's team: Where are we today in terms of the latest developments in computer vision and image learning?

Dr. Kragic: We have come very far but lots of the algorithms and methods perform inference based on the information from large databases. This may not be the optimal solution for the future if we would like to achieve systems that not only categorize but also understand context in images and video sequences.

IJARS's team: If robotic systems have been deployed in sectors such as service or in specialised industries, we are still not seeing the same trend happening in other markets such as the consumer one. What is still missing in terms of research to step that line?

Dr. Kragic: We need to see more investement in consumer market robots – we cannot develop systems that meet demands and solve all the challenges of the consumer market if these systems are not used 24/7 by the regular, untrained users.

IJARS's team: Being yourself involved in human-robot interaction research, will there be the necessity for a support system aiming at redefining the current perception the general population has of social robot as determined by popular culture?

Dr. Kragic: Yes, absolutely. An important objective for us as scientists is to inform and educate the society about the capabilities and constraints of the systems we are able to develop.

IJARS's team: You are currently working on numerous projects for the Computer Vision and Active Perception Lab at the KTH, Toposys, RoboHow, Tomsy, FlexBot and so on. Is there a common denominator to these project and if yes, what would be the ultimate goal that could lead to a breakthrough concerning robotics and the stage it is today from an applied science point of view?

Dr. Kragic: The common denominator is to achieve flexible and robust robotic grasping and manipulation of objects based on multiple sensory modalities. We work on developing new techniques based on mathematics, machine learning, automatic control. Therefore, we collaborate with theoretical computer scientists, mathematicians, psychologists, to name a few.

IJARS's team: You have been very active in promoting interdisciplinary areas of research within robotics. Do you feel there hasn't been enough effort to include somehow related disciplines in specific areas of robotic research?

Dr. Kragic: I actually think that we put a lot of effort in the area of robotics in terms of interdisciplinarity. Many of the projects from FP6 and FP7 are interdisciplinary – I expect to see this to continue in Horizon2020.

ANOTHER OPEN PROBLEM IS TASK RELATED GRASPING AND MANIPULATION THAT IS, HOW TO GRASP OBJECTS DEPENDENT ON WHAT A ROBOT IS SUPPOSED TO DO WITH THEM POSTERIOR TO GRASPING.

WE KNOW THAT MIXED TEAMS PERFORM BETTER AND I WOULD LIKE THIS TO BE USED MORE IN THE PROCESS OF RECRUTING PHD STUDENTS AND SENIOR STAFF. ON THE OTHER HAND, WE ALSO NEED TO BE REALISTIC IN TERMS OF WHAT WE CAN ACHIEVE GIVEN THAT WE HAVE RATHER LOW PECENTAGE OF GIRLS BEING INTERESTED IN TECHNICAL EDUCATION.

IJARS's team: You have stated in the past that it is very important to discuss and strike a balance between basic research and applied research in general. What is your personal take on this and how much do financial constraints limit or slow the process of advancement within practical applications in robotics in general?

Dr. Kragic: Robotics is a discipline that needs both basic and applied research. I think we should be happy about this – not all disciplines are like this. The fact that we can also choose to do both makes it possible to apply for different type of funding. Given also that innovation is an important aspect to be considered in Horizon2020, we will need to continue researching a good balance between basic and applied research – doing only one is not enough.

IJARS' team: You have been involved in the BOF Women Luncheons initiative part of the WIE-RAS. Women in Engineering are making a name for themselves and you are certainly a representative of that group. Is promoting women in Engineering with the aim to reach a balance within this historically men-populated field something you feel strong about up to this date? Where do we stand today in terms of equal opportunity in Engineering from your personal point of view?

Dr. Kragic: I think we have come very far in terms of equal opportunities but we need to continue to work on raising the understanding about what problems still exist. We know that mixed teams perform better and I would like this to be used more in the process of recruting PhD students and senior staff. On the other hand, we also need to be realistic in terms of what we can achieve given that we have rather low pecentage of girls being interested in technical education. So, we need to start much earlier in terms of rasing the interest – already at the level of primary and secondary schools.

IJARS's team: This year the International Journal of Advanced Robotic Systems celebrated 10 years of its establishment. Up to this date this is the only open access journal in Robotics to be indexed by Thomson Reuters. What is your perception of the current state of traditional publishing vs open access within Robotics?

Dr. Kragic: First, let me congratulate you. I find Open Access important – it is also required by many of the financing bodies. So, in my opinion, it will become even more important in the future.

IJARS's team: You have given a talk at a TEDx event back in 2010, talking about what you do. TEDx has had a major part in bringing closer science to the general population, spreading innovative ideas, concepts, recent developments and basic research to an audience of both professional and, most of all, those who feel passionate about a topic but do not possess a formal education or work within that particular field of science. Tedx uses mainstream, popular media in its effort to give visibility to all sorts of innovators. Does this initiatives actually help in facilitating financial support from independent/private sectors towards research in Robotics? Do you feel that new media including YouTube and social media are viable channels to communicate scientific outputs to a wider audience even if this implies the risk of misinterpreted notions by those who do not possess a scientific background and/or diplomas within the STM field?

Dr. Kragic: I think that all these channels are good and viable especially since these are so common and natural to use especially for the young generation. It is of course our responsibility as researchers that we present our research results in a didactic

and comprehensible manner. This should really not be a problem given that most of us are also teachers and should have the ability to present our research in a suitable manner.

IJARS's team: You will be part of the organising team for the 2016 IEEE ICRA in Stockholm. ICRA is the most important eobotics conference world-wide and you have obviously participated in the past years. Are you already engaged with this project and how do you foresee it since the event coincides with the 20th anniversary of CAS?

Dr. Kragic: Yes, we are looking forward to this and already working hard on preparations. It is definitely scary to organize something for 2000-2500 participants during a hole week but we need to take upon challenges such as this one. This is one way of contributing to the research community and the society.

I ENCOURAGE EVERYBODY TO WORK ACTIVELY ON INFORMING THE SOCIETY ABOUT ROBOTICS RESEARCH AND ITS IMPORTANCE FOR THE FUTURE.

IJARS's team: Any last thoughts or an advice you would like to share with us for IJARS's 10th year anniversary?

Dr. Kragic: I encourage everybody to work actively on informing the society about robotics research and its importance for the future. We are still in the early beginnings and I look forward to read about new breakthorughs in your journal.

This interview has been provided as part of many celebratory activities for the International Journal of Advanced Robotic Systems' 10th year anniversary. IJARS's editorial team would like to thank Dr. Danica Kragic for taking part in our robotics interview series.
IJARS's team

INTERVIEW
DR. CHRIS ROGERS:
APPLICATION OF LEGO-BASED ROBOTICS IN HIGHER EDUCATION

Dr. Chris Rogers, Professor, Department of Mechanical Engineering at Tufts University talks to AZoRobotics about the application of LEGO-based Robotics in Higher Education

Interview conducted by Kal Kaur

KK - What has been the main inspiration behind the development of LEGO-based robotics in higher education?

CR - The main inspiration comes from Papert's original thoughts about allowing students to construct their knowledge - rather than recite the knowledge of others. The LEGO toolkit allows kids to be creative, to invent, and to overcome hardships that cause them to think.

KK - How have LEGO-based robotics been introduce into the academic setting?
CR - At Tufts, we have taught introductory engineering, introductory robotics, and even image processing with the toolset.

KK - How have LEGO-based robotics changed in function and application over the past 15 years?
CR - They have switched from the classical LEGO construction to the Technic construction (with beams and pins). The software has become easier to use and the number of available sensors and actuators has increased substantially. More importantly, there is now a large community of users, sharing ideas, successful curricula and so on.

KK - What role have these learning robots played in college education over the last 15 years?

CR - They have been instrumental in exciting 15 years of first year students to start engineering from the moment they enter college. They have helped demonstrate the power of student-led learning and the importance of risk taking and failure on learning. They have also helped in getting college students to become involved with their local K-12 classrooms.

I believe that teaching is fundamentally about transferring an understanding or a story from our (teacher) heads to the heads of the students. We can do this through telling them our understanding (lecture), showing them our understanding (labs, demos, etc.), or enabling them to develop their own understanding and slowly nudge it, through argumentation, to coincide with our understanding. Good teaching is a balance of these three things - with that balance changing from student to student. I have found robotics a powerful means to get this balance with students.

FIRST, THE IDEA THAT A TOY COMPANY SHOULD BECOME SO INVOLVED WITH FORMAL EDUCATION IS EXCITING AND IMPRESSIVE.

KK - What age group has demonstrated the most progression in terms of end learning objects from interaction with LEGO-based robotics and why?

CR - I have no way of really measuring this progression - what you see is different learning at all

About Dr. Chris Rogers

Chris is a professor of Mechanical Engineering at Tufts University with a strong interest in engineering education. He has led research projects funded by LEGO Education, Steinway and Sons, Intel, McDonnell Douglas, NSF, NASA, Fulbright, and NIH. He has worked with LEGO Education for 15 years on the development of the LEGO Mindstorms for Schools platform and was one of the lead architects of ROBOLAB, a software environment for the LEGO RCX.

Over these 15 years, he worked with teachers around the world to find more ways to enable students to drive their own learning, to fail and iterate, and to develop expertise. He has won a few awards, has flown over 700 parabolas in NASA's vomit comet without getting sick, and was banned from kindergarten recess (as a 30 year old) for making too much noise.

levels - from the graduate student building a LEGO contraption that solves the Rubiks Cube to the 5 year old that measures the temperature of the earth with the same software and hardware.

KK - What type of student learning has been promoted in learning sciences?

CR - This is a tough question as different researchers within the learning sciences have different agendas – however, I think the one theme that is consistent throughout the literature is that all people learn differently and declaring that there is one right way to teach math, science, or any other subject is simply wrong. In fact, quite often your students will not understand the material the way you did after a certain activity.

KK - How does robotics fit with our understanding of how students learn?

CR - Robotics is a multi-disciplinary problem that requires expertise in many different subjects (from art to coding). Because of this, it allows students to appreciate and learn from the knowledge of other teammates, it promotes students to take risks, fail and iterate, and, if done well, it allows for many different viable solutions for the same problem (removing the "one right answer" approach to teaching).

KK - Can you provide a historical overview of LEGO mindstorms for education?

