Dear Colleagues,

It is our pleasure to invite all scientists, academicians, young researchers, business delegates and students from all over the world to attend the International Meet & Expo on Robot Intelligence Technology and Applications will be held in Edinburgh, Scotland during August 18-19, 2022. ROBOTMEET2022 shares an insight into the recent research and cutting edge technologies, which gains immense interest with the colossal and exuberant presence of young and brilliant researchers, business, delegates and talented student communities. ROBOTMEET2022 goal is to bring together, a multi-disciplinary group of scientists and engineers from all over the world to present and exchange break-through ideas relating to the Robot Intelligence Technology and Applications. It promotes top level research and to globalize the quality research in general, thus makes discussions, presentations more internationally competitive and focusing attention on the recent outstanding achievements in the field of Robotic Intelligence Technology. We’re looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Robotic Intelligence Technology.
## COMMITTEES

### Organising Committee

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...let's reflect knowledge...
Plenary Forum
Robot Skill Learning and Human-like Control

Chenguang Yang*

Bristol Robotics Laboratory, UK

Abstract
Expressing, learning and reusing skills as modularized ones can strengthen the generalization ability of skills and reusability. Human-Robot shared control combines the advantages of both human and robot. This talk will introduce our advance in the field of robot skill learning and human-robot shared control. We use control theory to model the control mechanism of motor neurons to assist us developing human-like robot controllers so that the robot can realize variable impedance control to adaptively physically-interact with the changing environment. We further propose a multi-task impedance control and impedance learning method used on a human-like manipulator with redundant degrees of freedom to achieve compliant human-robot interaction motor control. Learning from human demonstration methods are generally used to efficiently transfer modularized skills to robots using multi-modal information such as surface electromyography signals and contact forces, enhancing the effectiveness of skill reproduction in different situations. We have also developed an enhanced neural-network shared control system for teleoperation, which uses the redundancy of joint space to avoid collisions automatically. The operator does not need to pay attention to possible collisions during manipulation. Besides, with the help of deep learning, we designed a tool power compensation system for teleoperation surgery, thereby enhancing the performance of the force and motion tracking at both ends of the teleoperation system. Furthermore, this talk will also introduce our research on the topics of human-robot collaboration and skill generalization.

Biography
Professor Chenguang (Charlie) Yang is the leader of Robot Teleoperation Group of Bristol Robotics Laboratory, a Co-Chair of the Technical Committee on Bio-mechatronics and Bio-robotics Systems (B2S), IEEE Systems, Man, and Cybernetics Society, and a Co-Chair of the Technical Committee on Collaborative Automation for Flexible Manufacturing (CAFM), IEEE Robotics and Automation Society. He received PhD degree from the National University of Singapore (2010) and performed postdoctoral research at Imperial College London. He is a recipient of the prestigious IEEE Transactions on Robotics Best Paper Award (2012) and IEEE Transactions on Neural Networks and Learning Systems Outstanding Paper Award (2022) as lead authors. He has been awarded EPSRC Innovation Fellowship and EU FP-7 Marie Curie International Incoming Fellowship. He is a Fellow of British Computer Society and Higher Education Academy. He serves as Associate Editor of a number of leading international journals including a few IEEE Transactions. His research interest lies in human robot interaction and intelligent system design.
Advanced Biometrics

David Zhang *
Chinese University of Hong Kong, Hong Kong

Abstract
In recent times, an increasing, worldwide effort has been devoted to the development of automatic personal identification systems that can be effective in a wide variety of security contexts.

As one of the most powerful and reliable means of personal authentication, biometrics has been an area of particular interest.

It has led to the extensive study of biometrics technologies and the development of numerous algorithms, applications, and systems, which could be defined as Advanced Biometrics.

This presentation will systematically explain this new research trend. As case studies, a new biometrics technology (palmprint recognition) and two new biometrics applications (medical biometrics and aesthetical biometrics) are introduced. Some useful achievements could be given to illustrate their effectiveness.

