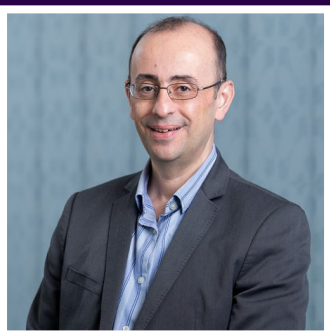
INTERNATIONAL SYMPOSIUM

ROBOTICS & ARTIFICIAL INTELLIGENCE 2019 [ISRAI]

NYU ABU DHABI CONFERENCE CENTER



Samer Madanat

Dean of Engineering

Dear Colleagues,

On behalf of my NYUAD Engineering colleagues, I am pleased to welcome you to our campus, and to the International Symposium on Robotics and Artificial Intelligence.

Robotics is aligned with the strategic research themes for NYUAD, with major activity in both Engineering and the Sciences. In the context of the Engineering strategic plan, Robotics is one of our emerging research clusters.

Intelligent robotics has emerged as one of the pillars of the new industrial revolution in the 21st Century. Nationally, robotics represents one of the key enablers of the UAE Vision 2021. The UAE is a leader in the adoption of artificial intelligence and robotics as a strategic plan for long-term economic growth and the improvement of quality of life. The prestigious 'UAE AI & Robotics Award for Good', one of the main initiatives that supports the research and development in AI and Robotics, reflects the commitment of the UAE National Innovation Strategy.

Our vision for the future of robotics at NYUAD includes a research center focused on interdisciplinary research in engineering and computer science, with participation of faculty in Engineering, Science, Arts and Humanities, and Social Science. This proposed center will engage in collaborative research with NYU's Tandon School of Engineering, thus taking advantage of the vast array of talent in the NYU Global Network.

I wish you a productive conference and, for those visiting us from outside Abu Dhabi, an enjoyable stay in our beautiful and vibrant city.

Samer Michel Madanat
Dean of Engineering, NYUAD
Global Network Professor of Engineering, NYU Tandon

The Chairs

ISRAI 2019

Dear 2019 ISRAI attendees,

Welcome to Abu Dhabi!

We are honored to host you at the 2019 International Symposium on Robotics and Artificial Intelligence (ISRAI), held at the NYU Abu Dhabi Campus. NYU and Abu Dhabi have come together as partners to build, in the UAE, a new institution, NYU Abu Dhabi, as a modern institution focused on the future. The NYUAD Institute developed as a hub of important intellectual discourse across the academic disciplines and is especially delighted to welcome all of you. NYUAD is the first comprehensive liberal arts and science campus in the Middle East to be operated abroad by a major American research university. NYU Abu Dhabi is a research university with fully integrated arts & humanities, social science, science and engineering divisions.

The symposium features presentations by invited experts in artificial intelligence and robotics. The goal of the symposium is to bring together leading researchers in several complementary fields and foster communication and collaboration. The two-day symposium includes two keynote speakers as well as seventeen additional presentations.

We would like to also thank the NYUAD Institute staff for providing the support and help to arrange the symposium. Additionally, we would like to thank Sharon Angelica, Associate Director Engineering Division, and her team for helping in local arrangements, exhibits, program, and publicity.

General Co-Chairs,

Anthony Tzes

Yi Fang

Mohamad Eid

Anthony Tzes

Yi Fang

Mohamad Eid

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Kostas Kyriakopoulos

Matteo Fumagalli

Mohamad Eid

Nizar Habash

Ruigang Yang

Shiguang Shan

Spilios Theodoulis

Stefan Leutenegger

Stjepan Bogdan

Van Anh Ho

Yi Fang

Yu-Shen Liu

Zoran Vukic

Program Agenda

Sunday, March 10, 2019 | Day 1

08:30 – 09:00	Breakfast	East Dining Hall (D2), Ground Floor
09:00	Welcome Remarks	**Antonios Tzes**, Chair & Professor of Electrical & Computer Engineering NYU Abu Dhabi
09:20 - 10:00	Keynote speaker	**Shiguang Shan**, Chinese Academy of Sciences, China *Title: Visual Recognition Across Heterogeneous Patterns*

Morning session - Control of Mobile Robots

Chair: Mohamad Eid, NYUAD

10:00 - 10:30	Speaker	**Stefan Lutenegger**, Imperial College London, UK *Title: Spatial Perception for Mobile Robots*
10:30 - 10:50	Coffee & Refreshments - Meeting Room Foyer	
10:50 - 11:20	Speaker	**Kostas Kyriakopoulos**, National Technical University Athens, Greece *Title: Cooperation in Autonomous Vehicle-Manipulator Systems: Ground and Underwater Paradigms*
11:20 - 11:50	Speaker	**Matteo Fumagalli**, Aalborg University of Copenhagen, Denmark *Title: Control of physical interactions of unmanned aerial vehicles*
11:50 - 12:20	Panel discussion	*Topic: Collaborative Control of Distributed Systems*
12:30 - 13:50	Lunch	The Torch Club (D2), First Floor
14:00 – 15:30	Lab tour	AIMlab, Visual Computing lab, Robotics lab, Core labs

Afternoon session – Learning, Perception, and Human-Robot Interaction

Chair: Yi Fang, NYUAD

15:30 - 16:00	Speaker	**Fady Al-Najjar,** UAE University, UAE *Title: Hybrid Robot-Virtual Avatar Autism Treatment & Evaluation System*
16:00 - 16:30	Speaker	**Yushen Liu**, Tsinghua University, China *Title: Deep Representation Learning for 3D Shape Retrieval*
16:30 - 17:00	Speaker	**Ruigang Yang**, Baidu Research / University of Kentucky *Title: Sim-to-Real: Using Simulations for 3D Perception & Navigation*
17:00 - 17:30	Speaker	**Van Anh Ho,** Japan Adv. Institute of Science and Technology, Japan *Title: Morphological Design of Soft Interfaces for Fostering Human-Robot Physical Interaction*
18:00 - 21:00	Social Dinner	Bus Departure from A6 street-side entrance Bus Return to Campus at 21:00