CR - First, the idea that a toy company should become so involved with formal education is exciting and impressive. LEGO Education started as a small division in the company and now is a stand-alone company, with a vision in how they want to see education change as well as making a profit. I have been impressed by how much they have grown since I started working with them - and more importantly how they are actively interested in changing how we educate to ensure students get a chance to be creative and innovative.

KK - What will be the next evolution of LEGO Mindstorms?

CR - I certainly have my hopes and ideas. I want to see more places for story telling through robotics, for whole classrooms to work together on one big project, for a robotic toolset that does not require any training to use.

KK - What will be the engineering challenges for students?

CR - Hopefully everything from new types of musical instruments to self-navigating cars made of LEGO bricks.

Reference

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CELEBRATING
10
YEARS

INTERVIEW
DR. CLAUDE F. TOUZET:
C0GNITIVE SCIENCE AND ARTIFICIAL NEURAL NETW0RKS

Claude F. Touzet is an Associate Professor at the University of Provence, Marseilles, specialized in Cognitives Sciences. He is a recognized specialist in artificial neural networks and their applications to the industry. Dr. Touzet authored two research papers published in the International Journal of Advanced Robotic Systems (IJARS), "Distributed Lazy Q-Learning for Cooperative Mobile Robots" (2004), and "Modeling and Simulation of Elementary Robot Behaviors Using Associative Memories" (2006).

IJARS's team: 10 years ago we had the chance to publish in the International Journal of Advanced Robotic Systems an interview with you concerning your interest in robotics and your research in robot control. Has your focus in robotics shifted to new areas of interest?

Dr. Touzet: It may seem that my areas of interest shifted towards neurosciences – after all, I belong to a neurosciences lab since 2001, but that is not the case. I have had the same question in mind for the last 30 years ("who are we?"). I started my research career with 10 years of ANN (Artificial Neural Networks), followed by 10 years of robot learning, after that I undertook the challenge to join a neurosciences team, got acquainted with the human aspects of "my" question, and put my modelization and simulation expertise at work in this new domain.

IJARS's team: In the past 10 years since that interview, what do you consider to be the biggest milestones in your research?

Dr. Touzet: In 2006, I wrote a paper for IJARS describing a new programming framework allowing the instantaneous synthesis of a large number of mobile robot behaviors. I used to think of myself as a learning specialist, but this "milestone" put an end to my "robot learning" career: no trick nor complex learning algorithm was required by this "associative memory programming" – which nevertheless achieves a much better performance. It was like to sawing the branch that you were sitting on. In return, this upsetting discovery helped me reconsider the idea that cognition was some kind of a side-effect (not searched for by mother Nature), that there was a possibility that a unique organizing/functioning principle would explain all of the human mind. Even today, that idea is considered to be wrong, if only because it was an unsuccessful quest over several decencies. It is not that easy to question dominant ideas – I was lucky to have been personally shaken by a discovery that required complete reassessment of myself.

IJARS's team: You have a multidisciplinary approach applied to your research, using principles of neurobiology in robotics. Thinking of the latest developments in robotics, have we reached the stage when without a multidisciplinary approach it's not possible to advance from an applied research point of view?

Dr. Touzet: Yes, completely true. To advance, we need imagination, but it is quite difficult to be imaginative when you share the exact same background as everybody else who is working in the field – it is much easier to borrow, and adapt from other domains. Some domains are logical choices, such as neurosciences, cognitive science, psychology – domains that have also a much longer history than robotics, and many more researchers. However, I am convinced that any domain could be of help.

IJARS's team: Your research in the field of robotics and automation impacts your research in the field of neurobiology and vice versa. How much has your research in robotics helped you in your work towards the prevention of cognitive aging and within the cognitive rehabilitation area?

Dr. Touzet: In 2005, I started a collaboration with Dr. B. Alescio-Lautier, a specialist in human memory and its dysfunctions. Together we developed and patented a method to prevent cognitive aging that received several national awards. A university spin-off company was even founded to distribute this program, with a version targeting the public and another one for professionals. The user has access to a set of multi- media exercises targeting the various memories and attentional processes. The level of difficulty is adjusted to the cognitive performance of the subject through the use of automatic learning procedures. This is of tremendous importance since the user performance will improve over time, and the level, order, duration of the exercises must match. Our cognitive training efficiency was demonstrated by several scientific studies targeting various populations (elderly, Alzheimer disease, Mild Cognitive Impairment, cranial trauma, etc.). It would not have been that successful without the "robot learning" part.

IJARS's team: Also, how has your recent research in neuroscience influenced your latest research output in the area of robot learning?

Dr. Touzet: Developing and evaluating softwares dedicated to improve human cognitive abilities has given me a practical knowledge about these not so well-defined concepts (episodic memory, semantic memory, working memory, focused attention, divided attention, planning, inhibition, etc.). Therefore, I was able to reinterpret some of the robot learning properties as representative of human cognition. It was a big improvement because it allowed me to consider – with reasons to do so – human cognition level as a realistic goal for a robot.

IJARS's team: Most of your work within robotics aims at the final goal of contributing to AI advancement. How close are we to developing a conscious robot and what does exactly mean "conscious" when applied to a robotic system?

Dr. Touzet: I believe that today's computing power allows the implementation of a robot with the cognitive capacity of a human. What was missing was the blueprints of such robotic brain – it is the raison d'être of my Theory of neural Cognition. Among other things, this

theory states that consciousness is the result of the implication of the language cortical maps. If their activations are strong and precise enough to put words on the events, then we like as if we are conscious. To make a long argument short, consciousness is an automatic verbalization. No doubt that a robot can be given the same ability – if its learning is very similar to that of a human child.
This is the reason why I coined the term "robot-sitting" (derived from "baby-sitting").

IJARS's team: In your recent book published in 2010 on the topic of the Theory of neural Cognition (TnC), you state that we are the result of our interactions with the environment around us and that, among other conclusions, the brain does not process information but it represents it; this gives a whole new meaning to the role of our neural networks and the perception we have of the world. How does this new theory affect your robotics research?

Dr. Touzet: One of the major outbreaks of the TnC is that a "conscious" robot is within our reach. We can even calculate the computing power requirements, the shape and size requested by such robot, its sensors and effectors equipment, and also have specifications relatively to its education (learning). I have done some speculations on that matter in the accompanying paper of this interview (cf. this journal).

IJARS's team: Robotics and the development and advancement of robotic systems are very much tied to financial support by both various industries and institutions with an interest in robotics; how much does that influence researchers in their research?

Dr. Touzet: Financial support is crucial, or – at least – it is believed to be so. In fact, when I compare the costs involved in neurosciences studies, and those in robotics, I can say that robotics is not a costly domain. In recently the EU decided to make a major research effort of 1.2 billion Euro (over 10 years) in a specific domain. Among many candidates, the two nominees for the final competition where the "Human Brain Project" and the "Robot Companion Project". To be the recipients of such amount of founding, one has to demonstrate that numerous industries and institutions support, and will benefit from the project. The interesting part of this EU Flagship project is that the management (including spending) is handed to the scientists responsible of the project. So, for about 10 years, the research will have a direct access to the necessary funding – instead of having to lobby various administrative and political levels. The Robot Companion Project did not make it, but the Human Brain Project is broadening its objectives which now include robotic testbeds – not yet a fusion of both projects, but who knows!

IJARS's team: How do you envision a society where robots with advanced AI are part of our every day life? What is the ultimate scope of AI in point of view?

Dr. Touzet: A cognitive/conscious/intelligent robot could be beneficial in many areas. In my opinion, the title of the "Robot Companion" Project was well chosen. These robots will have a human-like cognition, we will have to consider them as persons. However, the main difference will be that you can copy/paste a robot brain...
I don't think that this is the ultimate goal of AI. The ultimate goal is – in my opinion – to build a "super" intelligence (which is not the case of the human-like cognitive robot). Having built an intelligent robot, we will certainly have ideas about how to improve on that intelligence. I am not sure that we will be able to understand it. I presume that it will be an "alien intelligence", not very different from any deep space encounters that the astrophysicists are looking for.

IJARS's team: This year IJARS celebrates 10 years of its establishment. We published your paper titled "Distributed Lazy Q-Learning for Cooperative Mobile Robots" in the first issue of the journal. What do you think when you look back at that paper?

Dr. Touzet: If you go with the classical "citation index", then this paper was no blockbuster (36 citations). However, one must not look back at paper relevance using such indicator. The potential impact of any paper has no expiration date, and its importance does not rely on the number of persons who came to know it. A paper may affect the thinking process of just one researcher – even unconsciously – and that could lead to a great success. So, the answer to this question is: we will never know. However, as the author, I can add that these particular research results were used in a Web accelerator software based on the idea that multiple users may cooperate in order to predict Web user behavior (and prefetch pages, which cuts by 2 the waiting time). Today, I know of another company which is using this algorithm to increase the conversion rate (from Web visitors to customers) by predicting who can be converted by which incentive.

IJARS's team: What are your future short term plans or upcoming research projects?

Dr. Touzet: I just finished a 2nd book about the TnC, which tackles questions unanswered in the previous opus, such as the placebo effect, sleep, hypnosis, homeostasis, belief, motivation, etc. My next challenge has already started: writing a 3rd book that exposes the various (Python) programs required by the challenge of building a conscious robot. On a longer timescale, I would like to be part

of the adventure of building a real conscious robot. That would be like adding a child to my family.

IJARS's team: Any thoughts you would like to share with us for IJARS's 10th birthday?

Dr. Touzet: Progress, by definition, is not predictable. It is not mainstream thinking. I wish that IJARS and its readers will keep an open mind, refuse a priori, and forbid censure. These principles, today exhibited by the journal,must be preserved for the future reader generations.

This interview has been provided as part of many celebratory activities for the International Journal of Advanced Robotic Systems' 10th year anniversary. IJARS's editorial team would like to thank Dr. Claude F. Touzet for taking part to our robotics interview series.

WHERE DO WE GO FROM NOW

As much as we are thrilled with all the milestones reached in the past 10 years, IJARS'S editorial team has taken its time to work towards future goals that include a continual increase of quality through a series of invited articles, the journal's portfolio expansion with the launch of new robotics books (2015), and the addition of multimedia content to provide the readers with further insights into robotics novelties; finally, a special 2014 campaign to promote women in Robotics will take place by the end of the year.