Biography
David Zhang graduated in Computer Science from Peking University. He received his MSc in 1982 and his Ph.D. in 1985 in both Computer Science from the Harbin Institute of Technology (HIT), respectively. From 1986 to 1988 he was a Postdoctoral Fellow at Tsinghua University and then an Associate Professor at the Academia Sinica, Beijing. In 1994 he received his second Ph.D. in Electrical and Computer Engineering from the University of Waterloo, Ontario, Canada. He has been a Chair Professor at the Hong Kong Polytechnic University where he is the Founding Director of Biometrics Research Centre (UGC/CRC) supported by the Hong Kong SAR Government since 1998. Currently he is Presidential Chair Professor in Chinese University of Hong Kong (Shenzhen). Over past 40 years, he has been working on pattern recognition, image processing and biometrics, where many research results have been awarded and some created directions, including medical biometrics and palmprint recognition, are famous in the world. So far, he has published over 20 monographs, 500+ international journal papers and 40+ patents from USA/Japan/HK/China. He has been continuously 8 years listed as a Global Highly Cited Researchers in Engineering by Clarivate Analytics during 2014-2021. He is also ranked about 85 with H-Index 122 at Top 1,000 Scientists for international
Computer Science and Electronics. Professor Zhang is selected as a Fellow of both RSC (Royal Society of Canada) and CAE (Canadian Academy of Engineering). He also is a Croucher Senior Research Fellow, and an IEEE Life Fellow and an IAPR/AAIA Fellow.
Fusion of Hard and Soft (AI) Control Strategies for a Smart Prosthetic/Robotic Hand

Desineni Subbaram Naidu*PhD, Life Fellow IEEE
Minnesota Power Jack Rowe Endowed Chair
University of Minnesota Duluth, USA

Abstract

There are now over 20 million people in the world with missing limbs resulting from combat and non-combat operations and by 2050 there will be 50 million amputees all over the world. The availability of artificial limbs will help these people to lead a better normal life. Recent and emerging research focuses on the theme of Convergence and Integration Igniting Innovation between Physical and Life (& Biomedical) Sciences, Arts (& Humanities), Natural Sciences and Engineering and Technology (PLANET). The overall goal of the research on Prosthetic Hand Technology is to develop a smart prosthetic hand using intelligent strategies for electromyography (EMG) signal extraction, analysis, identification, kinematic synthesis, and embedded hierarchical real-time systems and control by fusion of soft computing and hard computing techniques. The presentation is based on Professor Naidu’s recent (2016-August-12) TED Talk (http://www.ted.com) on 3-D Printed Prosthetic Hand for the World (https://www.youtube.com/watch?v=rXyy5XN2oY0) and his recent research book published in October 2017 by the IEEE Press - Wiley (Series on Systems Science and Engineering) titled, “Fusion of Hard and Soft Control Strategies for a Robotic Hand”.


Biography

Desineni “Subbaram” Naidu received MTech and PhD degrees in Electrical Engineering (with specialization in Control Systems Engineering), from Indian Institute of Technology (IIT), Kharagpur, INDIA. Dr. Naidu taught, visited and/or conducted research at: IIT; National Research Council (NRC) Senior Research Associate at Guidance and Control Division, NASA Langley Research Center, Hampton, VA, USA (1985-90); Old Domain University, Norfolk, VA, USA (1987-90); Professor, Associate Dean and Director, School of Engineering at Idaho State University and Measurement and Control Engineering Research Center, Pocatello, Idaho, USA (1990-2014); National Research Council (NRC) Senior Research Associate at Center of Excellence in Advanced Flight Research at United States (US) Air Force Research Laboratory, Wright Patterson Air Force Base (WPAFB), Ohio, USA(1998-99); Visiting Research Fellow at Center of Excellence for Ships and Ocean Structures at Norwegian University of Science and Technology, Trondheim, NORWAY (2014); Academic Guest at Measurement and Control Laboratory at Swiss Federal Institute of Technology, Zurich, SWITZERLAND (2015); Visiting Professor at Nantong University, Nantong; Jiangsu College of Information Technology, Jiangsu,East China Normal University, Shanghai,Chinese Academy of Sciences, Beijing CHINA(2007,2-09,2011); Visiting Research Professor at the University of Western...
Professor Naidu received twice the Senior National Research Council (NRC) Associateship award from the US National Academy of Sciences (NAS), and is an elected (1995) (now Life) Fellow of the Institute of Electrical and Electronic Engineers (IEEE) and an elected (2003) Fellow of the World Innovation Foundation, UK. Professor Naidu’s teaching and research interests are Electrical Engineering (Power and Energy); Control Systems; Optimal Control: Theory and Applications; Biomedical Sciences and Engineering (Prosthetics and Infectious Diseases); Large Scale Systems and Singular Perturbations and Time Scales (SPaTS): Control Theory and Applications; Guidance and Control of Aerospace Systems: Aeroassisted Orbital Transfer for Mars mission and Uninhabited Aerial Vehicles (UAVs); Advanced Control Strategies for Heating, Ventilation, & Air-Conditioning (HVAC); Modeling, Sensing and Control of Gas Metal Arc Welding (GMAW) and has over 200 journal and conference publications including 9 books. He has been on the editorial boards of several journals including the IEEE Transactions on Automatic Control, Mechatronics: The Science of Intelligent Machines, An International Journal, ELSEVIER, and Optimal Control: Applications and Methods (Wiley). More details at http://www.d.umn.edu/~dsnaidu/
Continuum Robot Hoses and Applications

Ian D. Walker*
Clemson University, USA

Abstract
This talk will discuss issues in the design, modeling, prototyping, and deployment of continuum robot hoses. Operated as active hoses, continuous backbone continuum robots can use their inherent compliance to actively maneuver to access areas inaccessible to conventional hoses.