Program Agenda

Monday, March 11, 2019 | Day 2

08:30 – 09:00	Breakfast	East Dining Hall (D2), Ground Floor
09:00 - 09:40	Keynote Speaker	**Nizar Habash**, NYU Abu Dhabi *Title: On Arabic and Artificial Intelligence*

Morning session – Aerial and Underwater Systems

Chair: Anthony Tzes, NYUAD

09:40 - 10:10	Speaker	**Stjepan Bogdan,** University of Zagreb, Croatia *Title: Aerial Robotics – manipulation and interaction with the environment*
10:10 - 10:40	Speaker	**Spilios Theodoulis,** French-German Research Institute Saint-Louis France *Title: Flight Control Systems of Reduced Implementation Complexity: From Big Data to Feedback Control*
10:40 - 11:10	Speaker	**Zoran Vukic,** University of Zagreb, Croatia *Title: Underwater Systems and Technologies in Croatia – an overview*
11:10 - 11:30	Coffee & Refreshments - Meeting Room Foyer	
11:30 - 12:00	Speaker	**Giuseppe Loianno**, NYU Tandon, USA *Title: Autonomous Agile Human Friendly Drones*
12:00 - 12:30	Speaker	**Antonios Tsourdos,** Cranfield University, UK *Title: Swarm Technologies for Aerial Robots*
12:30 - 14:00	Lunch	The Torch Club (D2), First Floor

Afternoon session – UAVs, Learning, Mapping and Haptics

Chair: Nizar Habash, NYUAD

14:00 - 14:30	Speaker	**Jorge Dias,** Khalifa University, UAE *Title: Robotic based Semantic Mapping from Video and Multi-spectral Cameras*
14:30 - 15:00	Speaker	**Jee-Hwan Ryu,** KOREATECH, South Korea *Title: Twisted String Actuator and its Application to Wearable Soft Exosuit*
15:00 - 15.30	Speaker	**Anthony Tzes,** NYU Abu Dhabi *Title: Cooperative UAVs for Area Coverage using Panoramic Cameras for UAV Relative Pose Estimation*
15:30 - 15:50	Coffee & Refreshments - Meeting Room Foyer	
15:50 - 16:20	Speaker	**Yi Fang,** NYU Abu Dhabi *Title: Deep Learning in 3D Computer Vision Towards Robust 3D Object Recognition and Detection*
16:20 - 16:50	Speaker	**Mohamad Eid**, NYU Abu Dhabi *Title: Haptic Guidance for Handwriting Skills*
16:50 - 17:00	Closing Remarks	
17:00 - 19:00	Tour	Emirates Palace & Sheikh Zayed Grand Mosque Bus Departure from A6 street-side entrance
19:30 - 21:00	Social Dinner	Bus Return to Campus at 21:0

Table of Contents

Shiguang Shan

Chinese Academy of Sciences, China

Visual Recognition Across Heterogeneous Patterns

ABSTRACT

In computer vision, we often need to recognize objects represented in different views, modalities or domains. For instance, real-world applications need to recognize a person in non-frontal view while he/she was enrolled only a face photo in frontal view. Similarly, it is also demanding to recognize faces captured under near-infrared lighting by matching against face images taken under visible lighting.

Furthermore, a recognition model learned in one domain sometimes needs to be adapted to work in another domain providing only some unsupervised data in the novel domain. Even further, the so-called zero-shot object recognition needs to match between the image of an object and its textual description.

All the above recognition scenarios require to learning representations that bridging heterogenous visual patterns. In this talk, I will discuss the general principle solving these problems and introduce some of our recent practices.

BIO

Shiguang Shan received PhD degree in computer science from the Institute of Computing Technology, Chinese Academy of Sciences (CAS), Beijing, China, in 2004. He has been a full Professor of ICT, CAS since 2010 and now the deputy director of CAS Key Lab of Intelligent Information Processing.

His team has rich R&D experience in face recognition and has provided solutions to many face recognition systems running in China. He has published more than 300 papers, with totally more than 15,000 citations (Google scholar).

He served as Area Chairs for many international conferences including ICCV11, ICPR12/14, ACCV12/16/18, FG13/18, BTAS18, and CVPR19. And he was/is the Associate Editors of several journals including IEEE Trans on Image Processing, Pattern Recognition Letters, Neurocomputing, and Journal of Computer Vision and Image Understanding

Stefan Leutenegger

Imperial College London

Spatial Perception for Mobile Robots

BIO

Stefan Leutenegger is a Senior Lecturer (US equivalent: Associate Professor) at Imperial College London. He leads the Smart Robotics Lab, SRL (http://wp.doc.ic.ac.uk/sleutene/), and co-leads the Dyson Robotics Lab (www.imperial.ac.uk/dyson-robotics-lab) with Prof. Andrew Davison. Stefan holds BSc and MSc degrees from ETH Zurich, as well as a PhD on "Unmanned Solar Airplanes: Design and Algorithms for Efficient and Robust. Autonomous Operation" also from ETH Zurich, the Autonomous Systems Lab. His main research interests are centred on autonomous robot navigation in potentially unknown, cluttered, and even dynamic environments: he has been working on many different application domains, ranging from domestic robotics, as funded by Dyson, to autonomous drones for inspection, disaster management, and automatic construction. Stefan has furthermore co-founded a start-up company called SLAMcore (www.slamcore.com), which currently employs 19 engineers and researchers, after receiving Venture Capital funding in 2017 and 2018.