INVITED ARTICLES

With the aim to continually increase the quality of our journal and provide our readers with further content for a deeper understanding of current robotics trends, this year we initiated a series of invited articles by international roboticists very active in their research domain. All throughout 2014 you will be able to access these invited research papers once published on the journal's reading platform.

We invite you to visit the journal's homepage and browse through the invited papers published up-to-date. In addition to that, here-below we include the abstracts of our upcoming invited papers to be published in full by the end of 2014.

These will concern a wide array of robotic systems applications and comprehensive overviews of outstanding research achievements including driving automation, new methods for robotic perception, mobile robots and wireless sensor networks, STRIDE II, milli-robots for medical drug delivery, current developments in SLAM, ground-robot impedance identification, gripping force measurement overview, current state of humanlike robots, LEGO robotics in higher education, neural cognition applied to robotics, zePPeLIN, cognitive robotics system performing surgical tasks, robotic mobile ad-hoc NETwork in indoor environment, use of robotic coach for the elderly, effects of earthquake motion on mechanism operation, dog-inspired social behaviour in social robots, musical performance robots and service robots for disabled people.

Take a look at the list of titles and abstracts of the 2014 invited articles series, some of which have already been published online. All articles on our website are free to read and download.

OPEN ACCESS

Modular Open Source Architecture for Medical Capsule Robots

AUTHORS: MARCO BECCANI, EKAWAHYU SUSILO, CHRISTIAN DI NATALI, PIETRO VALDASTRI
STORM LAB, DEPARTMENT OF MECHANICAL ENGINEERING, VANDERBILT UNIVERSITY, USA

Abstract: The field of Medical Capsule Robots (MCRs) is gaining momentum in the robotics community with applications spanning from abdominal surgery to gastrointestinal endoscopy. MCRs are miniature multifunctional devices usually constrained in both size and onboard power supply. The design process for MCRs is time consuming and resource expensive, as it involves the development of custom hardware and software components. In this work, we present SMAC, a modular open source architecture for MCRs aiming to provide the MCRs research community a tool for shortening the design and development time for capsule robots. The SMAC platform consists of both hardware modules and firmware libraries that can be used for developing MCRs. In particular, the SMAC modules are miniature boards of uniform diameter (i.e., 9.8 mm) that are able to fulfill five different functions: signal coordination, sensing, actuation,

powering, and vision. They are small in size, low power, with reconfigurable software libraries containing module abstraction layers and software interfaces, which have been proven to work reliably for different types of MCRs. A design template for a generic failsafe application that can be implemented with SMAC is presented in this work, together with its finite state machine capturing all the architectural components. The battery performances and the package loss rates were characterized together with SMAC communication responsiveness for different levels of data transmission power.

Keywords: Capsule Endoscopy, Medical Capsule Robots, Robotic Capsule Endoscopy, Robotic Surgery, Wireless Capsule Endoscopy, Open Source Robot Design

STRIDE II: Water Strider Inspired Miniature Robot with Circular Footpads

AUTHORS: ONUR OZCAN, HAN WANG, JONATHAN D. TAYLOR AND METIN SITTI
NANOROBOTICS LABORATORY, DEPARTMENT OF MECHANICAL ENGINEERING CARNEGIE MELLON UNIVERSITY, PITTSBURGH, PENNSYLVANIA, USA

Abstract: Water strider insects have attracted many researchers' attention due to their power efficient and agile water surface locomotion. This study proposes a new water strider insect inspired robot, called STRIDE II, which uses new circular footpads for high lift, stability, and payload capability, and a new elliptical leg rotation mechanism for more efficient water surface propulsion. Using the advantage of scaling effects on surface tension versus buoyancy, similar to water strider insects, this robot uses the repulsive surface tension force on its footpads as the dominant lift principle instead of using buoyancy by using very skinny (1 mm diameter) circular footpads coated with a superhydrophobic material. The robot and the insect propel fast and power efficiently on the water surface by a skulling motion of their two side legs which never break the water surface completely. This paper proposes models for the lift, drag, and propulsion forces and the energy efficiency of the proposed legged robot, and experiments are conducted to verify these models. After optimizing the robot design using the lift models, the maximum lift capacity of 55 grams is achieved using 12 footpads with 4.2 cm outer diameter while the robot weighs 21.75 grams. For this robot, a propulsion efficiency of 22.3% is measured. Maximum forward and turning speeds of the robot are measured as 71.5 mm/sec and 0.21 rad/sec, respectively. These water strider robots could be used in water surface monitoring, cleaning, and analysis in lakes, dams, rivers, and sea.

Keywords: Biologically Inspired Robots, Water Strider, Surface Tension, Miniature Robots

Biologically-inspired Control Architecture for Musical Performance Robots

AUTHORS: JORGE SOLIS[1,2] AND ATSUO TAKANISHI[2]
1 KARLSTAD UNIVERSITY, SWEDEN
2 DEPARTMENT OF MODERN MECHANICAL ENGINEERING & HUMANOID ROBITICS INSTITUTE, WASEDA UNIVERSITY, JAPAN

Abstract: Since 1990, at Waseda University; we have been doing developing anthropomorphic musical performance robots as a mean for understanding the human control, introducing novel ways of interaction between musical partners and robots and proposing applications for humanoid robots. Therefore; the authors are aiming at developing anthropomorphic flutist robots from two research approaches: reproducing the required motor dexterity to play the flute and displaying cognitive functions to coordinate the motion of simulated organs to express emotions in musical terms. In this paper, the design of biologically-inspired control architectures for both an anthropomorphic flutist robot and saxophone playing robot are described. As for the flutist robot, the authors have focused on implementing an auditory feedback system to enable the robot to enhance its musical skills during the performance. In particular, the proposed auditory feedback system is composed by three main modules: Expressive Music Generator (ExMG), Feed Forward Air Pressure Control System (FFAiPC) and Pitch Evaluation System (PiES). The ExMG uses as an input the musical parameters (i.e. pitch, volume, tempo, etc.) from the performance of a professional flutist. Those parameters are analyzed and extracted by using a FFT tool. As an output, a set of musical performance rules (which defines the deviations introduced by the performer) are produced (offline). The process of modeling the expressiveness features of the flute performance by means of an artificial neural network. As for the saxophone playing robot, a pressure-pitch

controller during the sustain phase of the sound has been designed. For this purpose, we implemented a feed-forward error learning method to create the inverse model of the proposed multiple-input multiple-output system which is computed by means of an artificial neural network.

zePPeLIN: Distributed Path Planning Using Overhead Camera Networks

AUTHORS: ANDREAGIOVANNI REINA[1], LUCA GAMBARDELLA[2], MARCO DORIGO[1], GIANNI DI CARO[2]
1 IRIDIA, UNIVERSITE LIBRE DE BRUXELLES, BELGIUM
2 IDSIA, UNIVERSITY OF LUGANO, SWITZERLAND

Abstract: We introduce zePPeLIN, a distributed system designed to address the challenges of path planning in large, cluttered, and dynamic environments. The objective is to define the sequence of instructions to move a ground object from an initial to a final configuration in the environment. zePPeLIN is based on a set of wirelessly networked overhead cameras. While each camera only covers a limited environment portion, the camera set fully covers the environment through the union of the fields of view. Path planning is performed in a fully distributed and cooperative way, based on potential diffusion over local Voronoi skeletons and local message exchanging. Also the control of the moving object is fully distributed: it gets moving instructions from each camera when it enters a camera's field of view. The overall task is made particularly challenging by intrinsic errors in the overlapping in cameras' fields of view. We study the performance of the system vs. these errors, as well as its scalability for size and density of the camera network. We also propose a few heuristics to improve performance and computational and communication efficiency. Reported results include both extensive simulation experiments and validation using real devices.

Keywords: Distributed Path Planning, Sensor Network, Robot Navigation

Design and Manufacturing of a Cognitive Robotics System Performing Surgical Tasks

AUTHORS: PAOLO FIORINI[1], DUYGUN EROL BARKANA[2], MARCELLO BONFE'[3], RICCARDO DODI[4], OLE JACOB ELLE[5], FEDERICA FERRAGUTI[6], LORENZA GASPEROTTI[7], ROGER GASSERT[8], KIM MATHIASSEN[9], DILLA HANDINI[10], OLIVIER LAMBERCY[11], LIN LI[12], MAARJA KRUUSMAA[13], AURALIUS OBERMAN MANURUNG[14], GIOVANNI MERUZZI[15], RICCARDO MURADORE[16], HO QUOC PHUONG NGUYEN[17], NICOLA PREDA[18], ASKO RISTOLAINEN[19], CRISTIAN SECCHI[20]
1 DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF VERONA, ITALY
2 DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING,YEDITEPE UNIVERSITY, TURKEY
3 MARCELLO BONFE', DEPARTMENT OF ENGINEERING, UNIVERSITY OF FERRARA, ITALY
4 FONDAZIONE CENTRO SAN RAFFAELE, MILANO, ITALY
5 THE INTERVENTION CENTRE, OSLO UNIVERSITY HOSPITAL, NORWAY AND DEPARTMENT OF INFORMATICS, UNIVERSITY OF OSLO, NORWAY
6 DEPARTMENT OF SCIENCE AND METHODS FOR ENGINEERING (DISMI), UNIVERSITY OF MODENA AND REGGIO EMILIA, ITALY
7 DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF VERONA, ITALY
8 REHABILITATION ENGINEERING LAB, ETH ZÜRICH, SWITZERLAND
9 THE INTERVENTION CENTRE, OSLO UNIVERSITY HOSPITAL, NORWAY
10 THE INTERVENTION CENTRE, OSLO UNIVERSITY HOSPITAL, NORWAY
11 REHABILITATION ENGINEERING LAB, ETH ZÜRICH, SWITZERLAND
12 CENTER FOR BIOROBOTICS, TALLINN UNIVERSITY OF TECHNOLOGY, ESTONIA
13 CENTER FOR BIOROBOTICS, TALLINN UNIVERSITY OF TECHNOLOGY, ESTONIA
14 REHABILITATION ENGINEERING LAB, ETH ZÜRICH, SWITZERLAND
15 DEPARTMENT OF LAW STUDIES, UNIVERSITY OF VERONA, ITALY
16 DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF VERONA, ITALY
17 THE INTERVENTION CENTRE, OSLO UNIVERSITY HOSPITAL, NORWAY
18 DEPARTMENT OF ENGINEERING, UNIVERSITY OF FERRARA, ITALY
19 CENTER FOR BIOROBOTICS, TALLINN UNIVERSITY OF TECHNOLOGY, ESTONIA
20 DEPARTMENT OF SCIENCE AND METHODS FOR ENGINEERING (DISMI), UNIVERSITY OF MODENA AND REGGIO EMILIA, ITALY

Abstract: This paper reports on the development of technologies for introducing automation within the surgical workflow. The outcomes have been obtained during the on-going FP7 European funded project I-SUR. Since I-SUR stands for Intelligent Surgical Robotics, the main goal of the project is to demonstrate that autonomous robotic surgical systems can carry out simple surgical tasks effectively and without mayor intervention of surgeons. To fulfill this goal, the consortium brings innovative solutions (both in terms of technologies and algorithms) to the following aspects: manufacturing of soft organ starting from real CT images, surgical planning and execution of movement of robot arms in contact with a deformable environment, designing surgical interface minimizing the cognitive load of the surgeon super visioning the actions, intra-operative sensing and reasoning to detect unexpected events. All these technologies have been integrated using a component-based software architecture to control a novel robot designed for performing the surgical actions under study. In this work we report on the automatic execution of the insertion of needles for the cryoablation of the kidney tumors.

