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IEEE/RSJ International Conference on Intelligent Robots and Systems
Abu Dhabi, 14-18 October 2024

Workshop (Tuesday, 15th October, 8h00-12h00, Room 6)

Safety of Intelligent and Autonomous Vehicles: Formal Methods vs. Machine Learning approaches for reliable navigation (SIAV-FM2L)

I. Abstract

Automated driving systems have become one of the most exciting and important innovations in transportation history. Indeed, **the challenge to have fully autonomous vehicles** (AV) **for passenger transportation** is about to become a reality. Nevertheless, the **diversity of driving conditions** and **situations** which could be encountered by the AV may **lead to unexpected events**, and induce thus hazards. The efficiency of AVs is then subject to the **capability of managing risks**, while preserving the **vehicles' integrity**, with respect to several aspects, such as: **vehicle dynamics variations**, **reliability of sensor/perception information**, and **variation of driving and environmental conditions**. The proposed workshop will permit us to discuss how to ensure a **Long-Term Autonomy** (LTA[1]) of intelligent/autonomous vehicles (**I/AV**) while maintaining a **high level of safety** during the navigation process. Moreover, the workshop is expected to initiate interesting discussions about a possible **generic design methodology closing the link between systemic formal approaches and Artificial Intelligence** (AI) developments in order to **efficiently and safely address I/AV navigation** in complex environments/situations.

The workshop aims the presentation of **cutting-edge research topics**, new **original theoretical achievements**, **practical results**, and **high-fidelity simulation protocols**, with a focus on **guaranteed safety** and **flexibility of maneuvering** with **I/AV** in various transportation domains, and using different research methodologies: the formal and machine learning ones. Submissions illustrating combinations of these two general methodologies leading to synergetic results, to obtain robust and flexible navigation of I/AV in complex environments / scenarios, are in a special interest of the workshop.

II. Content of the workshop

This proposal describes a new series of workshops, which aims to address the important topic of intelligent/autonomous vehicles' (I/AV) **safety insurance in any navigation context / environment** (e.g., uncertain perception / localization; complex urban situations like roundabout or intersection crossing for instance; highway and connected cooperative vehicles, etc.). It is clear that in any practical scenario safety guarantee is among the main key properties required to have a large deployment of I/AVs in the near future, and to use them as a common and reliable transportation system.

The development of I/AV has made tremendous advances in the last decade. Several companies have announced the deployment of highly automated vehicles into a public road in the near future. However, safety guarantee, which is one of the key challenges to be addressed, limit drastically these ambitions to strictly limited use cases and operational domains. In order to ensure safe and flexible operation of automated vehicles in more extensive scenarios, comprehensive multimodal design approaches towards

[1]It is important to note that LTA means in the proposed project, that the **vehicle can deal with a large variety of driving situations** (e.g., navigation in dense urban traffic, round-about/intersection or unstructured area) and **environment conditions** (e.g., wet ground, fog conditions), without obliging the vehicle to stop or to delegate the driving to the person inside.

safety are required. We strongly believe that one of the promising ways to reach the mentioned objective can be obtained by a smart combination of formal methods and data-driven approaches when applied in a coherent, complementary, and synergistic manner. This important subject is of interest to both academia as well as industry, and it is expected during this workshop to share the different points of view by having presentations from both sides.

Therefore, the focus and the ambition of this workshop is to gather the communities, that use either formal (model-driven) methods or machine learning (data-driven) approaches to deal with this important subject, while emphasizing the strengths and weaknesses of each methodology. The possibility of creation of a tight and systemic link between formal and AI based approaches is among the main motivations of the proposed SIAV-FM2L workshop, which will allow the attendees to share different views on the same problem and initiating honest conversations about the safety of automated vehicles from both the academic and industrial points of view.