ABSTRACT

Robustness and accuracy of real-time localisation and mapping systems have dramatically improved recently, thanks to advances in processing hardware and commoditisation of sensors such as RGB-D cameras and inertial measurement units. Stefan has been working on related algorithms and their software implementations, with a more recent focus on bringing together dense geometry and semantic, object-level scene understanding. The aim of these recent works is to bridge the sense-AI-gap and empower the next generation of mobile robots that need to plan and execute complex tasks in potentially cluttered, and dynamic environments, possibly in proximity of people. Example applications to be shown include inspection and autonomous construction with drones

Kostas Kyriakopoulos

National Technical University of Athens

Cooperation in Autonomous Vehcle Manipulator Systems: Underwater, Ground and Aerial Paradigms

ABSTRACT

Our efforts are centered around developing provable sensor-based motion planning and interaction control methodologies for autonomous systems. Our ultimate goal is to design sound interfaces of our provable control theoretic-based techniques with higher-level machine-intelligence based decision making schemes. Our experiences in three domains (marine, ground and aerial) are briefly reported:

Decentralized Impedance Control for Cooperative Manipulation of Multiple Underwater Vehicle Manipulator Systems under Lean Communication:-
We address the problem of cooperative object transportation for multiple Underwater Vehicle Manipulator Systems (UVMSs) in a constrained workspace with static obstacles. We propose a novel distributed leader-follower architecture.

Motion Planning Scheme for Cooperative Loading using Heterogeneous Robotic Agents:-
We present a decentralized motion planning and control architecture for the cooperative loading task using heterogeneous robotic agents operating in a constraint workspace with static obstacles. A motion control scheme for each agent is designed and implemented in order to autonomously guide each robot to the desired loading configuration with guaranteed obstacle avoidance and convergence properties. The performance and the applicability of the proposed strategy is experimentally verified in a variety of loading scenarios using a redundant static manipulator and a mobile platform.

Parity-Based Diagnosis in UAVs - Detectability and Robustness Analyses:-
Parity-Based methodologies for fault diagnosis in UAVs often result in nonlinear residual generators. Still, a systematic framework to perform detectability (sensitivity) and robustness analyses of residual generators does not exist. In this work, sensitivity and robustness metrics for static and dynamic residuals are presented, while numerical methods, specifically Particle Swarm Optimization, are employed to calculate them. The results are used to characterize the performance of a diagnostic system. An extended application on a UAV model is shown, based on real flight data.

BIO

He was born in Athens, Greece in 1962. He received the Diploma in mechanical engineering with Honors from the National Technical University of Athens (NTUA), Greece, in 1985 and the MS and Ph.D. in Electrical, Computer & Systems Engineering from Rensselaer Polytechnic Institute (RPI), Troy, NY in 1987 and 1991, respectively. From 1988 to 1991 he did research at the NASA Center for Intelligent Robotic Systems for Space Exploration. Between 1991-93 he was an Research Assistant Professor at the Electrical, Computer and Systems Engineering Department of RPI and the New York State Center for Advanced Technology in Automation and Robotics.

Since 1994 he has been with the Control Systems Laboratory of the Mechanical Engineering Department at NTUA, Greece, where he currently serves as a Professor and Director of the Post-Graduate Program on “Automation Systems”. His current interests are in the area of Nonlinear Control and Embedded Systems applications in Sensor Based Motion Planning & Control of multi-Robotic Systems: Manipulators & Vehicles (Mobile, Underwater and Aerial). He was awarded the G.Samaras award of academic excellence from NTUA, the Bodosakis Foundation Fellowship (1986-1989), the Alexander Onassis Foundation Fellowship (1989-1990) and the Alexander Von Humboldt Foundation Fellowship (1993).

Dr. Kyriakopoulos has published more than 320 papers to journals and refereed conferences; he is Specialty Chief Editor for “Frontiers in Robotics and AI” and he serves in the editorial committees of a number of journals and conferences, while he has served as an administrative member of a number of international conferences. He has acted as a PI in 35 R & D projects, half of which were funded by the European Commission. He is an IEEE Fellow.

Matteo Fumagalli

University of Aalborg, Denmark

Control of physical interactions of unmanned aerial vehicles

BIO

Matteo Fumagalli received his M.Sc. in mechanical engineering in 2006 from the Politecnico di Milano, and his PhD from the University of Genoa, where he worked in collaboration with the IIT – Istituto Italiano di Tecnologia.

He has been a postdoctoral fellow at the Robotics and Mechatronics group of the University of Twente (Netherlands), where he carried out research on mechatronic design of advanced robotic systems, including aerial manipulators, compliant mechanisms and physical interaction of advanced robotic systems. In December 2015 he joined Aalborg University of Copenhagen (Denmark) where he got the position of Assistant Professor. In 2018 he became Associate Professor within Aalborg University.

His research interests are in the study and control of the interaction between mechanical systems, and design of advanced robotic mechanisms (such as compliant aerial manipulators) and control of physical interaction tasks.

ABSTRACT

The number of civil applications in which unmanned aerial vehicles (UAVs) are used has grown rapidly over the past few years. Aerial robots are often solely used as an agile sensing platform, incapable of physically interacting with its environment. Contactless operations have already proved to be very valuable, however a large potential still lies in tasks that do require physical interaction.

Aerial vehicles that are able to physically interact with the environment, often called Aerial Manipulators, are a class of unmanned aerial vehicles that have the capability to perform physical interaction without the limitation of being constrained to the ground, meaning that they ideally possess an unbounded workspace.

Despite the strong expected impact of such technology within civil applications, both scientific and technological challenges still need to be addressed. This presentation will provide an overview of the main limitations of such technology, which prevent it from being applied in real life applications, and the understandings leading to the development of new aerial manipulators' physical interaction capabilities and meaningful operations on the environment.

Fady Al-Najjar

The United Arab Emirates University, UAE

Hybrid Robot-Virtual Avatar Autism Treatment & Evaluation System

ABSTRACT

We are proposing a potential treatment tool for children with Autism Spectrum Disorder (ASD). The approach was made of an assistive system and an automatic scoring system. The assistive system uses a combination of robot-avatar and virtual-avatar controlled by the therapist's body movements and facial expressions, respectively, though artificial neural networks (ANN) as an intermediate. The automatic scoring system uses Kinect-camera to provide quantitative assessments of the patient's attention and engagement level. The scores were used to feedback the therapist on the engagement status of the patient, as well as, to adjust the intervention level of the assistive system. From a pilot study involving six ASD and five neurotypical development children, we could empirically prove that the proposed tool is superior to the traditional human therapist and pre-programmed robot-based approaches in increasing the children attention and engagement, the key to ensure good outputs from the planned treatment by the therapist. More importantly, our system is auto-adapted based on the individual patient's need

BIO

Dr. Fady received his MSc in Artificial Intelligence and his PhD in System Design Engineering at the University of Fukui, Japan in 2007 and 2010, respectively. Since 2010, Dr. Fady worked as a research scientist at Brain Science Institute (BSI), RIKEN, Japan. He conducted neuro-robotics study to understand the underlying mechanisms for embodied cognition and mind. From 2012, he started an interest in exploring the neural mechanisms of motor learning, adaptation, and recovery after brain injury from the sensory- and muscle-synergies perspectives. His research target is to propose an advance neuro-rehabilitation application for patients with brain injuries. Since 2016, he joined a three-year joint research group, including Nagoya University-Japan, and the University of Michigan-USA, to develop a bio-inspired prosthetic arm. from 2018, he became the director of AI and Robotics Lab at UAE University.