They can be used to deliver payloads ranging from compressed air and water to medicines, fuel, or cementious materials. Alternative design options for continuum robot hoses, including pneumatic actuation and tendon-based designs, will be reviewed, along with approaches to their modeling and control. Potential applications, including firefighting, ship-to-ship refueling, and 3D printing of cement in construction, will be discussed.

Biography
Ian Walker is a Professor in the Department of Electrical and Computer Engineering at Clemson University, USA. Professor Walker’s research focuses on research in the construction, modeling, and application of continuum robots. He is a Fellow of the IEEE and an Associate Fellow of the AIAA.
Learning-based Control in the Era of AI and Autonomous Vehicles

Zhong-Ping Jiang*
New York University

Abstract
This talk presents a new design paradigm, called “learning-based control”, that is fundamentally different from traditional model-based control and model-free machine learning. Learning-based control is aimed at learning real-time optimal controllers directly from input-output data, for stability and robustness of dynamical systems in uncertain environments. Novel tools and methods for data-driven control are proposed as an entanglement of techniques from reinforcement learning and control theory. The effectiveness of learning-based control design is demonstrated via its applications to network systems such as connected and autonomous vehicles and neural science problems such as computational principles of human movement.

Biography
Zhong-Ping Jiang received the B.Sc. degree in mathematics from the University of Wuhan, Wuhan, China, in 1988, the M.Sc. degree in statistics from the University of Paris XI, France, in 1989, and the Ph.D. degree in automatic control and mathematics from the Paris Tech-Mines, France, in 1993, under the direction of Prof. Laurent Praly. Currently, he is a Professor of Electrical and Computer Engineering at the Tandon School of Engineering, New York University. He is known for fundamental contributions to nonlinear control theory and applications. In particular, he is a key contributor to nonlinear small-gain theory. His main research interests include stability theory, robust/adaptive/distributed nonlinear control, adaptive dynamic programming and their applications to information, mechanical and biological systems. He is coauthor of five books Stability and Stabilization of Nonlinear Systems (with Dr. I. Karafyllis, Springer, 2011), Nonlinear Control of Dynamic Networks (with Drs. T. Liu and D.J. Hill, Taylor & Francis, 2014), Robust Adaptive Dynamic Programming (with Y. Jiang, Wiley-IEEE Press, 2017), Nonlinear Control Under Information Constraints (with T. Liu, Science Press, 2018) and Robust Event-Triggered Control of Nonlinear Systems (with T. Liu and P. Zhang, Springer Nature, 2020). Dr. Jiang is a Deputy Editor-in-Chief of the Journal of Control and Decision and of the IEEE/CAA Journal of Automatica Sinica, and has served as a Senior Editor for the IEEE Control Systems Letters and the Systems and Control Letters, an Editor for the International Journal of Robust and Nonlinear Control and an Associate Editor for several journals including Mathematics of Control, Signals and Systems (MCSS), Systems & Control Letters, IEEE Transactions on Automatic Control, European Journal of Control, and Science China: Information Sciences. Dr. Jiang is a recipient of the prestigious Queen Elizabeth II Fellowship Award from the Australian Research Council (1998), the CAREER Award from the U.S. National Science Foundation (2001), JSPS Invitation Fellowship from the Japan Society for the Promotion of Science (2005), the Distinguished Overseas Chinese Scholar Award from the NSF of China (2007), and the Chair Professorship by the Ministry
of Education of China (2009). His recent awards include the Steve and Rosalind Hsia Best Biomedical Paper Award at the 2016 World Congress on Intelligent Control and Automation in Guilin, China, the Best Paper Award at the 2017 Asian Control Conference, Gold Coast, Australia, and the Best Paper Award on Control at the 2018 IEEE Conf. on Real-Time Computing and Robotics, Maldives.
Towards robust machine learning for transportation systems