Keywords: Robotic Surgery, Autonomous Surgery, Robot Design, Supervisor Control, Soft Organ, Cognitive Load

Connectivity Control of Robotic Mobile Ad-hoc NETwork in Indoor Environment

AUTHORS: FILIPPO ARRICHIELLO
LABORATORY OF INDUSTRIAL AUTOMATION OF UNIVERSITY OF CASSINO AND SOUTHERN LAZIO, ITALY

Abstract: The paper presents a behaviour-based approach for connectivity maintenance of networked robotic systems. In the considered scenario, the team of robots forms a mobile ad-hoc network, and the nodes mobility is used to dynamically ensure multi-hop connectivity between an autonomous node and a fixed base station. The motion strategy for each node is developed on the base of the information gained by a routing protocol for Mobile Ad-hoc NETworks (MANETs), and the motion directives are elaborated via a behavior-based approach, namely the Null-Space based Behavioral control. The proposed strategy has been experimentally tested by means of demanding experimental tests in a indoor environment with a distributed multi-robot system composed of wheeled mobile robots.

A Critique of Current Developments in SLAM

AUTHORS: SHOUDONG HUANG AND GAMINI DISSANAYAKE
CENTRE FOR AUTONOMOUS SYSTEMS, FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY, UNIVERSITY OF TECHNOLOGY, SYDNEY, AUSTRALIA

Abstract: The number of research publications dealing with the Simultaneous Localization and mapping (SLAM) problem has grown significantly over the past few years. Many fundamental and practical aspects of SLAM have been addressed and some impressive practical solutions have been demonstrated. The aim of this paper is to provide a critical review of the current state of the research, in particular to examine the current understanding of the fundamental properties of the SLAM problem and associated issues with the view to consolidate recent achievements.

Adaptive Multi-sensor Perception for Driving Automation in Outdoor Contexts

AUTHORS: ANNALISA MILELLA[1*] AND GIULIO REINA[2]
1 INSTITUTE OF INTELLIGENT SYSTEMS FOR AUTOMATION, NATIONAL RESEARCH COUNCIL, BARI, ITALY
2 DEPARTMENT OF ENGINEERING FOR INNOVATION, UNIVERSITY OF SALENTO, LECCE, ITALY

Abstract: In this research, an adaptive statistical framework for driving automation is introduced. The system enables a vehicle to automatically detect traversable areas in the scene. It is especially designed for outdoor contexts where conventional perception systems that assume a priori knowledge of the terrain geometric properties, appearance properties, or both, would most likely fail, due to the variability in the terrain characteristics and environmental conditions. In contrast, the proposed framework uses a self- learning approach to build online a model of the ground class that is continuously updated to reflect the latest ground appearance. The system also features high flexibility

as it can work using a single sensor modality or a multi-sensor combination. In the context of this research, different embodiments have been demonstrated using range data coming from either a radar or a stereocamera, and adopting self-supervised strategies where monocular vision is automatically trained by radar or stereovision. A comprehensive set of experimental results, obtained with different ground vehicles operating in the field, are presented to validate and assess the performance of the system.

Ten Years of Cooperation Between Mobile Robots and Wireless Sensor Networks

AUTHORS: ANIBAL OLLERO AND JESUS CAPITAN FERNADEZ
DEPARTMENT OF SYSTEMS ENGINEERING AND AUTOMATION, UNIVERSITY OF SEVILLE, SPAIN

Abstract: The cooperation of heterogeneous systems when completing complex tasks can be beneficial for many applications. The combination of mobile robots with Wireless Sensor Networks (WSNs) is a good example of these fruitful collaborations. In this sense, research communities in mobile robots and WSNs are making remarkable efforts to bring together these two technologies in order to accomplish complex missions in a cooperative fashion.
The Group of Robotics, Vision and Control (GRVC) from the University of Seville has been working on integrated systems with WSNs and mobile robots during the last decade. This paper presents the main guidelines and works of our group regarding this topic, as well as the projects involved. Also, the main challenges and open issues when combining WSNs with mobile robots are analyzed from our experience.

Design and Control Architecture of a Team of Milli-robots for Non-invasive Medical Drug Delivery

AUTHORS: CHRISTOPHE PERRARD[1], MATTIA CAPPALDO[1], STÉPHANE KOCH[2], NICOLAS ANDREFF[1]
1 FEMTO-ST INSTITUTE, AS2M DEPARTMENT, UFC/CNRS/ENSMM/UTBM, FRANCE
2 DEPARTMENT OF GASTROENTEROLOGY, UNIVERSITY HOSPITAL OF BESANÇON, FRANCE

Abstract: In this paper, we propose to address a drug-delivery mission in the small intestine, which can not be reached by traditional endoscopy. The main target of this study is the Crohn's disease, for which conventional centimetric videocapsules are not recommended because of the risks of occlusion. The targeted size of these milli-robots is in the order of 1mm3. Each unit embeds the minimum of computing power and memory (minimalistic electronics) to run a very light program, such as a finite-state machine. The mass effect of the joined milli-robots will allow the achievement of the mission through a satisfactory way. Considering a milli-robot as a disposable unit, as simple as possible, our contribution is to combine reduced computing power with recent architectures.
Original concepts are proposed in order to:
• ave on-board energy
• easily configure the team using interchangeable modules,
• provide some local decision autonomy to each unit in the team
• ensure global control of the team by the physician

A Review of New Methods for Robotic Perception by Using In-air Sonar Data

AUTHORS: NICOLA IVAN GIANNOCCARO* AND LUIGI SPEDICATO
DEPARTMENT OF INNOVATION ENGINEERING, UNIVERSITY OF SALENTO, LECCE, ITALY

Abstract: In the last years, the authors studied the possibility of using low frequency in-air ultrasonic sensors in several applications of robotic interest related to the perception and the reconstruction of the external environment.
They introduced several methods based on innovative mathematical tools for solving problems such as the position detection and orientation of a mobile robot with respect to a corridor wall, the correct reconstruction of two orthogonal panels in spite of the multiple reflections effect affecting the data in the corner zone, the reconstruction of the boundary

walls of a room environment. All the proposed innovative strategies have been tested on a designed mechatronic scanning system consisting of ultrasonic sensors rotated by a servo modular actuator and also on the data of a scanning validated model. In this review the main steps and achievements shown in the last years will be summarized and commented in such a way to give an idea of the importance of appropriate and innovative techniques for managing ultrasonic data.

Keywords: Sonar Sensors, Mechatronics Device, Signal Processing, Automatic Classification, Statistical Data Analysis, Data Fitting

Identifying Ground-robot Impedance to Improve Adaptability in Running Robots

AUTHORS: JUAN C. AREVALO, DANIEL SANZ-MERODIO, MANUEL CESTARI, ELENA GARCIA
CENTRE FOR AUTOMATION AND ROBOTICS (CAR), SPANISH NATIONAL RESEARCH COUNCIL – TECHNICAL UNIVERSITY OF MADRID (CSIC-UPM), SPAIN

Abstract: To date, running robots are still outperformed by animals, but their dynamic behaviour can be described by the same model. This coincidence means that biomechanical studies can reveal much about the adaptability and energy efficiency of walking mechanisms. In particular, animals adjust their leg stiffness to negotiate terrains with different stiffnesses to keep the total leg-ground stiffness constant. In this work, we aim to pro- vide one method to identify the ground-robot impedance so that control can be applied to emulate the aforementioned animal behaviour. Experimental results of the method are presented, showing well-differentiated estimations on four different types of terrain. Additionally, an analysis of the convergence time is presented and compared with the contact time of humans while running, indicating that the method is suitable for use at high speeds.

An Overview on Gripping Force Measurement at the Micro and Nano-scales Using Two-fingered Microrobotic Systems

AUTHORS: MOKRANE BOUDAOUD AND STEPHANE REGNIER
THE INSTITUTE FOR INTELLIGENT SYSTEMS AND ROBOTICS (ISIR), FRANCE

PUBLISHED ONLINE

Abstract: Two-fingered micromanipulation systems with an integrated force sensor are widely used in robotics to sense and control gripping forces at the micro and nano-scales. They became of primary importance for an efficient manipulation and characterization of highly deformable biomaterials and nanostructures. This paper presents a chronological overview of gripping force measurement using two-fingered micromanipulation systems. The work summarizes the major achievements in this field from the early 90s to the present, focusing in particular on the evolution of measurement technologies regarding the requirements of microrobotic applications. Measuring forces below the microNewton for the manipulation of highly deformable materials, embedding force sensors within microgrippers to increase their dexterity, and reducing the influence of noise to improve the measurement resolution are among the addressed challenges. The paper shows different examples of how these challenges have been addressed. Resolution, operating range and signal/noise ratio of gripping force sensors are reported and compared. A discussion about force measurement technologies and gripping force control is performed and future trends are highlighted.