Yu-Shen Liu

Tsinghua University, China

Deep Representation Learning for 3D Shape Retrieval

BIO

Dr. Yu-Shen Liu is an Associate Professor in School of Software at Tsinghua University, China. He spent three years as a post doctoral researcher in Purdue University from 2006 to 2009. He earned his PhD in the Department of Computer Science and Technology at Tsinghua University, China, in 2006. He received his BS in mathematics from Jilin University, China, in 2000.

His current research interests include algorithms in 3D Computer Vision, Shape Analysis, Deep Learning, AI, Building Information Modeling (BIM). He serves as PC member of IJCAI, editors for Construction Innovation, International Journal Smart Construction Research, Lead Guest Editor of Special Issue on Recent Advances on Building Information Modeling (BIM), and reviewers for TIP, CVPR, ICCV, ICME, Automation in Construction, Advanced Engineering Informatics, Computer-Aided Design, The Visual Computer, Computers & Graphics, Computers in Industry, et al. He has published 30+ papers in premier journals and conferences like TIP, TPAMI, TII, AAAI, PR, CAD, Automation in Construction, Advanced Engineering Informatics. In 2016, one of his papers received the Highly Cited Research Award by Advanced Engineering Informatics (the Elsevier journal). One paper is awarded the Best Student Presentation Award, at the 16th International Conference on Computing in Civil and Building Engineering (ICCCBE2016). One paper is awarded the Best Student Paper Award at the Proceedings of the Ninth International Conference on Computer Aided Design and Computer Graphics (CAD-CG'05).

He has over ten years research experience in 3D shape analysis, such as 3D shape retrieval and recognition. Especially, in the past two years, Dr. Yu-Shen Liu has published 6 top papers in TIP and AAAI, which all are related to 3D Shape Representation, Recognition and Retrieval based on deep learning.

ABSTRACT

Learning feature representation of 3D objects is a fundamental problem in Computer Graphics (CG) and Computer Vision (CV), which aims to learn informative and discriminative features for 3D objects. The learned representation can be used in various applications such as object recognition, classification, segmentation and retrieval.

Most of previous studies use hand-crafted shape descriptors for representing 3D object features, but such hand-crafted descriptors are designed carefully and cannot generalize well for various types of objects across different domains. Recently, with the advances in deep representation learning and the introduction of large-scale 3D object databases like ShapeNet and ModelNet, there have been some inspiring attempts developed for learning deep representation of 3D objects from large-scale 3D object databases. Deep learning has achieved great success in various recognition tasks for CV. However, it is still a challenge for learning deep representation of 3D objects.

In this talk, we will first briefly review recent research progress of deep representation learning for 3D shapes. According initial 3D representations, the existing methods can be roughly classified into voxel-based, surface-based, view-based, and point cloud based approaches. Then, our several latest deep representation learning methods will be introduced, including Point2Sequence (AAAI-19), SeqViews2SeqLabels (TIP-19) and VIP-GAN (AAAI-19). Next, the application of shape-shape retrieval is demonstrated with the help of the above deep representation learning.

Finally, we introduce an attractive extension -- cross-modal representation learning for shape-text retrieval (AAAI-19).

Ruigang Yang

Baidu Research / University of Kentucky

Sim-to-Real: Using Simulations for 3D Perception and Navigation

ABSTRACT

The importance for simulations, in both robotics and more recently autonomous driving, has been more and more recognized. In this talk,

I will talk the fairly extensive line of simulation research at Baidu's Robotics and Autonomous Driving Lab (RAL), from low-level sensor simulation, such as LIDAR, to high-level behavior simulation, such as drivers/pedestrians.

These different simulations tools are designed to either produce an abundant amount of annotated data to train deep neural network, or directly provide an end-to-end environment to test all aspects of robots/autonomous vehicles movement capabilities.

BIO

Ruigang Yang is currently Chief Scientist for 3D Vision at Baidu Research. He leads the Robotics and Autonomous Driving Lab (RAL).

Before joining Baidu, he was a full professor of Computer Science at the University of Kentucky. He obtained his PhD degree from University of North Carolina at Chapel Hill and his MS degree from Columbia University.

His research interests span over computer graphics and computer vision, in particular in 3D reconstruction and 3D data analysis.

He has published over 100 papers, which, according to Google Scholar, has received over 10000 citations with an h-index of 48 (as of 2017).

He has received a number of awards, including US NSF Career award in 2004 and the University of Kentucky's Dean's Research Award in 2013.

He is currently an associate editor of IEEE TPAMI and a senior member of IEEE.

Van Anh Ho

Japan Adv. Institute of Science and Technology

Morphological Design of Soft Interfaces for Fostering Human-Robot Physical Interaction

BIO

Van Anh Ho received the B.S degree on Automation Engineering at Hanoi University of Science and Technology in 2007, M.S. degree and the PhD degree on Robotics at Ritsumeikan University, Japan in 2009 and 2012, respectively. He had completed the JSPS Post doctoral fellow in 2013 before joining Advanced Research and Development Center, Mitsubishi Electric Corp. in Japan. From 2015 to 2017, he worked as Assistant Professor at Ryukoku University in Kyoto, where he led a laboratory on soft haptics. From 2017, he joined Japan Advanced Institute of Science and Technology (JAIST) as an Associate Professor for setting up a laboratory on Soft Robotics. His research interests are soft robotics, soft haptics, grasping and manipulation, bio-inspired robots. He is member of IEEE, RSJ.