Even if the two considered methodologies (i.e., the formal and machine learning ones) could be applied to all the elementary components composing an overall I/AV control architecture (perception / localization / planning and control), the proposed workshop intended to focus on the integrated approaches, starting from the used perception modeling/features (even simple) and finishing on the control phase in order to show the impact of all the whole chain of decision-action process (and its interactions) to evaluate safety of the I/AV motion.

List of Topics:

The workshop will encourage contributions coming from applications of formal methods or machine learning approaches reporting on original research, work under development, experimental results and high-fidelity simulation protocols, related, but not limited, to one of the following topics for I/AV:

- Safety modeling, analysis, validation and testing
- Motion planning for safe maneuvering
- Control architecture design and standardization for flexible navigation and guidance
- Risk assessment and management under uncertainty
- Long-term autonomy
- Safety and flexibility in connected and cooperative I/AV
- Simulation benchmarking for characterizing safety
- Model-driven and data-driven methods increasing safety, reliability, and flexibility
- Safety in advanced driver assistance systems (ADAS)
- Perception, localization, and map-building methods for safe applications
- Applications of I/AV in the public, freight and agriculture transportation domains
- …

Keywords: Intelligent/autonomous vehicles; Safe maneuvering; Safety guarantees; Control architecture, Motion planning; Risk assessment and management; Long-term autonomy; Safe connected and cooperative vehicles; Model-based approaches; Data-driven approaches; Safety in ADAS.

III. Format of the papers / contributions (authors and keynote speakers)

Papers should be prepared according to the IROS'24 final camera-ready format and should be 4 to 6 pages long. The detailed information on the paper format is available through : https://iros2024-abudhabi.org/cf-contribution

For possible keynote speakers' proposals, a short biography, a title and an abstract are requested before September 1st.

Papers and keynote speakers' proposals must be sent to Lounis ADOUANE by email at: lounis.adouane@hds.utc.fr

Important dates

- Deadline for paper submission and keynote speakers' proposals: August 30th, 2024
- Notification of paper acceptance (with review comments): September 14th, 2024
- Final paper submission: October 1st, 2024

- Workshop date: October 15th (8h00-12h00)

NB : The speakers or panelists must register for the “workshop and tutorial” sessions while following the instructions on the main IROS 2024 website (https://iros2024-abudhabi.org/registration).

Talk information and registration

- Keynote talk: 30 min (24 min presentation, 6 min questions)
- Short talk: 20 min (16 min presentation, 4 min questions)

Proceedings and Special issue

The workshop proceedings will be published as a pdf file within the SIAV-FM2L workshop website.

Selected papers will be considered for extended version for a special issue in International journals such as Journal of Intelligent & Robotic Systems (JINT, IF : 3.1), Transactions on Intelligent Vehicles (T-IV, IF : 14), or Frontiers in Robotics and AI (IF : 2.9, Q2). We will issue an open call, submissions will go through a separate peer review process.

IEEE-RAS TC on ITS

This workshop is organized in the framework of the IEEE Robotics and Automation’s Technical Committee on: Autonomous Ground Vehicles and Intelligent Transportation Systems.

IV. Workshop Program

08:00 -08:10	Welcome & Introduction
08:10 -08:40	**Amr Alanwa**, Assistant Professor, Technical University of Munich (TUM), School of Computation, Information and Technology, Germany **Title:** *Data-Driven Safety Verification Using Reachability Analysis* **Abstract:** Reachability analysis computes the set of reachable states of a system with uncertain initial states, inputs, and parameters. One major application of reachability analysis is the formal verification of cyber-physical systems. However, obtaining an accurate model for such systems to perform a model-based reachable analysis is a challenging task. This talk will present a new algorithm for developing data-driven reachability analysis from input/output data with formal guarantees. The proposed algorithms support incorporating side information in terms of signal temporal logic to decrease the conservatism of the reachable sets. Then, through an application on autonomous driving, the effectiveness of the algorithms will be presented. **Biography:** Amr Alanwar has been an assistant professor at the Technical University of Munich since September 2023. He was an assistant professor at Constructor University at Bremen before that. Also, he was a postdoctoral researcher at the KTH Royal Institute of Technology. He got his Ph.D. with the Cyber-Physical Systems Group at the Technical University of Munich (TUM) in 2020. Before that, he was a research assistant at the University of California, Los Angeles (UCLA). Amr won the Best Demonstration Paper Award at the 16th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN/CPS week) and was a finalist in the Qualcomm Innovation Fellowship for two years in a row. He received his B.Sc. and M.Sc. from Ain Shams University in Egypt. His current research interests include safety, privacy, and general topics in cyber-physical systems.
08:40 - 09:00	**Zhongqiang Ren**, Assistant Professor, UM-SJTU Joint Institute, Shanghai Jiao Tong University, China **Title:** *Multi-Objective Path Planning for Safe Navigation*