Justin Dauwels*
Delft University of Technology, Netherland

Abstract
The field of machine learning has progressed rapidly in the recent years, fueled especially by new developments in deep learning. While such technologies are often hyped in the media, weaknesses of deep learning systems are starting to become obvious, potentially spelling trouble for mission-critical systems such as autonomous vehicles (AVs). Most current deep learning systems are brittle, since they typically do not encode or learn information about the physical world. For instance, state-of-the-art deep learning based object detection systems can potentially distinguish hundreds of animals, but do not necessarily know that birds fly or fish swim. In that sense, they are far from intelligent. The next generation of deep learning systems will be more robust, by letting them learn about the physical world. How such prior information can be encoded into the deep learning networks is an emerging area of research. In the first part of my talk, I will present recent work where we have shown that convolutional neural networks for objection detection in images can be made substantially more robust to image transformations (occurring in real-world applications) and to adversarial attacks by incorporating prior knowledge about the physical world. We encode physical properties of objects by means of hidden variables, and let the model infer what physical transformations have taken place in a given scene. As an illustration, we will present the Affine Disentangled Generative Adversarial Network (ADIS-GAN). On the MNIST dataset, ADIS-GAN can achieve over 98 percent classification accuracy within 30 degrees of rotation, and over 90 percent classification accuracy against FGSM and PGD adversarial attack, outshining systems trained through data augmentation.

Although computer vision systems can be made more robust by such methods (and others). Therefore, it is important to take perception imperfections into account in autonomous vehicles, which rely on computer vision and AI. In the second part of my talk, I will describe our efforts towards simulating perception errors in AVs and their impact on the behavior of AVs. I will also briefly outline ongoing application-oriented machine learning projects in our team related to intelligent transportation systems. At the end of the talk, I will explore future research directions.

This is joint work with TuV Sud (Singapore) and CETRAN at NTU.

Biography
Dr. Justin Dauwels is an Associate Professor at the TU Delft (Circuits and Systems, Department of Microelectronics). He was an Associate Professor of the School of Electrical and Electronic Engineering at the Nanyang Technological University (NTU) in Singapore till the end of 2020. He was the Deputy Director of the ST Engineering – NTU corporate lab, which comprises 100+ PhD students, research staff and engineers, developing novel autonomous systems for
airport operations and transportation. His research interests are in data analytics with applications to intelligent transportation systems, autonomous systems, and analysis of human behaviour and physiology. He obtained his PhD degree in electrical engineering at the Swiss Polytechnical Institute of Technology (ETH) in Zurich in December 2005. Moreover, he was a postdoctoral fellow at the RIKEN Brain Science Institute (2006-2007) and a research scientist at the Massachusetts Institute of Technology (2008-2010). He has been a JSPS postdoctoral fellow (2007), a BAEF fellow (2008), a Henri-Benedictus Fellow of the King Baudouin Foundation (2008), and a JSPS invited fellow (2010, 2011). He served as Chairman of the IEEE CIS Chapter in Singapore from 2018 to 2020, and serves as Associate Editor of the IEEE Transactions on Signal Processing (since 2018), Associate Editor of the Elsevier journal Signal Processing (since 2021), member of the Editorial Advisory Board of the International Journal of Neural Systems, and organizer of IEEE conferences and special sessions. He is also Elected Member of the IEEE Signal Processing Theory and Methods Technical Committee and IEEE Biomedical Signal Processing Technical Committee, both since 2018. His research team has won several best paper awards at international conferences and journals. His research on intelligent transportation systems has been featured by the BBC, Straits Times, LianheZaobao, Channel 5, and numerous technology websites. Besides his academic efforts, the team of Dr. Justin Dauwels also collaborates intensely with local start-ups, SMEs, and agencies, in addition to MNCs, in the field of data-driven transportation, logistics, and medical data analytics. His academic lab has spawned four startups across a range of industries, ranging from AI for healthcare to autonomous vehicles.
Invited Forum
Automation of Virtual Products and the Effects on Development and Test Processes of Mechatronomic Components

Alexander Fragner¹*, Alexander Kreis²
¹Institute of Automotive Engineering, Automotive Mechatronics, Virtual Product Development, Graz University of Technology, Inffeldgasse 11, Graz, Austria
²Institute of Automotive Engineering, Automotive Mechatronics, Virtual Product Development, Graz University of Technology, Inffeldgasse 11, Graz, Austria

Abstract
The world of automotive manufacturers is evolving rapidly due to the increasing complexity of their products as well as global and environmental constraints. Due to these facts, the automotive industry is pressured to reduce the development and testing times needed for these additional adjustments. In addition to time reduction, attention is also focused on the effort associated with development and testing processes, as this also needs to be reduced. As a result of this pressure that is placed on the automotive sector, adequate development and testing methods must be implemented to optimize the entire development process. One of these methods is enhanced virtual products in the areas of design, simulation, and production engineering within various computer-aided environments. Nowadays, the automotive sector also focuses on the environmental friendliness of its products. Therefore, emission reduction and environmental compatibility should be considered from the outset in the development and integration of virtual products. Vehicle manufacturers and suppliers have been able to take a big strike ahead to fasten engineering processes thanks to virtual product development. Especially in the initial phase of vehicle development, it is feasible to achieve virtual test results by analysis and simulation resulting in avoidance of superfluous process steps as well as resource and time savings throughout the entire development process. For example, crash tests and aerodynamic airflow tests on vehicles are good examples of how virtual simulation models can increasingly replace physical prototypes to a large extent. The influence of virtual products in combination with knowledge-based engineering methodologies in early stages of automotive development and testing processes is the subject of this research. In addition, the presented approach shows enormous potential of time, cost and resource savings leading to an earlier market entry of products and furthermore asks for environmentally friendly aspects to apply the approach in industrial development and manufacturing processes.