ABSTRACT

Haptics is an integration of science and technology for applying the sense of touch in control of computers, also brings understanding of human interaction to technology. In addition, touch is not only a simple physical tactile contact, it is a complex mean for conveying communication during interaction between a human and the surroundings (such as human-human, human-machine, human-virtual reality, and so on). Therefore, future of human interaction is not only about technology, it is also about the determination of social influence through physical interaction of human. In this talk, I would introduce our latest development of soft universal physical interactive interface, from small to large scale, with affordable technology for enhancement of human's physical interaction with actual and virtual environment. Before that, I would introduce the general idea of morphological design in development of such devices in soft haptics field.

Nizar Habash
New York University Abu Dhabi, UAE

On Arabic and Artificial Intelligence

ABSTRACT

An ultimate goal of Artificial Intelligence is to create machines that can learn to understand and generate any human language from data. Over the last fifty years or so, the research in this area, also known as natural language processing or computational linguistics, have been disproportionate in which specific languages it targeted and for what applications.

In this talk, we present some of the challenges Arabic poses, from its rich word form and ambiguity to its numerous dialects. We also present a short history of AI research on Arabic; together with examples of results on Arabic language technologies.

Finally, we present a vision for what Arabic AI should aspire to accomplish and thoughts on how to reach it.

BIO

Nizar Habash is an Associate Professor of Computer Science at New York University Abu Dhabi (NYUAD). Professor Habash specializes in natural language processing and computational linguistics (artificial intelligence for human languages).

He received his PhD in Computer Science from the University of Maryland College Park. Before joining NYUAD, he was a research scientist at Columbia University's Center for Computational Learning Systems. His research includes extensive work on machine translation, morphological analysis, and computational modeling of Arabic and its dialects.

Professor Habash has been a principal investigator or co-investigator on over 20 grants. And he has over 200 publications including a book entitled "Introduction to Arabic Natural Language Processing".

He is the director of the NYUAD Computational Approaches to Modeling Language (CAMeL) Lab (http://www.camel-lab.com). His website is http://www.nizarhabash.com.

Stjepan Bogdan

University of Zagreb, Croatia

Aerial Robotics – manipulation and interaction with the environment

BIO

Stjepan Bogdan, Ph.D. is a Full Professor at the Laboratory for Robotics and Intelligent Control Systems (LARICS), Department on Control and Computer Engineering, University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER), where he teaches several courses in robotics and automation.

His research interests include autonomous systems, aerial robotics, multi-agent systems, intelligent control systems, bio-inspired systems and discrete event systems. He spent one year as Fulbright researcher at the Automation and Robotics Research Institute, Arlington, USA, in Prof. Frank Lewis' lab.

He is a co-author of 4 books and has published more than 180 conference and journal papers. He was the Principal Investigator and a researcher on 24 national and international scientific projects. Currently, he is involved in 6 EU H2020 projects (HORSE, ENCORE, subCULTron, RoboCom++, ENDORSE and ACROSS) and coordinates 2 projects: NATO-SpS international project MORUS and H2020 Twinning project AeroTwin.

Currently, he is an Associate Editor of Journal of Intelligent and Robotic Systems; European Journal of Control; International Review of Mechanical Engineering (IREME); Transactions of the Institute of Measurement & Control; Journal of Control Theory and Applications.

He served as a Program Committee member and Associate Editor of major control and robotics conferences, IEEE International Symposiums and General Chair of 2018 Mediterranean Conference on Control and Automation. And was a vice-chair of Croatian Robotics Society.
He is recipient of Bronze Plaque "Josip Lon ar" (1990-achievements as a student); Silver Plaque "Josip Lon ar" and "Best Young Scientist", "Fran Bošnjakovi" award (2015 – exceptional achievements in science and education – University of Zagreb).

ABSTRACT

In this talk we will present results in aerial robotics research conducted in the Laboratory for Robotics and Intelligent Control Systems. After brief introduction of the topic we will describe a problem of controlling the force of interaction between an aerial vehicle equipped with dexterous manipulator and the environment.

We will demonstrate the experimental validation of canonical peg-in-hole manipulation task using an aerial robot by implementation of kinematic constraints which make sure the robot holds a bolt with both arms. We build our peg-in-hole approach using impedance control which is the foundation of compliant interaction with the environment. We utilize a finite state automaton to plan a multi stage strategy which relies on tactile perception in order to pin point the target. Finally, the whole body locomotion is considered, meaning both the degrees of freedom of multirotor base and the dual arm manipulator are considered.

In the second part of the talk we study a symbiotic aerial vehicle-ground vehicle robotic team where unmanned aerial vehicles (UAVs) are used for aerial manipulation tasks, while unmanned ground vehicles (UGVs) aid and assist them. UGV can provide a UAV with a safe landing area and transport it across large distances, while UAV can provide an additional degree of freedom for the UGV, enabling it to negotiate obstacles. We propose an overall system control framework that includes high-accuracy motion planning for each individual robot and ad-hoc decentralized mission planning for complex missions.

Experimental results obtained in a mockup arena for parcel transportation scenario show that the system is able to plan and execute missions in various environments and that the obtained plans result in lower energy consumption.

Spilios Theodoulis

Research Institute of Saint-Louis, France

Flight Control Systems of Reduced Implementation Complexity: From Big Data to Feedback Control

ABSTRACT

This presentation details an original design framework for the computation of gain-scheduled controllers. The heart of this framework is a novel merging of two disciplines: System & Control Theory (especially the -gap and pointwise gap metric) with Cluster Analysis (a common technique in statistical big data analysis, machine learning, data mining, etc.). The proposed design framework is divided into two distinct phases: Sectoring and Adjustment.