Keywords: Microrobotics, Microgrippers, Force Measurement, Control

The Progress in Humanlike Robots Towards Having Them in Every Home and Business

AUTHORS: YOSEPH BAR-COHEN
JET PROPULSION LABORATORY (JPL), CALIFORNIA INSTITUTE OF TECHNOLOGY, USA

Abstract: The human species has been the most sophisticated result of about four billion years of evolution where Nature is continually making trial and error experiments. In both art and technology, humans have always been inspired to mimic and adapt the human appearance, capabilities, and intelligence. The related biomimetics objective consists of

the effort to engineer robots that have the appearance as well as behaviors and functions that mimic biological humans. Advances in computer science including powerful miniature microprocessors, materials science, real-time imaging and recognition, speech interpretation, biped dynamic control and many other technologies have led to creating lifelike robots that closely resemble humans. Such robots are being developed with impressive capability and sophistication making them capable of verbally and facially express emotions, as well as respond emotionally in conversation with natural humans. Electroactive polymers (EAP), also known as artificial muscles, are being used to produce biologically inspired mechanisms that once were considered only in the realm of science-fiction. As progress is being made it is increasingly becoming a realistic goal of having such robots enter our life in every home or business. This manuscript summarizes the state-of-the-art, and the challenges that are facing the developers of humanlike robots.

LEGO-based Robotics in Higher Education: 15 Years of Student Creativity

AUTHORS: ETHAN DANAHY[1], ERIC WANG[2], JAY BROCKMAN[3], ADAM CARBERRY[4], BEN SHAPIRO[1] AND CHRIS B. ROGERS[1*]
1 TUFTS UNIVERSITY, MEDFORD, MA, USA
2 UNIVERSITY OF NEVADA, RENO, USA
3 UNIVERSITY OF NOTRE DAME, USA
4 ARIZONA STATE UNIVERSITY, USA

PUBLISHED ONLINE

Abstract: Our goal in this article is to reflect on the role LEGO robotics has played in college engineering education over the last 15 years, starting with the introduction of the RCX in 1998 and ending with the introduction of the EV3 in 2013. By combining a modular computer programming language with a modular building platform, LEGO Education has allowed students (of all ages) to become active leaders in their own education as they build everything from animals for a robotic zoo to robots that play children's games. Most importantly, it allows all students to develop different solutions to the same problem to provide a learning community. We look first at how the recent developments in the learning sciences can help in promoting student learning in robotics. We then share four case studies of successful college-level implementations that build on these developments.

Keywords: Constructionism, Educational Robotics, LEGO Robotics, Student-led Learning

The Theory of Neural Cognition Applied to Robotics

AUTHORS: CLAUDE TOUZET
AIX-MARSEILLE UNIVERSITY, FRANCE

Abstract: The Theory of neural Cognition (TnC) states that the brain is only a memory, explains how a memory can become an actor pursuing various goals, and proposes explanations about the implementations of a large variety of cognitive abilities, such as attention, memory, language, planning, intelligence, emotions, motivation, pleasure, and consciousness. The explanatory power of this new framework extends farther and tackles special psychological states such as hypnosis, placebo effect and sleep, as also brain diseases such as autism, Alzheimer and schizophrenia. The most interesting however concerns robotics and is related to the fact that the TnC considers the cortical column to be the cognitive unit (in place of the neuron), reducing de facto the requirements for a brain implementation to only 3 millions units (instead of 500 billions). A robot exhibiting human-like cognitive abilities is therefore within our reach.

Keywords: Self-organizing Maps, Cognitive Abilities, Consciousness, Artificial Intelligence, Robot-sitting

Effects of Earthquake Motion on Mechanism Operation: an Experimental Approach

AUTHORS: ÖZGÜN SELVI[1*], MARCO CECCARELLI[2], ERMAN B. AYTAR[3]
1 CANKAYA UNIVERSITY, ANKARA, TURKEY
2 LARM, LABORATORY OF ROBOTICS AND MECHATRONICS, UNIVERSITY OF CASSINO, ITALY
3 IZMIR INSTITUTE OF TECHNOLOGY,TURKEY

Abstract: This paper presents an experimental characterization of the effects of earthquakes on the operation of mechanical systems with the help of CaPaMan (Cassino Parallel Manipulator), which is a 3 DOF service robot that can simulate 3D earthquake motion properly. The sensitivity of operation characteristics of machinery to earthquake disturbance is identified and characterized through experimental tests by using proper motion of the mobile platform of the service robot. Experimental tests have been carried out by using a slider-crank linkage, a small car model, and LARM Hand as test-bed mechanisms that have been sensored with acceleration or force sensors. Results are reported and discussed to describe the effects of earthquake motion on the characteristics of mechanism operation

Keywords: : Service robots, Experimental Mechanics, Simulation, Mechanisms, Earthquake Effects

Overcoming Barriers and Increasing Independence: Service Robots for Elderly and Disabled People

AUTHORS: MARION HERSH
SCHOOL OF ENGINEERING, UNIVERSITY OF GLASGOW, SCOTLAND

Abstract: This paper discusses the potential for service robots to overcome barriers and increase independence of elderly and disabled people. It includes a brief overview of the existing uses of service robots by disabled and elderly people and advances in technology which will make new uses possible and provides suggestions for some of these new applications. The paper also considers the design and other conditions to be met for user acceptance. It also discusses the complementarity of assistive service robots and personal assistance and considers the types of applications and users for which service robots are and are not suitable.

On the Readability of the Dog-inspired Social Behaviour in Social Robots

AUTHORS: GABRIELLA LAKATOS
ADAPTIVE SYSTEMS RESEARCH GROUP, UNIVERSITY OF HERTFORDSHIRE, UK

Abstract: Recently there has been an increasing interest in designing social robots that are able to interact in a meaningful way with humans. In order to interact in a socially acceptable way a robot has to convey emotions in order to increase believability, and in addition, it has to convey intentionality in a way that the human partner can attribute beliefs and intentions to the robot, leading to more acceptable and believable robotic behaviour.
In contrast to the tendency that present day social robotics is dominated by the design of human-like social creatures, the relatively novel ethological approach has recently suggested that social robots should not be human-like but rather be functional with regard to their roles in the human community. This approach suggests that the field of social robotics could draw more on the insights of ethology, since human–animal interaction can provide a useful behavioural model for building companion robots that are able to socially interact with humans. Dogs proved to be a good biological model since during the domestication process they adapted to the human social environment and they participate in complex social interactions with humans in their everyday life. In this paper I am going to review three different experimental studies, in which we tested the readability of the dog inspired behaviour implemented in social robots. Results of these studies demonstrate that applying human-dog interaction as a model for designing robots' social behaviour towards the users we can achieve believable and socially acceptable human-robot interactions in case of different robot embodiments. In addition, the dog-inspired social behaviour proved to be a suitable medium for making people attribute intentions and emotional states to non-humanoid robots.

Use of Robotic Coach for an Aging Population: An Overview

AUTHORS: NILANJAN SARKAR
VANDERBILT UNIVERSITY, USA

Abstract: The global population is aging rapidly. The proportion of the world's older adults is expected to reach 22% by 2050. Mental health of older adults has an impact on their physical health. Research shows that mental health can

be improved via physical exercises and psychosocial interventions. However, the changing of worldwide demographics and increase of life expectancy are becoming a challenge to the existing resource-strained healthcare facilities. In this context, social robotic technologies can be a potential solution to support both older adults and their caregivers. In this paper, a state-of-the-art systematic overview of existing robotic systems that have been developed to help older adults with mental needs is presented. The current limitations of these systems and the future potential of such social robots are also discussed.

Augmented Environments in Surgical Robotics – Current State and Future Perspectives

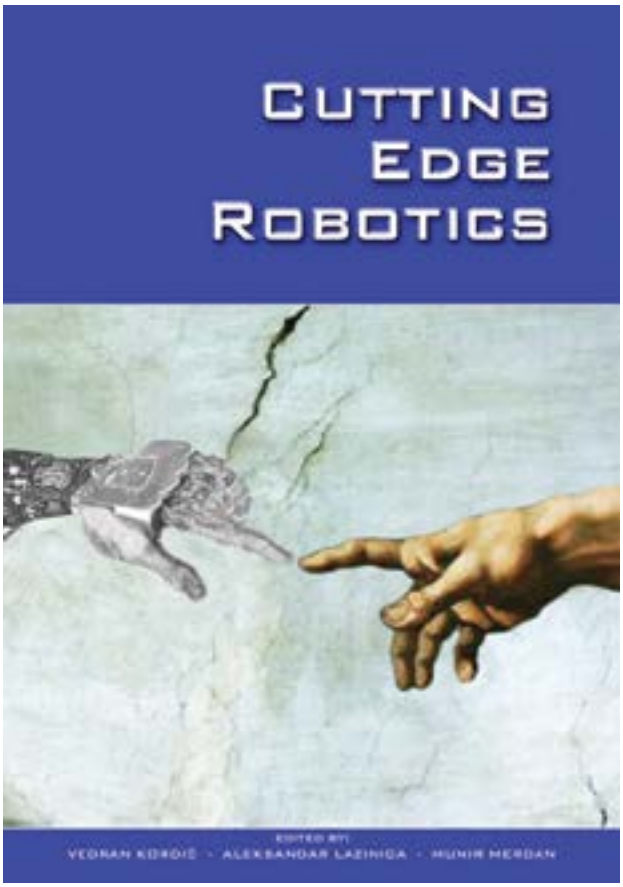
AUTHORS: LEONARDO DE MATTOS
ITALIAN INSTITUTE OF TECHNOLOGY, ITALY

Abstract: Surgeries are complex tasks that can greatly benefit from robotic systems. Such technologies can enhance the capabilities of surgeons, bringing improved precision, efficacy and safety to their work. In addition, recent novel interaction paradigms have been demonstrating potential to further improve surgeons' performance. In particular, Augmented Environments (AE) offer the possibility to enrich the surgeon's perception and interaction with the surgical site by allowing the co-existence of real and virtual objects in the same setting. This review will describe existing approaches to the creation of Augmented Environments that have been or can potentially be adopted in surgical robotics, including Augmented Reality and Augmented Virtuality systems. These constitute different interaction paradigms that can augment the surgeon's awareness and control of thesurgical environment by providing information and assistance through the inclusion of virtual objects in the real scenario, or real objects in a virtual scenario. After introducing the general features and recent advancements in AE, their applications in robot-assisted surgery will be described. The advantages and the limits of AE in this area will be discussed, as well as the potential development of such systems based on novel emergent solutions.