	Abstract: Safety is of fundamental importance in autonomous systems. However, ensuring safety usually comes at the cost of losing other properties such as efficiency. As a result, one have to intelligently balance between safety and other properties, which often leads to multi-objective planning problems. These problems are often computationally expensive as they seek a set of Pareto-optimal solutions as opposed to a single optimal solution. This talk focuses on multi-objective path planning for single and multiple agents, and discusses some recent approaches in addressing this computational challenge with theoretic guarantees on solution optimality and runtime complexity. These advances provide new possibilities to ensure safety during planning in autonomous systems.  **Biography:** Dr. Zhongqiang (Richard) Ren is currently an assistant professor at UM-SJTU Joint Institute at Shanghai Jiao Tong University. Prior to that, he received his bachelor degree from Tongji University in China. He obtained his master and PhD from Carnegie Mellon University in USA, where he also served as a Post-doc. His research focuses on motion planning, multi-robot planning, and autonomous systems. His research has led to more than 20 publications in top journals and conferences in Robotics such as T-RO, RSS, and ICRA.
09:00 - 09:30	**Lounis Adouane**, Full Professor (part of the organizing committee, workshop chairman), Université de Technologie de Compiègne, CNRS, Heudiasyc, Compiègne, France **Title:** *Safe and Resilient Control Architecture for Autonomous Navigation in Complex Environments* **Abstract:** With the complexity of the situations encountered by autonomous vehicles (AV) in their dynamic environments (e.g., dense round-about, overtaking in highways under uncertainty, urban areas with PELVs (Personal light electric vehicles)), it becomes more and more complex to ensure an absolute level of safety and efficiency of the AV navigation. It is targeted in this talk to show step by step the structuration of a multi-controller architecture (planning / decision-making under uncertainty and control) allowing to even more mastering, with analytic metrics and formulation, the performance of the autonomous navigation.  **Biography:** cf. section V.
9:30 - 10:00	**Argyrios Zolotas**, Full Professor (part of the organizing committee, co-chair), Centre for Autonomous and Cyber-Physical Systems, Cranfield University, Shrivenham, United Kingdom **Title:** *On control engineering, reliability and smart infrastructure enabling safer autonomous vehicle operation* **Abstract:** That the research and development of autonomous vehicle has entered the era of commercialization, is not in doubt. Vehicle self-driving technology grows rapidly, the same trend seen (even more emphasized) in aerial and maritime autonomous vehicle technology. However, testing and validation for reliable and safe autonomous vehicle solutions is still maturing and it is not only the mobile units under question but also the relevant infrastructure. In addition, control engineering still enables technology within the autonomous vehicle development ecosystem, albeit existing at the lower (or more hidden) layers of the overall architecture. The talk will present research supporting the roadmap to enabling safer autonomous vehicle operation.  **Biography:** cf. section V.