During the first Sectoring phase, the nonlinear system's operating domain is divided into sectors whose affiliated operating points tend to be more similar to each other than to operating points of other (even adjacent) sectors. The result of this sectoring procedure is also used to select the controller design points themselves from the cluster centers (also calculated for each sector during the cluster analysis). The advantage of this approach is that computationally expensive and inaccurate scanning of the operating domain is substituted by a global, operating domain-wide optimization, based on a pre-defined and user-selectable optimization design threshold level. Once an optimal distribution of controller design points has been obtained, any linear controller design technique can be used to locally satisfy the performance and robustness requirements imposed. During the second Adjustment phase, the aforementioned linear controllers can be retuned or additional design points are added (depending on the interpolated nonlinear controller's deficiency level) in order to gradually improve the final implemented controller. Following this two-step procedure, the designer may tailor the overall design to the level of design maturity desired

BIO

Graduated from the Electrical & Computer Engineering Department (2004) at the University of Patras (UPAT), Greece and received his MSc (2005) and PhD (2008) degrees from SUPAERO and SUPELEC, France respectively, both of them in the area of systems and controls.

He joined the GNC department of the Research Institute of Saint-Louis (ISL), France (2009) as a research scientist on the flight dynamics, guidance & control of aerospace systems and also serves as the GNC department deputy head.

He is the vice-chair of the International Federation of Automatic Control (IFAC) Aerospace technical committee as well as a member of the IFAC robust control (2017) and the American Institute of Aeronautics and Astronautic technical committees. He has served in the Organizing and International Program Committee of various conferences (ACA2019, ROCOND2018, EUROGNC2019) and AIAA SciTech Forum. He received MBDA 1 Star Innovation Award (2019). He has supervised or co-supervised more than 30 post-doctoral, graduate and undergraduate students. He holds holds 2 patents, contributed for various books, technical reports, and more than 40 journal (IEEE Transactions on Aerospace & Electronic Systems, AIAA Journal of Guidance, Control & Dynamics, etc.) and international conference (CDC, IFAC, ECC, MED) papers.

He teaches flight dynamics and controls at academia (Cranfield University, University of Strasbourg, University of Paris-Saclay). Research interests span robust and adaptive flight control and optimal guidance law design applied to various aerospace systems, nonlinear and LPV modeling, anti-windup algorithms, uncertain system analysis, system simulation and evaluation as well as software and hardware in the loop simulation. His most daunting challenge to date though remains the (robust) stabilization of his daughter Iris throughout her infinite-dimensional flight envelope.

Zoran Vukic

University of Zagreb, Croatia

Underwater Systems and Technologies in Croatia – An overview

BIO

Zoran Vuki is a Full Professor at the University of Zagreb Faculty of Electrical Engineering and Computing, Dept. of Control & Computer Engineering with more than 40 years of experience in education & research. At present he is Head of the Laboratory for Underwater Systems & Technologies (LABUST) and Director of the NGO "Center for underwater systems & technologies"(CUST)

He specialized at Royal Institute of Technology (KTH) in Stockholm, Sweden and at Vanderbilt University in Nashville, USA.

He published four books, three book chapters and more than 200 papers (in journals and at conferences) as author or co-author.

His research interest is in the application of control theory for marine vessels (surface and underwater), especially the area of cooperative navigation guidance and control, robust and adaptive control, nonlinear control, intelligent control, fault tolerant and reconfigurable control.

He has led a number of research projects (national and international). He teach courses on Automatic control, Nonlinear control, Adaptive & Robust Control, Guidance & Control of Marine Vehicles. He has received "J.J. Strossmayer" award, IMarEST SMI Donald Maxwell Award, Golden plaque 'Josip Lon ar' for various achievements in research and education.

He is a member of editorial boards of Croatian journal "Brodogradnja" (Shipbuilding) published by University of Zagreb, and "Underwater Technology" published by Society for Underwater Technology (SUT). He is a member of various professional societies such as: IEEE, IFAC TC on Marine Systems, Croatian Registry of Shipping, Mediterranean Control Association etc. Zoran Vuki is General chair of the field-training"Breaking the surface".

ABSTRACT

The Croatian role in development of marine technology will be briefly presented as well as the role of the Laboratory for underwater systems and technologies (LABUST).

The missions in which the Laboratory was involved will be listed covering marine biology, unexploded ordnance (UXO), underwater archaeology and others. The most relevant international projects in which Laboratory was involved will be given and few will be described. Some topics of research will be presented.

The lecture closes with the perspectives of developments in this domain and with influences that these technical systems will have on future exploration and exploitation of underwater areas.

Giuseppe Loianno

New York University, Tandon

Autonomous Agile Human Friendly Drones

ABSTRACT

Drones are starting to play a major role in several tasks such as search and rescue, interaction with the environment, inspection, patrolling and monitoring.

Agile navigation of Micro Aerial Vehicles (MAVs) through unknown environments poses a number of challenges in terms of perception, state estimation, planning, and control. To achieve this, MAVs have to localize themselves and coordinate between each other in unstructured environments.

In this talk, I will present some recent research results on high speed and agile flight maneuvers for navigation, transportation, physical environment interaction, and human drone collaboration using a minimal on-board sensor suite composed by a single camera system and IMU.

Finally, I will also present some recent achievements that can improve the autonomy of micro and nano platforms recovering the robot's state just using inertial data and optionally the information from vision sensors.

BIO

Prof. Giuseppe Loianno is an assistant professor at the New York University and director of the Agile Robotics and wwPerception Lab, working on autonomous Micro Aerial Vehicles. Prior to NYU he was a lecturer, research scientist, and team leader at the General Robotics, Automation, Sensing and Perception (GRASP) Laboratory at the University of Pennsylvania. He received his BSc and MSc degrees in automation engineering, both with honors, from the University of Naples "Federico II" in December 2007 and February 2010, respectively. He received his PhD in computer and control engineering focusing in robotics in May 2014 in the PRISMA Lab group.

Dr. Loianno has published more than 50 conference papers, journal papers, and book chapters. His research interests include visual odometry, sensor fusion, and visual servoing for micro aerial vehicles. He is worldwide recognized for his expertise in autonomy for agile small scale aircrafts. He received the Conference Editorial Board Best Reviewer Award at ICRA 2016, National Italian American Foundation (NIAF) Young Investigator Award 2018.