CELEBRATING
10
YEARS

PORTFOLIO EXPANSION AND INTRODUCTION OF MULTIMEDIA CONTENT

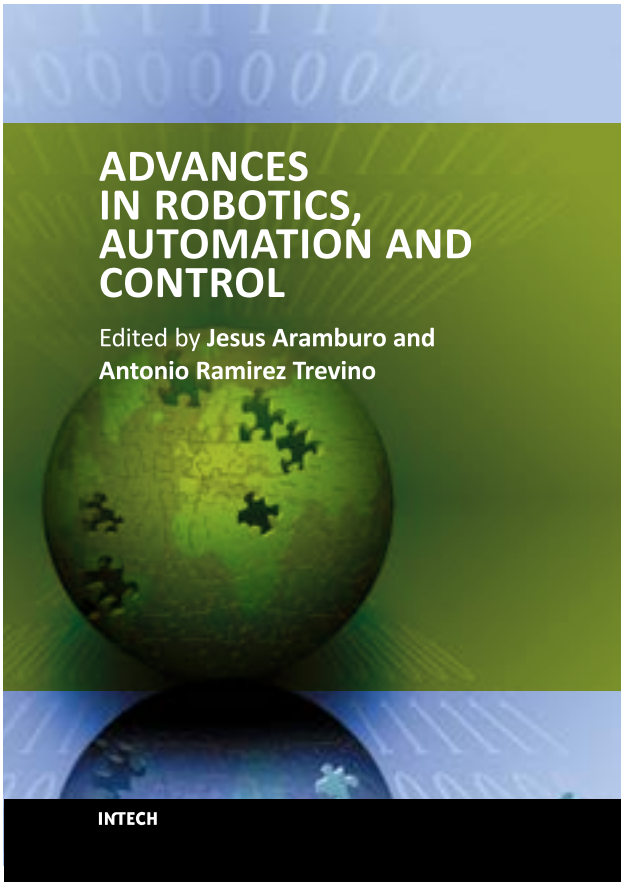
To mark IJARS's 10th year anniversary with additional research tools, the journal's team has arranged to regularly publish multimedia resources such as video lectures and talks presenting the latest developments and trends in robotics or notions directly affecting this multidisciplinary field of research. The introduction of these multimedia resources will allow readers to further explore particular topics related to content regularly published on our platform. The multimedia section will also function as a dynamic page that features the latest trends and news you might be interested in finding out about. All upcoming lectures will be announced in the News section on the journal's homepage.



We will also be having the pleasure to celebrate another upcoming anniversary; 2015 marks exactly 10 years from our first published robotics book, titled 'Cutting Edge Robotics'. In honour of this milestone, the editorial team will launch a new series of books, hence expanding the portfolio of openly accessible robotics resources.

2015 MARKS EXACTLY 10 YEARS FROM OUR FIRST PUBLISHED ROBOTICS BOOK

IJARS's portfolio currently includes 74 Open Access books in all domains of robotics, including Robotics and Automation, Robotic Navigation, Mobile Robotics, Multiagent Systems, Robot Learning, Robot Vision, Humanoid Robotics, Biomimetic Robotics, Industrial Robotics, Machine Intelligence.



Our most downloaded book up-to-date is 'Advances in Robotics, Automation and Control', edited by Jesus Aramburo and Antonio Ramirez Trevino, published in 2008. Written as an overview of the latest developments in different areas of Robotics, Automation and Control, this Open Access robotics book scored 853,319 total downloads, an impressive number also determined by IJARS'S publishing model that levies subscription barriers to scientific content.

THIS OPEN ACCESS ROBOTICS BOOK SCORED 853,319 TOTAL DOWNLOADS

You are welcome to browse through our portfolio of Open Access robotics books which you can find by visiting our homepage. We look forward to seeing the new series of robotics books (available on our website in 2015) engage international robotics communities to such level of success as achieved with the first 74 books.

To keep up with with all IJARS's latest multimedia resources, news and latest research, you can follow us via our social media accounts on Twitter and LinkedIn. Our Managing Editor tweets all things IJARS and robotics on a daily basis, also updating the journal's LinkeIn group with discussions we invite you to join.

International Journal of Advanced Robotic Systems

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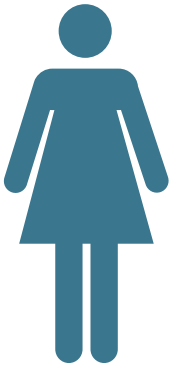
WOMEN IN ROBOTICS SUPPORTING OUR COLLABORATORS

There has always been a common perception that women entering the academic and working environment of Engineering are fewer than men. Without trying to find plausible answers to why still today there is quite a disproportion between women and men in science, the International Journal of Advanced Robotic Systems has taken upon action rather than words to promote women entering the working domain of Engineering and scientific Research&Development. While openly supporting all organisations and action groups with the goal to encourage more female students to choose Engineering careers, the team behind IJARS has taken particular interest in the current state of women in robotics. Since its establishment in 2004, IJARS has featured and endorsed many female researchers pushing the boundaries of robotics research.
With the impression of women being mostly involved in biomedical and social robotics, our female collaborators provided some of the most exciting research findings and applications that have set a cross-field trend in developing robots as an aid to hospital care, teaching, companionship and children education. Since 2004, the number of published female authors has exponentially grown, proving that in robotics the landscape is indeed changing and the negative trend reversing. On the same positive note, IJARS's female Editorial Board Members have grown from 3.8% in 2004, to 9.24% in 2014.

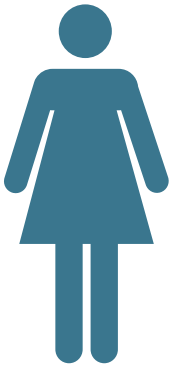
THE TEAM BEHIND IJARS HAS TAKEN PARTICULAR INTEREST IN THE CURRENT STATE OF WOMEN IN ROBOTICS. SINCE ITS ESTABLISHMENT IN 2004, IJARS HAS FEATURED AND ENDORSED MANY FEMALE RESEARCHERS PUSHING THE BOUNDARIES OF ROBOTICS RESEARCH

NUMBER OF WOMEN IN IJARS EDITORIAL BOARD MEMBERS



Percentage of Women
in IJARS Editorial Board in 2004:

3.8%



Percentage of Women
in IJARS Editorial Board in 2014:

9.24%

When talking to our female authors and collaborators in regard to the state of women in Engineering today, many have pinpointed that there is still a long way to go before rising to an equal status of their male counterparts. **Dr. Zielinska** from the Warsaw University of Technology, Poland, has shared her point of view underlining the fewer women in Engineering and the difference between men and women in approaching Engineering studies,

There are not many women visible in Engineering and unfortunately they are not often holding the key positions. In English there is the term 'Non - traditional occupations' which means occupation in which women or men make up for 25% or less of the total employment in a career. The statistics says that non - traditional careers help to create economic self-sufficiency and enable girls to attain high - skills and earn high wages.
Women in non - traditional jobs typically earn 20%-30% more than women in traditional jobs. The jobs with few women are: aerospace engineer, aircraft pilot, aircraft mechanic, architect etc., I think that to that we can add engineers in robotics.
It is interesting to observe that female students failing a technical course often conclude that they re not skilled enough, whereas the boys are inclined to search for the reason of such failure in external factors. Similar features concerns their farther career. Male students are more often willing to take the risk than the girls. That is the average pattern; however, there are many exceptions - the best glider pilot at my Faculty was a girl, she won the country competition.

Inquiring about their own work environment and personal experience, many of our female collaborators have confirmed the negative trend in numbers when it comes to women employed in Engineering.

Dr. Hristova, Ghent University, Belgium, told us the following,
I work in a research department of some 150 people of which 18 are women. If this is a realistic picture of the statistics of women in other universities, companies, then I find these figures quite painful. We form 50% of the population and we still have only 10% of the jobs. That's a lot of intelligence companies are missing out.

Some can't but notice the difference in role hierarchy assigned to women and men. **Dr. De Momi**, Polytechnic of Milan, **Dr. Ottaviano**, University of Cassino, Italy, and **Dr. Chevallereau**, Ecole Centrale de Nantes, France, told us the following in regard to this point,
As far as the marketplace is concerned, women are hired for selling components and technical support, rarely they are involved in the research and developments. (Dr. De Momi) The number of women in Engineering is positively increasing but a lot has to be done in terms of roles and engagements, referring both to academia and private and public companies. (Dr. Ottaviano)
There is obviously a deficiency of women participation in Engineering. The number of women decreases when the level of responsibly or scientific recognition increases. (Dr. Chevallereau)

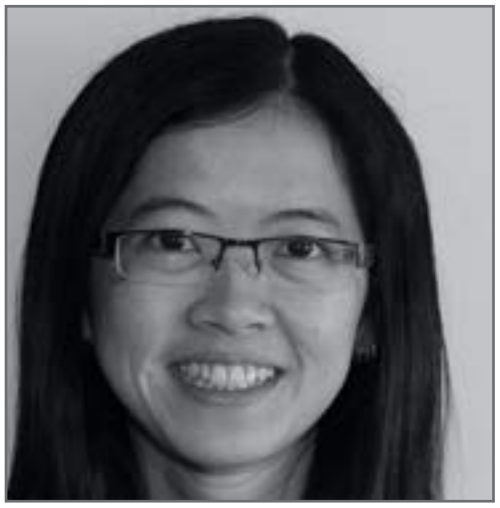
Dr. Antoska Knights, St. Clement of Ohrid University, Macedonia, expands on the above-stated views,
Not a great deal of women are involved in Engineering. The women that are involved mostly cover positions as Engineers in Technology, Technical and Electrical Engineering. Most senior positions are still held by men. Maybe there is a higher percentage of women that act as Professors at Engineering Sciences. Only about 3 years ago the Department for Robotics was launched by the State University in Macedonia.

However, a few female researchers have had a completely different experience, noticing the trend changing as their career progressed through the years. **Dr. Palottino**, University of Pisa, Italy, is one of them,
Probably the myth of "Engineering is typical for men" is becoming obsolete due to larger numbers of women taking high level of educational degrees. Moreover, topics such as Bioengineering and Management (this one perceived as less technological) are very attractive for women. In general, the role of the woman in the society and in the family is changing and more and more women are having access to education. This, in several years, will rebalance percentages in the Engineering sector.