Keywords
Automation of Automotive Development and Testing Processes; Process Optimization; Knowledge-Based Engineering

Biography
Alexander Fragner is a student in mechanical engineering and business economics. He is a scientific researcher at the Institute of Automotive Engineering at Graz University of
Technology and part of the research group Virtual Product Development. In his position, he participates in various international R&D and funding projects in the areas of automation, virtual reality, artificial intelligence, and automotive sensor, actuator systems and electrical propulsion technologies. Besides these activities, Mr. Fragner also participates in courses at the Graz University of Technology and has already published several papers in the field of virtual product development.
Optimization of Automotive Development-, Production- and Testing-Processes by Using Virtual Products in Combination with AI Approaches

Alexander Kreis
Institute of Automotive Engineering, Automotive Mechatronics, Virtual Product Development, Graz University of Technology, Inffeldgasse 11, Graz, Austria

Abstract
Due to progressive increase of complexity, the automotive industry is subject to constantly changing trends varying from the introduction of greener product life cycles to the deployment of technological advances in development and production processes up to the highly sophisticated end-products. In relation to both, sustainable automotive products as well as the deployment of technological advances, the integration of AI (Artificial Intelligence) approaches in combination with virtual products in automotive development, production and testing processes is of great importance. In combination with knowledge-based CAx (Computer-Aided x, where x serves as a placeholder) development, the integration of AI approaches delivers an enormous potential to enhance processes in the automotive industry and beyond.
In addition to process optimizations, the integration of AI approaches also takes sustainability (e.g., optimization of component geometries and materials, reduction of emissions over the entire life cycle, CO$_2$ reduction through improved development) and economical aspects (e.g., resources savings throughout the entire development process, time and cost savings through earlier error detection, avoidance of unnecessary process steps) into account. The present approach deals with the integration of AI approaches in combination with knowledge-based engineering methods in the early phases of automotive development, production and testing processes. Furthermore, the presented approach shows an enormous time, cost and resources reduction potential, leading to an earlier market entry. The novel approach demonstrates the integration of AI approaches into industrial development and production processes based on possible application scenarios.

Keywords
Automotive Development and Production Processes; Process Optimization; Integration of Artificial Intelligence Approaches; Knowledge-based Engineering and Virtual Products

Biography
Alexander Kreis has been awarded a master's degree in mechanical engineering and business economics and a Ph.D. in mechanical engineering in the field of virtual product development. He is a Post-Doc at Graz University of Technology and a frequent guest lecturer at universities and in the automotive industry in Europe, North America and Asia. Dr. Kreis is head of the Virtual Product Development Research Group and head of the Position Sensor Test Bench at the Institute of Automotive Engineering, Graz University of Technology. In his position, he is responsible for various international R&D and funding projects in the areas of automation, virtual reality, artificial intelligence, and automotive sensor and actuator systems, and also lectures in these areas at Graz University of Technology. Dr. Kreis is a reviewer for journal and conference publications and evaluator for various funding programs of Austria and the European Union.
Reconstruction of Multidimensional Data on Intelligent Technology and Artificial Intelligence

Dariusz Jacek Jakóbczak*
Koszalin University of Technology, Poland

Abstract
Artificial Intelligence is applied for prediction and calculations of unknown values of data or coordinates. Decision makers, academicians, researchers, advanced-level students, technology developers, and government officials will find this text useful in furthering their research exposure to pertinent topics in AI, computer science, numerical analysis or operations research and assisting in furthering their own research efforts in these fields. Proposed method, called Two-Points Smooth Interpolation (TPSI), is the method of 2D curve interpolation and extrapolation using the set of key points (knots or nodes). Nodes can be treated as characteristic points of data for modeling and analyzing. The model of data can be built by choice of probability distribution function and nodes combination. TPSI modeling via nodes combination and parameter $\gamma$ as probability distribution function enables value anticipation in AI, risk analysis and decision making. Two-dimensional curve is extrapolated and interpolated via nodes combination and different functions as continuous probability distribution functions: polynomial, sine, cosine, tangent, cotangent, logarithm, exponent, arc sin, arc cos, arc tan, arc cot or power function.
Advanced Motion Control for a Six-wheel-legged Robot (BIT-6NAZA)