He is the program chair for IEEE SSRR 2019, he has organized multiple workshops on Micro Aerial Vehicles during IROS conferences and created the new International Symposium on Aerial Robotics (ISAR). His work has been featured in a large number of renowned international news and magazines.

Antonios Tsourdos

Cranfield University

Swarm Technologies for Aerial Robots

BIO

Professor Antonios Tsourdos is the Director of Research School of Aerospace Transport and Manufacturing. Antonios completed his PhD on Nonlinear Robust Autopilot Design and Analysis with Cranfield in 1999 before joining the same year as a lecturer. He was appointed Head of the Autonomous Systems Group in 2007 became Professor of Autonomous Systems and Control in 2009 and is now head of the Centre for Autonomous and Cyber-Physical Systems. Antonios became the Director of Research for the School of Aerospace Transport and Manufacturing in September 2015. He has a diverse expertise in both unmanned and autonomous vehicles as well as cyber-physical systems. Antonios is an editorial board member of the Proceedings of the Institution of Mechanical Engineers (IMechE) Part G Journal of Aerospace Engineering, the International Journal of Systems Science, the IEEE Transactions on Aerospace and Electronic Systems and Aerospace Science and Technology.He is chair of the International Federation of Automatic Control (IFAC) Technical Committee on Aerospace Control. Antonios is also a member of the AIAA Technical Committee on Guidance Control and Navigation, the AIAA Unmanned Systems Program Committee, the IEEE Control System Society Technical Committee on Aerospace Control (TCAC) and IET Robotics and Mechatronics Executive Team.

ABSTRACT

We have developed key techniques to enable swarm UAVs to self-decide optimal task allocation and resource management to use co-operative guidance as well as creating a robust sensor network enabling the UAVs to operate independently. These techniques has been integrated within the platforms and tested and validated using empirical simulation studies and small scale experiments. Our main tasks was the developments of mobile tasking and information fusion (behaviour monitoring) and demonstrating the swarm technologies developed.

Jorge Dias

Khalifa University, UAE

Robotic based Semantic Mapping from Video and Multi-spectral Cameras

ABSTRACT

Jorge Dias is Professor of ECE/Robotics at Khalifa University, Abu Dhabi. Professor Jorge Dias has a Habilitation degree and a Ph.D. degree on Electrical Engineering by the University of Coimbra, Portugal (specialization in Control and Instrumentation).

Jorge Dias research in the area of Computer Vision and Robotics and has contributions on the field since 1984. He has several publications in international journals, books, and conferences. Jorge Dias was been principal investigator from several international research projects.

Jorge Dias published several articles in the area of Computer Vision and Robotics that include more then 80 publications in international journals, 1 published book, 15 books chapters, and more then 280 articles in international conferences with referee.

The research activities of Jorge Dias have been concentrated in the Artificial Perception applied to Robotics involving international cooperation projects such as CyberMove - Cybernetic Transportation Systems for the Cities of Tomorrow (EC-RTD Project, EVK4 – 2001), VISOR - Visual Perception System for a Social Robot (EURON-European Robotics Research Network) , IRPS - Intelligent Robotic Porter System (EU-IRPS FP6-IST-45048) , BACS - Bayesian Approach to Cognitive Systems (FP6-IST-027140), PROMETHEUS - Prediction and interpretation of human behaviour based on probabilistic structures and heterogeneous sensors (FP7 - 214901) and HANDLE - Developmental pathway towards autonomy and dexterity in robot in-hand manipulation (FP7-2008– 231640), Social Robot (FP7 Marie Curie - 285870),CHOPIN - Cooperation between Human and rObotic teams in catastrophic Incidents, TICE Mobility, DIVA – Instrumented Airship for Aerial Surveillance.
Since July 2011, Jorge Dias is on leave of absence from University of Coimbra to do research activities on robotics at Khalifa University (Abu Dhabi, UAE).

BIO

This talk will present a methodology to conduct surveillance of urban environments using multiple low-cost UAVs equipped with a diversity of imaging sensors (standard cameras, IR cameras, etc.). The objective is to create accurate environmental maps through integration of imaging acquired by multiple unmanned vehicles for accurate evaluation of changes in the environment. Two types of data interpretation paradigms will be considered in this project: semantic imaging and semantic reconstruction. The project will build short-term and long-term predictions of changes in the environment.

Jee-Hwan Ryu

KOREATECH, South Korea

Twisted String Actuator and its Application to Wearable Soft Exosuit

BIO

Jee-Hwan Ryu received the B.S. degree in mechanical engineering from Inha University, South Korea, in 1995, and the M.S. and Ph.D. degrees in mechanical engineering from KAIST, South Korea, in 1995 and 2002, respectively. From 2002 to 2003, he worked as a post-doc researcher in the department of electrical engineering at the University of Washington, and at the similar time, he was also affiliated with the institute of robotics and mechatronics in DLR as a visiting scientist.

Prior to joining KOREATECH, from 2003 to 2005, he was a research professor in the department of electrical engineering at KAIST. He is currently a full professor with the department of mechanical engineering, KOREATECH, South Korea.

His research interests include haptics, telerobotics, exoskeletons, and autonomous vehicles.

He has received several awards including IEEE Most Active Technical Committee Award as a Co-chair of TC Haptics in 2015, Best poster award in 2010 IEEE Haptic Symposium. He has been served as an Associate Editor in IEEE Transactions on Haptics, and since 2017, he has been serving as an Associate Editor-in-chief in World Haptics Conference.

He was involved in many international conference organization, and especially, he was working as a general chair of AsiaHaptics2018.

ABSTRACT

Even with the recent enormous advancement of software and hardware technology in robotics, it is quite frustrating that most of the exoskeletons are still quite heavy and too rigid to be wearable.

One of the major bottleneck is the limited power-to-weight ratio and the rack of softness of actuators. In particular, rigid and heavy mechanical transmission system has been dragging down the advancement of the wearable exoskeleton technology.