The same goes for **Dr. Milella**, Institute of Intelligent Systems, Milan, Italy,
Since I started my career as a researcher in robotics about 10 years ago, I experienced an increasing involvement of women in Engineering and science-related areas of study. This may be partly considered a result of the changing perception of women's role in society. Nowadays, there is a general agreement that technological and scientific advances are central for human development and that no talent able to promote such a progress, whether male or female, should be wasted. Women themselves are becoming more conscious of their value and potential in science and technology, and they are actively contributing to destroy stereotypes about careers for women.
In this view, many feel that the negative trend is at an actual turning point. **Dr. Dias**, Carnegie Mellon University, USA, and **Dr. Grujic**, LaBACS, Croatia, share their opinion with us.
I think there has been a great increase in the presence of women in Engineering and women are occupying increasingly important roles in the field. But we are nowhere close in being where we should be. We still need to increase the pipeline of women entering the field, and do a lot more to retain women in the field, promote women to more important positions. (Dr. Dias)
In the years more and more women are present at our Faculty, not only as students, but as faculty staff, young researchers, and young professors. And, from my point

















I strongly believe that the recognition will come from the relevance of the developed work and not from the gender of the person behind it. Dr. Pinto

of view, all of them are highly motivated, enthusiastic of their study and research, very, very bright and equal in their competence to their male colleagues. Therefore, young female undergraduate and PhD students usually achieve excellent results in their work. After graduation, some women who choose to continue their career in the industry gain dominant positions in their corporations as project leaders. During these difficult times in terms of economic crisis, to find a job after graduation became a really demanding task. So when I meet some of my former students who are employed and in responsible positions, like project managers, my heart sings. (Dr. Grujic)

Dr. Gini from the Polytechnic of Milan, shares actual data concerning this year's enrollment quotes at her own Institute to prove more women choosing Engineering, also interpreting in her own view such trend.
In 2013, for the first time in 150 years of the Polytechnic Institute of Milan where I teach, more than 9,500 students took the admission tests for Engineering. Among these students 2,816 were women, 11% more than the previous year.
Why?
It is quite known (and the national media reported on it many times) that graduates in Engineering find a job shortly after graduation. At this difficult time finding a job is more important than ever, and women are sensible to it. Traditionally, some branches of Engineering are popular with women, for instance Bioengineering; now women are entering other Engineering curricula as well.

Dr. Pinto, Polytechique of Porto, Portugal, endorses strongly the countertrend as well as underlining the need to focus the science communities' attention to the work done rather than who has done it,
I believe that there exists an increasing number of women working in Engineering. The time for men dominance in this area of knowledge is definitely left behind.
Women's work is gaining more and more relevance and **I strongly believe that the recognition will come from the relevance of the developed work and not from the gender of the person behind it.**

On the other hand, **Dr. Callejas**, University of Grenada, Spain, attributes the ongoing change in the Engineering environment solely to women'a personal aspirations, strongly tied to what was expected of them within society until not so long ago,
There are certainly less women than men in the Engineering field, however we are progressively having more opportunities to achieve our full potential, and this is partly because we are allowing ourselves to have higher aspirations.

If women have always been interested in Engineering and robotics but the biggest tackle have been their own aspirations as delimited by society, are we to find the key to more women in Engineering via proactive compaingns

In general, any support or promotion of engineering aimed to attract young people, regardless of the gender should be started from very early ages and within the school environment.
Dr. Callejas

towards this goal? According to **Dr. Callejas** and some of her colleagues, that seems to be a very effective influencing factor:
In the last year there have appeared many organizations doing a very good job in promoting Engineering among girls. In order to make their campaigns more effective, it would be interesting to establish a closer contact with Engineering schools. This way, the initiatives could be implemented locally, and then shared and replicated with the support of the organizations. - Dr. Callejas, University of Grenada, Spain
There are some activities of WIE in different organizations such as IEEE, APENS, universities, national science and Engineering funding agencies. More efforts towards promoting a career in Engineering to young girls definitely will make a change in the future. Note that the main group that we should attract is high school students. To do this, we can advertise or promote Engineering-related subjects, introduce interesting projects or give interesting presentations to high school students. For example, we have annual robotics competitions for high school students in the province. Students get to know the challenge in Engineering Design and also have fun in doing team projects. However, more volunteers from universities should be found so that regular visits can be arranged to high school classes. I would be happy to be one of the volunteers as an academic role model of WIE. - Dr. Pan, Dalhoise University, Canada
From my experience, if they are encouraged, most girls work harder than boys for getting their diplomas and often they are able to obtain better results. Therefore,

more efforts towards promoting careers of young girls in Engineering fields must be displayed by institutions and industries. We must make more efforts to recruit women, and implement more formal mechanisms to deal with gender-based harassment. We must continue to fight nationally and internationally in recommending solutions to gender bias. For a better social balance, we must help young girls to be able to have healthy families and successful careers.- Dr. Boubaker, National Institute of Applied Science and Technology, Tunisia
Any initiative taken in this sense would be very much appreciated. **In general, any support or promotion of engineering aimed to attract young people, regardless of the gender should be started from very early ages and within the school environment.** *In the particular case of females, this should also be promoted from within the family by making them realize they are as capable as males to develop a professional future within this field. - Dr. Tomas – Rodriguez, City University of London, UK*

Talking about women in Engineering and robotics with those who live through it every day by being directly involved in these research areas, the journal's editorial team felt strongly about taking an initiative on behalf of IJARS. We are excited to announce that we decided to show support to female roboticists by asking our journal's Topic Editors-in-Chief to select **a number of outstanding papers submitted by female researchers that we will publish at no cost** for the submitting researcher.

A number of outstanding papers submitted by female researchers will be published at no cost.

The campaign will be reviled in full by summer 2014, including the mode of best papers selection and the campaign's ambassadors. The team will be announcing all news related to the campaign via the journal's social media, News page and newsletter.

Even though there is still a long road ahead of all of us towards the goal of attracting female Engineering and Robotics students, including more actions undertaken by science communities, institutions, organisations, research labs and higher education institutes, we strongly believe we are close to reaching a balance between men and women in all scientific fields.

We also believe that sometimes small actions such as publishing meritable research papers by female authors at no cost can make a difference if more stakeholders would follow such example with further supporting activities.

WITH AN EYE SET TO THE FUTURE TOWARDS **CONQUERING ALL THE CHALLENGES** IN FRONT OF US SUCH AS MAKING OUR JOURNAL EVEN **BETTER AND RAISING ITS QUALITY** FURTHER AND FURTHER, **THE EDITORIAL TEAM** WOULD LIKE TO THANK **EACH AND EVERY PERSON** THAT HAS WORKED WITH US TO MAKE THIS JOURNAL WHAT IT IS TODAY. WITHOUT THE SUPPORT OF **OUR EXTENDED TEAM AND EVERY COLLABORATOR** THAT WORKED WITH US IN THE PAST DECADE, THIS JOURNAL WOULD HAVE BEEN LESS OF AN EXCEPTIONAL PUBLICATION.

THANK YOU.