Jiehao Li*
State Key Laboratory of Intelligent Control and Decision of Complex Systems, School of Automation, Beijing Institute of Technology, Beijing, China

Abstract
Most recently, wheel-legged robots with high delivery and flexible manoeuvrability are widely used in practical engineering scenarios, including material transportation, food and medicine delivery, space exploration, unmanned driving and other fields. In this speech, a novel electronic parallel six-wheel-legged robot (BIT-6NAZA) is introduced. Firstly, the design concept of the wheel-legged robot based on the Steward platform is proposed. Furthermore, the autonomous tracking control theory for the wheel-legged robot is discussed, and the flexible motion control framework is also presented. Finally, some extensive experiments on complex environments are conducted on the developed wheel-legged robot.

Keywords
Mobile Robotics; Wheel-Legged Robot; Motion Control; Autonomous Motion.

Biography
Jiehao Li received the M.Sc. degree in Control Engineering at South China University of Technology, Guangzhou, China, in 2017. He received the Ph.D. degree at the State Key Laboratory of Intelligent Control and Decision of Complex Systems, School of Automation, Beijing Institute of Technology, Beijing, China, in 2022. His interests mainly include mobile robotics, wheel-legged robot, motion control, autonomous navigation. Dr. Li has been awarded the Best Conference Paper Finalist of IEEE International Conference on Advanced Robotics & Mechatronics in 2020, and the Outstanding Reviewer of China Automation Congress in 2021. He is the Session Chair of Youth Academic Annual Conference of Chinese Association of Automation in 2022. He has served as the Academic Editor of Journal of Control Science and Engineering, and also as a reviewer for some journals such as IEEE/ASME Transactions on Mechatronics, IEEE Transaction on Cybernetics, IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Fuzzy Systems, IEEE Transactions on Industrial Electronics, IEEE Transactions on Systems, Man, and Cybernetics: Systems, IEEE Transactions on Automation Science and Engineering, IEEE Robotics and Automation Letters, and so on.

Petr Stadler
Department of Vascular and Robotic Surgery, Na Homolce Hospital, Prague, Czech Republic

Abstract

Objective
The aim of this retrospective study was to describe and evaluate our single center experience with robotic aortic and non-aortic vascular surgery to treat mostly occlusive disease and aneurysms.

The da Vinci system has been used by a variety of disciplines for laparoscopic procedures but the use of robots in vascular surgery is still relatively uncommon.

Methods
The authors present 540 robot assisted vascular operations (aortic and non-aortic). 347 patients were prospectively evaluated for occlusive disease, 139 patients for abdominal aortic aneurysm (AAA), 7 for a common iliac artery aneurysm, 11 for a splenic artery aneurysm, 1 for a internal mammary artery aneurysm, 17 patients for median arcuate ligament release, 13 for endoleak II treatment post endovascular aneurysm repair (EVAR), 2 for renal artery reconstruction and 3 cases were inoperable. 6 hybrid procedures in study were performed.

Results
517 cases (95,7%) were successfully completed robotically, 3 patients surgery (0,5%) was discontinued due to heavy aortic calcification and severe peri-aortitis respectively. In 20 patients (3,7%) conversion was necessary. The thirty-day mortality rate was 0,4% (2 patients), and early non-lethal postoperative complications were observed in 8 patients (1,5%).

Conclusions
Our experience with robot-assisted laparoscopic surgery has demonstrated the feasibility of this technique for occlusive diseases, aneurysms, endoleak II treatment post EVAR, for median arcuate ligament release and hybrid procedures. The robotic system provides a real opportunity for minimally invasive surgery in the field of vascular surgery and offers true mini-invasive surgical vascular interventions with all its advantages. Robotic AAA treatment and aorto-femoral represent the standard operations in vascular surgery, and they are not only possible but also safe and successful.
Successful Implementation of Robotic Surgery in A Safety-Net Public Access Hospital is Associated With Improved Clinical Outcomes: An Evaluation of the First 1000 Cases

Shaneeta M. Johnson*, Larry Hobson, and Omar Danner
Morehouse School of Medicine, USA

Abstract

Background: Robotic-assisted surgical technology in public access hospitals is limited. Nevertheless, established robotic surgery programs have seen tremendous growth and improved results across all patient populations. Success of the program requires a collaborative effort. Combined with information technology, quality and outcomes data, fiscal support, and strategic partnerships, stellar results can be achieved. In order to address the disparity in care for our underserved patients, we implemented a program to increase the number of robotically-trained surgeons and staff. We hypothesize that implementation of a robotic training program with structured curriculum would enhance the quality of surgical outcomes including length of stay, safety, and overall hospital cost.