In this presentation, I'm going to introduce some of the recent development of Twisted String Actuator (TSA) as an effort to increase the power-to-weight ratio and softness of the actuator. Typically, I want to focus on basic mathematical model, several extended modules and implementations of this. I will also touch several mechanisms to overcome the limitation of the TSA such as nonlinearity and low contraction speed. In additional to the basics of TSA, as an example of the implementation, I will be showing a soft upper limb exosuit together with several different version of soft hand exoskeleton systems.

Anthony Tzes

New York University Abu Dhabi, UAE

Cooperative UAVs for Area Coverage using Panoramic Cameras for UAV Relative Pose Estimation

ABSTRACT

The development of collaborative control schemes for UAVs for planar area coverage purposes is the subject of this speech. Each UAV is assumed to be a point (dimensionless) agent equipped with a PTZ-camera with circular FOV-visual sensing patterns. Using panoramic vision the UAV infers its relative pose from its neighbors which carry fiducial markers. Subsequently, if there is uncertainty in inferring the locations of these UAVs, the Additively Weighted Guaranteed Voronoi scheme is employed resulting in a rather conservative performance in computing the area of responsibility of each UAV. The noted controllers are applied to a swarm of UAVs, where the notion of visual coverage using PTZ-cameras is illustrated. The talk concludes with experimental studies for highlighting the efficiency of the relative pose estimation and the suggested control laws

BIO

Anthony Tzes is a Global Network Professor of the Electrical & Computer Engineering (ECE) Department of New York University (NYU) and Head of the ECE-program of the Engineering Division of NYU Abu Dhabi. Prior to this, he was a member of the Council (Board of Trustees) of University of Patras (UPAT) in Greece and Professor and Head of the ECE department at UPAT. He was the director of UPAT's graduate program in Biomedical Engineering (2015-7). He is a graduate of UPAT (1985) and received his Ph.D. from the Ohio State University in 1990. From 1990 till 1999 he was with the Tandon School of Engineering of NYU.
He has been the Chairman of IEEE's Control Systems Society Greek Chapter, a member of the national (Greek) committee of the European Control Association (EUCA), and member at several committees of the International Federation of Automatic Control (IFAC). He has served in various positions (Program Chairman (MIM'00), Organizing Committee Chairman (ECC'07), General Chairman (MED2011), Program Chairman (MED2015)), and as IPC-member at several international conferences.
His research interests include Cooperative Control of Networked UAVs, Surgical Robots, Cyberphysical systems, and Mechatronics.
Prof. Tzes has received research funding from various organizations including NASA, the National (U.S.) Science Foundation, the European Union (Horizon2020), and the European Space Agency (ESA).

Yi Fang

New York University Abu Dhabi, UAE

Deep Learning in 3D Computer Vision Towards Robust 3D Object Recognition and Detection

BIO

Yi Fang received his PhD from Purdue University with a research focus on computer graphics and vision. Upon one-year industry experience as a research intern in Siemens in Princeton, New Jersey and a senior research scientist in Riverain Technologies in Dayton,
Ohio, and a half-year academic experience as a senior staff scientist at Department of Electrical Engineering and Computer science, Vanderbilt University, Nashville, he joined NYU Abu Dhabi as an Assistant Professor of Electrical and Computer Engineering. He is currently working on the development of state-of-the-art techniques in large-scale visual computing, deep visual learning, deep cross-domain and cross-modality model, and their applications in engineering, social science, medicine, and biology. He jointly founded NYU Multimedia and Visual Computing Lab with other faculty from New York and Abu Dhabi campus, which served as an intellectual hub for faculty, researchers, and students from both New York and Abu Dhabi campuses, who come together to study and address the key challenges in multimedia and visual data processing.

ABSTRACT

Recently researchers have been shifting their focus towards learned 3D shape feature from handcraft ones to better address challenging issues of the deformation and structural variation inherently present in 3D objects. 3D geometric data are often transformed to 3D Voxel grids with regular format in order to be better fed to a deep neural net architecture. However, the computational intractability of direct application of 3D convolutional nets to 3D volumetric data severely limits the efficiency (i.e. slow processing) and effectiveness (i.e. unsatisfied accuracy) in processing 3D geometric data. In our recent work, powered with a novel design of adversarial networks (3D-A-Nets), we have developed a novel 3D deep dense shape descriptor (3D-DDSD) to address the challenging issues of efficient and effective 3D volumetric data processing. We developed new definition of 2D multilayer dense representation (MDR) of 3D volumetric data to extract concise but geometrically informative shape description and a novel design of adversarial networks that jointly train a set of convolution neural network (CNN), recurrent neural network (RNN) and an adversarial discriminator. More specifically, the generator network produces 3D shape features that encourages the clustering of samples from the same category with correct class label, whereas the discriminator network discourages the clustering by assigning them misleading adversarial class labels. By addressing the challenges posed by the computational inefficiency of direct application of CNN to 3D volumetric data, 3D-A-Nets can learn high-quality 3D- DSDD which demonstrates superior performance on 3D shape classification and retrieval over other state-of-the-art techniques by a great margin.

Mohamad Eid

New York University Abu Dhabi, UAE

Haptic Guidance for Handwriting Skills

ABSTRACT

It has been shown in previous studies that haptic guidance improves the learning outcomes of handwriting motor skills. Various haptic guidance methods are developed and evaluated in the literature. In this talk, we present experimental studies to examine the effectiveness of three haptic guidance methods, namely full guidance, partial guidance, and disturbance guidance for improving the learning outcomes of handwriting skills. Three groups of users are explored: adults learning handwriting skills for second or third language, typical children, and children with learning difficulties.

BIO

Mohamad Eid holds a PhD in Electrical and Computer Engineering from the University of Ottawa, Canada. He is an assistant professor of electrical and computer engineering at New York University - Abu Dhabi. He is the co-author of the book: “Haptics Technologies: Bringing Touch to Multimedia”, the technical chair of HAVE symposium for several years. He is the recipient of several best paper award such as ICBAE 2016, DS-RT 2008 and the prestigious ACM Multimedia 2009 Grand Challenge Most Entertaining Award. With more than 90 publications, his academic interests include affective haptics, haptic modeling and tactile stimulation interfaces, and Tele-haptics.

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