Yoseph Bar-Cohen, Andrea Bonarini, Thomas Braeunl, Yangquan Chen, Toshio Fukuda, Yasuo Kuniyoshi, Pedro U. Lima, Kin Huat Low, Claude Touzet, Ljubo Vlacic, Wenhui Wang , Guangming Xie, Basil M. Al-Hadithi, Albagul Abdulgani , Nitin Afzulpurkar , Levent Akin , Hayder Al-Assadi, Ebrahim Al-Gallaf/Mattar , Adel Al-Jumaily , Fouad M. Al-Sunni, Juan Carlos Alvarez, Chitta Amarnath, Sumeet Aphale , Mohd Rizal Arshad, Panagiotis K. Artemiadis, Masoud Asadpour, Harald Aschemann, Wudhichai Assawinchaichote, Fernando Auat Cheein, Yasar Ayaz, Shaoping Bai , Gert Balling, Zbigniew Banaszak, Alejandra Barrera, Yvan Baudoin, Mohammed Bennamoun, Sergi Bermudez I Badia, Karsten Berns, Giovanni Berselli, Asim Bhatti, Dionysis Bochtis, Olga A. Bogatyreva, Fabio Bonsignorio, John-John Cabibihan, Angelo Cangelosi, Jesus Capitán Fernández, Giuseppe Carbone, Marco Ceccarelli , Stephan Chalup, Hung-Yi Chen, Xiaoqi Chen , Frank Cheng , Ka Cheok , Ben Choi, Jui-Jen Chou , Daisuke Chugo , Woojin Chung , Grazia Cicirelli, Shuang Cong, Burkhard Corves, Sam Cubero, Jock Cunningham, Elmer P. Dadios, Torbjorn S. Dahl, Kerstin Dautenhahn, Kenneth Mark Dawson-Howe, Mario Fernando De la Rosa Rosero, Armando Carlos de Pina Filho, Amir Degani, Lefteris Doitsidis, Fadi Dornaika, Eva Henrietta, Georges Dumont, Ashish Dutta, Atilla Elci , M. Reza Emami, Mustafa Suphi Erden, Duygun Erol Barkana, Jiancheng Fang, Alessandro Farinelli , Sajjad Fekriasl, Manuel Ferre Perez, Nuno Ferreira, Toyomi Fujita, Zoran Gacovski, Jaime Gallardo-Alvarado, Andrej Gams, Antonios Gasteratos, Ali Selk Ghafari, Ahmad Ghanbari, Pablo Gonzalez-de-Santos, Efren Gorrostieta Hurtado, Stevica Graovac, Sorin Mihai, Joze Luis Guzman, Maki Habib, Moharam Habibnejad Korayem, Saman Halgamuge, Ernie Hall, Heba Ahmed Hassan, Dominik Henrich , Han-Pang Huang, Ming Huang, Seung Hyuk Baik , Roberto Iglesias, Daigoro Isobe , Rozita Jailani, Patric Jensfelt, Ping Jiang , Agustin Jimenez, Xing-Jian Jing, Mansour Karkoub, Manolya Kavakli-Thorne, Kuniaki Kawabata, Tetsuya Kinugasa, Frank Kirchner, Gerhard K. Kraetzschmar, Wilfried Kubinger, Serdar Kucuk, Vladimir Kulyukin, Chin-Hsing Kuo, Ernst Kussul, Mark Lee, Ilya Levin , Zhenbo Li , Yangmin Li, Chien-Chou Lin , Euan Lindsay, Cheng-Yuan Liou, Huashan Liu , Honghai Liu , Luis Seabra Lopes , Carlos Rodriguez Lucatero, Adel M. Alimi , Raul Marin Prades, Edgar Martinez Garcia, Ignacio Mas , Ellips Masehian, Jean Bosco Mbede, Ali Meghdari, Patricia Melin, Yan Meng, Marjan Mernik, Annalisa Milella, Huaqing Min, Thomas Moeslund, S. Ali A. Moosavian, Eduardo Javier Moreno, George Moustris, Faisal Mufti, Enzo Mumolo, Rohan Munasinghe, Saeid Nahavandi, Shuro Nakajima, Lazaros Nalpantidis , Lorenzo Natale , Chandrasekhar Nataraj , Sudha Natarajan, Chrystopher L. Nehaniv, Trung Dung Ngo, Amin Nikoobin , Kenzo Nonami, Goro Obinata, Erika Ottaviano, Yongsheng Ou, Chee Khiang (Justin) Pang, Vladan Papic, Manukid Parnichkun, Pubudu N. Pathirana, Luis Paya, Songhao Piao , Francesco Pierri, Du Pingan, Carla M. A. Pinto , Jorge Pomares, Aiguo Song, S.G. Ponnambalam, Veljko Potkonjak, Dilip Kumar Pratihar, Oliver Prenzel, Jinwu Qian, Safanah M. Raafat, Kuppan Chetty Ramanathan, Maki K. Rashid , Oscar Reinoso Garcia, Gerasimos Rigatos, Rui P. Rocha, Aleksandar Rodić, Lotfi Romdhane, Alberto Rovetta, Chellali Ryad, Mohamad Saad , Daisuke Sakamoto, Ichiro Sakuma, Nilanjan Sarkar, Christian Schlegel, Ulrich Schmucker, Marco P. Schoen, Emanuele Secco, Gerald Seet, Antonio Sgorbissa, Amir Shapiro, Alex Simpkins, Rostyslav Sklyar, Kai-Tai Song , Mohan Sridharan, Luis Enrique Sucar, Il Hon Suh, Nagarajan Sukavanam, Hartmut Surmann , Tadeusz Szkodny, Hamid D. Taghirad, Jozsef Tar, Danesh Tarapore, Mahdi Tavakoli, J. A. Tenreiro Machado, Andon V. Topalov, Mohamed Trabia, Aleš Ude, Erol Uyar Dokuz, Massimo Vaccarini, Andrey V. Savkin, Venugopal Varma, Jasmin Velagic, Gurvinder S. Virk, Antonio Visioli, Mattias Wahde, Wilson Q. Wang, Yin-Tien Wang, Changda Wang, Hesheng Wang, Jack Wang, Shinq-Jen Wu, Simon X. Yang, ShengQuan (Shane) Xie, Wen-Fang Xie, Zezhong Xu, Fei Yan-Qiong Shanghai, Jung-Min Yang, Tao Yang, Toshiyuki Yasuda, Şahin Yíldírím, Peng-Yeng Yin, Liu Yong, Wen Yu,Yu Ming Yue-Qing, Hanafiah Yussof, Meysar Zeinali, Yu Ming Zhang, Yanxin Zhang, Houxiang Zhang, Shengyong Cheng, Saaed Ziaei Rad, Cezary Zieliński, Leon Zlajpah, Loredana Zollo, Juan Antonio Corrales Ramón, Gabriel Jesus

García Gómez, Carlos Alberto Jara Bravo, Mohammed, Ahmed Shah, Feng Tang, Jun Wu, Rong Xiong, Kang Kang Yin, Hasan Demirel, Samer Hanoun, Hieu Trinh, Mohammed Hossny, Yanzheng Zhao, Selcuk Erkaya, Fatih Mehmet Botsalı, Cuneyt Oysu, Daniel K. Flippo, Muzaffer Kanaan, Husi Geza, Yongtae Do, Ravinder S. Dahiya, Abdennour El Rhalibi, Hasan Alli, Mete Kalyoncu, Nazrul Islam, Yi Cao, Ana Cristina Majarena, Alberto Trevisani, Howard Li, Mohammad Abedinnasab, António Mendes Lopes, Christine Q. Wu, Andreas Nuchter, Jan Babic, Alexander Pogromsky, Elio Tuci, Melvyn L. Smith, Ben Horan, Syed Amjad, Qining Wang, Bram Vanderborght, Dah Jye Lee, Stanislav Kovačič, Yuen Kuan Yong, Daniela Constantinescu, Oleg Yakimenko, Guangming Song, Jia Liu Nanjing, Yuru Zhang, Zeyang Xia, David Hanson, Peijiang Yuan, Karl F. MacDorman, Mustafa Tinkir, Wei Wang, Hans Petter Hildre, Youfu Li, Quanjun Song, Branislav Borovac, Andreas Mueller, Masayuki Inaba, Owen Holland, Andrés Kecskeméthy, Rob Knight, Hugo Gravato Marques, Keigo Watanabe, Jong-Hwan Kim, Hebertt J. Sira-Ramírez, Saheeb Ahmed Kayani, Petko Hr. Petkov, Ngai M. Kwok, Maryam S. Mirian, Tze-Yun Sung, Michael Hoy, Petar Kormushev, Thomas Yang, Shuhuan Wen, Ashis Banerjee, Hadi Moradi, Burak Aksak, Zheng Chen ,Chen-Chien James Hsu, Sohrab Eslami, Zheng Fan, Mehmet Onder Efe, José Santos Reyes, Antonio Barrientos, Chieh-Chih (Bob) Wang, Christian Petrov, Alok Sharma, Dimo Ivanov Zafirov, Ragunath Appasamy, John M. Dolan, Xiaorui Zhu, Changchun Liu, Alessio Brutti, Yannick Benezeth, Qingsong Xu, Ehsan Kamrani, LuZheng Bi, Iman M. Rezazadeh, Ali Boyali, Tomasz Bednarz, Luis Merino, Feng Jiang, Giovanni Legnani, Changming Sun, Christian Becker-Asano, David Handelman, Haibin Duan, Tao Mao, Ibrahiem El Emary, Alex Ellery, Jouni Mattila, Reza Ravani, Hong Liu, Rocco Furferi, Oscar Manuel Curet, David Jacobs, Chung-Hsun Sun, Maurizio Porfiri, Sheng Guo, Antoine Morice, Pablo Gil, Olfa Boubaker, Pierre Bonnal, Raffaele Di Gregorio, Oscar Castillo, Dirk Thorleuchter, Victor Santibanez, Karim Khayati, Haruhisa Kawasaki, Ramón Rodríguez-Castro, Wenjie Chen, Rachid Manseur, Ramiro Velázquez, Hyo-Sung Ahn, Holger Voos, Angelos Amanatiadis, Ke-Cai Cao, Nariman Sepehri, Yan Li, Farid Kendoul, Philip N. Azariadis, Pedro Santana, Matteo Fumagalli, Daniel Pack, Swaroop Darbha, Hyochoong Bang, Giulio Reina, Christopher Kitts, Andrea Caiti, Pascual Campoy, Mircea Badescu, Jaime Gómez Garcia-Bermejo, Anthony Mandow, Jayantha Katupitiya, Luis Mejías Alvarez, Martin Magnusson, Marion Hersh, Jorge Solis, Gunnar Bolmsjö, Cecilio Angulo Bahón, Eduardo Zalama, Hidenori Ishihara, Chul-Goo, Phil Crothers, Nak-Young Chong, Genci Capi, M. Bernardine Dias, Jason Gu, Anis Koubaa, Raj Madhavan, Fabio Morbidi, Wonpil Yu, Lino Marques, Nikolaus Vahrenkamp, Flavio Roberti, Kiju Lee, Nir Shvalb, Igor Skrjanc, Lucia Pallottino, Guanghui Wang, Filippo Arrichiello, Ya-Jun Pan, Luca Consolini, Qinggang Meng, Kenneth A. McIsaac, Suyoung Chi, Antonio Fernández-Caballero, Ismael Garcia-Varea, D. J. Lee, Stan Birchfield, Domenico Vitulano, Robert Sablatnig, Yuhao Wang, Theodore Pachidis, Stanislav Kovacic, Sergio Escalera, Giovanni Indiveri, Elisa Martinez Marroquin, Barbara Caputo, Damian Lyons, Quan Zhou, Cedric Clévy, Pierre Lambert, Li Zhang, Irene Fassi, David Folio, Stefan Havlik, Sarthak Misra, Kanty Rabenorosoa, Edward Steager, Riko Šafarič, Fumio Uchikoba, Mohsen Shahinpoor, Kwang J. Kim, Hoon Cheol Park, Xiaobo Tan, Jinsong Leng, MinJun Kim, Claudio Rossi, Massimiliano Zecca, Maurizio Porfiri, Oscar M. Curet, Bertrand Tondu, Teresa Zielinska, Rodrigo Ventura, Shigang Yue, Joseph H. Solomon, Philippe Gorce, Poramate Manoonpong, Arianna Menciassi, Jose M. Azorin, Honghai Liu, Chao Chen, Elena De Momi, Rafael Morales, Achim Schweikard, Shahin Sirouspour, Eric Wade, Abhilash Pandya, Gian-Luca Mariottini, Mitsuhiro Hayashibe, Carlo Menon, Peter Brett, Jungwon Yoon, Philippe Gorce, Sylvain Calinon, Hagen Lehmann, Tony Belpaeme, Dongheui Lee, Álvaro Castro González, Amy Loutfi, Pedro Sanz, Jacopo Aleotti, Paulo Menezes, Hagen Lehmann, Giuseppina C. Gini, Alexander Ferrein, Jacky Baltes, Liliana Rogozea, Vadim Tikhanoff, Kenji Hashimoto, Henry Leung, Yifeng Zhou, Martin Smith, Arturo de la Escalera, Shigang Yue, Ahmad Lotfi, Manuel Armada, Christine Chevallereau, Yannick Aoustin, Luther Palmer, Dominik Belter, Kenji Hashimoto.

Published by InTech
Janeza Trdine 9, 51 000 Rijeka, Croatia

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International Journal of Advanced Robotic Systems
CELEBRATING 10 YEARS

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