Methodology: All surgical cases performed robotically since inception in February 2017 through December 2021 at a public academic medical center were evaluated. Annual total and general robotic surgery volume and case type were analyzed for hospital LOS, patient safety/complications, and mortality.

Results: Since inception, 1001 robotic cases have been completed and shown dramatic improvements in clinical. The program saw 29% volume growth in procedures performed from 2017 to 2018 and 14% from 2018 to 2019. Wound infection rates and mortality decreased. Reductions in hospital length of stay were seen in hernia repairs, colectomies, and prostatectomies. This has translated into significant hospital cost reduction due to a decrease in inpatient hospital days and improved patient access.

Conclusion: Although robotic surgery may be associated with higher upfront expenses, the cost savings on the back end combined with improved outcomes are beneficial to both public access hospitals and their patient population.

(Up to 250 words)

Biography
Dr. Shaneeta Johnson is a Professor of Surgery, Director of Minimally Invasive, Robotic, and Bariatric Surgery, and Program Director, General Surgery Residency Program at Morehouse School of Medicine in Atlanta, Georgia USA.
Dr. Johnson received her BA from The Johns Hopkins University, Doctorate of Medicine from Loma Linda University School of Medicine, surgical training at Howard University and Minimally Invasive and Bariatric Surgery Fellowship at the Cleveland Clinic. She is a Fellow of the American College of Surgeons and International College of Surgeons.

She is an expert in robotic minimally invasive surgery and bariatric surgery.
Proactive Robot System Defence Policies from Game Theory

Stefan Rass*1,2
1 Johannes Kepler University Linz, LIT Secure and Correct Systems Lab, Altenbergerstrasse 69, 4040 Linz, Austria
2 Universitaet Klagenfurt, Institute of Artificial Intelligence and Cybersecurity, Universitaetsstrasse 65-67, 9020 Klagenfurt, Austria

Abstract
Robots are highly distributed systems, unifying components from possibly many vendors and hence making it particularly challenging to orchestrate them securely. Contemporary advanced persistent threats (APTs) match this diversity with an equally rich set of strategies to penetrate deeply into a system while long going unnoticed. The increasing use of robots in industry requires new security models against stealthy attacks to production systems. The goals go beyond availability, integrity or confidentiality, and may for example be about deteriorating quality of goods up to causing permanent damage to the production itself.

This talk introduces a defence policy computation and optimization model from game theory. The game is to compute an optimal moving target defence against an invisible intruder that penetrates into a system towards conquering some target asset, such as an actuator, sensor or others. The defender can, at no time, reliably recognize any adversarial activity, and hence strives to keep the attacker away from the vital asset. The game is lost as soon as the attacker reaches its target. The game is designed to be played on attack graphs compiled from practical penetration tests, to guide security officers towards the most critical points to protect in the distributed system. It is furthermore designed for ease of implementation and flexibility w.r.t. different defence and attack patterns, such as periodic check-ups or random actions possible at any time (by 24/7 security teams or the attacker). The protection is herein proactive, meaning that we do not wait for incidents and then respond to it. This is due to the documented nature of APTs to happen silently in the background, and becoming noticeable when it is too late to react. The talk closes with an outlook to other related defence models, and a discussion of practical issues in security policy optimization using game theory.

Keywords
Security; Game Theory; Robot; Advanced Persistent Threat

Biography
Stefan Rass graduated with a double master degree in mathematics and computer science from the Alpen-Adria Universität Klagenfurt in 2005. He received a PhD degree in mathematics in 2009, and habilitated on applied computer science and system security in 2014. His research interests include applied system security, as well as complexity theory, statistics, decision theory and game-theory. He authored numerous papers related to security and applied statistics and decision theory in security. He co-authored the book Cryptography for Security and Privacy in
Cloud Computing, published by Artech House, and was an editor of the Springer book Game Theory for Security and Risk Management: From Theory to Practice, published by Springer Birkhäuser. He participated in various nationally and internationally funded research projects, as well as serving on various review boards and as an organizer of scientific events (such as the GameSec 2017 conference and others). Currently, he is a full professor for security, at the Johannes Kepler University Linz, and associated professor at the Universitaet Klagenfurt.
Robot Intelligence Technology for Skillful Viniculture based on the Lattice Computing Paradigm

Vassilis G. Kaburlasos*
Human-Machines Interaction Laboratory (HUMAIN-Lab), Department of Computer Science, International Hellenic University (IHU), 65404 Kavala, Greece

Abstract
Agricultural robots have an increasing popularity because they address vital issues such as seasonal shortages in manual labor as well as the increasing concern regarding environmentally friendly practices. Several agricultural robots have already been developed for specific tasks (e.g., for monitoring, spraying, harvesting, transport, etc.) with varying degrees of effectiveness. Nevertheless, the use of cooperative teams of agricultural robots in farming tasks is not as widespread. The interest here, in particular, is in skillful viniculture by a cooperative team of agricultural robots. The enabling technology for analysis and design is Lattice Computing (LC) which has been proposed lately as a mathematical modelling paradigm regarding cyber-physical system applications (Kaburlasos, 2022).

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References
Autonomous Robot Evolution

Wei Li*
Fudan University, Shanghai, China

Abstract
This research will investigate the long-term vision of a technology enabling the evolution of entire autonomous robotic ecosystems that live and work for long periods in challenging and dynamic environments without the need for direct human oversight. Based on state-of-the-art 3D printing techniques with novel materials and a hybridized hardware-software evolutionary architecture - the research will address current weaknesses in robot design methodology by establishing self-reproducing robots that evolve their morphologies and controllers in real-time. Imagine an environment where autonomous systems (robots) are not designed by humans (or indeed designed at all) but are created through a series of steps that follow evolutionary processes. These robots will be “born” through the use of 3D manufacturing, with novel materials and a hybridized hardware-software evolutionary architecture. “Child” robots will learn in a safe and controlled environment where success will be rewarded. The most successful individuals will make available their genetic code for reproduction and for the improvement of future generations. Such a process will ultimately lead to a change in the way things are designed and manufactured. This research focuses on a disruptive robotic technology where robots are created, reproduce and evolve in real-time and real space. The long-term vision is a technology enabling the evolution of entire autonomous robotic ecosystems that live and work for long periods in challenging and dynamic environments without the need for direct human oversight. This means radically new autonomous systems are needed, where robots are conceived and born, rather than designed and manufactured. Such robots will fundamentally change the concept of machines, showcasing a new breed that can change their form and behavior, not in error but on purpose.

Biography
Wei Li received the B.Eng. degree in automation and the M. Eng. degree in control science and engineering from the Harbin Institute of Technology, China, in 2009 and 2011, respectively, and the Ph.D. degree from the University of Sheffield, U.K., in 2016. After being a research associate at the University of York, UK, he is currently an assistant professor at the Academy for Engineering and Technology, Fudan University, China. He has published more than 30 academic articles in peer-reviewed journals and conferences, such as the IEEE Transactions on Robotics and Neur IPS. His research interests include robotics and computational intelligence, and especially self-organized systems, and evolutionary machine learning.
IoT Driven Artificial Intelligence Techniques for Human-Robot Interaction

Wen Qi*
Politecnico di Milano, Italy

Abstract
The ever-growing Internet-of-Things (IoTs) promotes further efficient and comprehensive healthcare through wearable and interconnected devices (e.g., Fitbit watches and MonBaby). An adaptive Human–robot Interface (HRI) was adopted in by using a Kalman filter to estimate the orientation and a particle filter to estimate the palm position of human hands. Recent advances in wearable devices and multi-modality fusion technologies have witnessed a growing interest in comfortable healthcare and track multiple health information in recognized human activities. These integrate various wearable sensors, mobile devices, cloud storage, and data center over a wired or wireless network to interact, communicate, collect, and exchange information. The HRI system used to operate dual robots by using both left and right hands. In the following research deployed from the same authors, they introduced a markerless HRI by using interval Kalman filter to estimate palm position and improved particle filter to estimate the orientation of the human hands. Thanks to this new algorithm, the accuracy of palm position and stability of the orientation estimation concerning their previous work have been improved. This topic focuses on IoTs based HRI system to achieving robot control and multiple sensors fusion.
Feasibility testing of Robotics and Part handling by Advanced Simulation for Small and Medium-sized Enterprises

Nour Mohamed Morsi*
Glasgow Caledonian University, UK

Abstract
Industry 4.0 would benefit from a flexible robotic system that can be utilised across a series of inspection applications. Utilising the digital twin concept, the physical system paired with a simulated environment allows a quickly feasibility evaluation of a particular application. The approach defrays the financial investment risks SMEs face when using robotic systems as a possible approach. In particular, this paper examines an inspection method for the correct alignment of drilled holes onto a rectangular block. A Techman robot mounted with a VSPP-5F2113 camera is utilised and simulated in Robodk to develop initial programming. The control of the inspection system is based on visual feedback from the robot’s camera (no pre-programmed positions are used) and implemented as a Finite State Machine (FSM) where states are designed to be easily replaced by alternative ones for different applications. In this particular example, for instance, the detection of the drill holes is performed via Hough Transformation and the tilt is measured from the misalignment between the drill circles at the top and back. Error propagation is used to calculate the theoretical precision and contrast it with the experimental results in the simulator. Drill tilt measurement results are accurate to the nearest 0.6 degrees. Further analysis shows that precision can be increased by improving the accuracy of the drill centres’ determination.
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