10:00 -10:30	Coffee Break (30mn)
10:30 -11:00	**Umar Zakir Abdul Hamid**, PhD (Head of Global Product, International Business and Market Entry Strategy, PROTON - Part of GEELY Group), Malaysia **Title:** *Bridging R&D and Market Needs: Identifying Key Commercializable Gaps for Safer Autonomous and Software-Defined Electric Vehicles* **Abstract:** Autonomous vehicle technology is increasingly adopted in next-gen vehicles, including entry-level models with ADAS Level 2, yet significant improvements remain necessary. This presentation will explore how the R&D community can identify and prioritize key issues to accelerate mass adoption by addressing the most critical user pain points in current technologies, ultimately leading to better solutions and faster time to market. The discussion will focus on: i) understanding customer pain points and their journey with emerging technologies through customer-centric technology R&D; ii) overcoming challenges in identifying gaps, such as breaking down cross-functional silos; and iii) investigating opportunities like integrating Formal Methods with Machine Learning to improve safety in next-gen software-defined battery electric vehicles. This strategic approach aims to bridge the divide between product marketing and technological R&D, providing valuable insights into enhancing safety and reliability in autonomous navigation systems for widespread adoption. **Biography:** Umar Zakir Abdul Hamid, PhD, is a globally recognized expert in future mobility and connected and autonomous vehicles, with a diverse international career spanning Malaysia, Singapore, Japan, Finland, and Sweden. His extensive experience covers autonomous driving software, electric vehicles, shared mobility, and connected vehicles, having held key roles at organizations such as Moovita, Sensible 4, Zeekr, and Proton (part of Geely Holding Group). Notably, he contributed significantly to Sensible 4's growth in Finland and led the European Union Market Digital-Driven and Software-Defined Product Strategy for Electric Vehicles at Zeekr Groups. Currently, he heads International Product Export Management at Proton in Kuala Lumpur, Malaysia. Dr. Hamid's expertise spans both technical and business aspects of future mobility, with leadership and contributions to over 30 projects in driverless technology, robotics, and automotive advancements. His achievements include the 2020 Finnish Engineering Award for all-weather autonomous driving solutions and the 2023 SAE International Young Industry Leadership Award. Active in academia, he has authored over 30 technical publications, serves as Secretary for SAE International's Cooperative Driving Automation Committee, and was the Institute of Electrical and Electronic Engineers Secretary in Sweden from 2021 to 2022. A sought-after speaker at industrial and technical events, Dr. Hamid brings invaluable insights to discussions on future mobility and is currently completing his Executive MBA at the Gothenburg School of Business, Sweden.
11:00 -11:20	**Jiyeon Bae**, Researcher, Mobility Platform Research Center, Korea Electronics Technology Institute (KETI), Bundanggu, Seongnam-si, Gyeonggi-do, Republic of Korea **Title:** *Navigating Continuous Space: ODD Exit Monitoring in Urban Environments* Jiyeon Bae, Kyungwon Min, Haengseon Son, Youngbo Shim **Abstract:** Since urban environments incorporates complex traffic rules, restricted zone, and legal regulations beyond spatial interpretation, world modeling in Automated Driving Systems(ADS) need to integrate invisible traffic norms alongside scene-based modeling. So, we present a practical approach to evaluates both system failures

	related to Dynamic Driving Tasks(DDT) and ODD compliance. We propose a processfor ODD assessment, including initial and cyclic methods, and introduce an approach for issuing TakeOverRequest based on detected issues. Our safety module monitors system failures such as sensor connectivity, error tolerance, and visibility, as well as ODD exits related to scenery and environmental conditions. Experiments conducted in K-city in Hwaseong-si and Autonomous Driving Demonstration Zone in Pangyo district demonstrate the application of our approach in real-world environments. Our research contributes to the advancement of ADS operations in urban environments by proposing a formal approach for continuous ODD assessment, incorporating both visible scene elements and invisible traffic rules. We aim this framework bridge the gap between theoretical ODD definitions and practical ADS implementation. **Biography:** Jiyeon Bae received the B.S. degree in Mathematics from Kyungpook National University, South Korea in 2016. She has been involved in government-funded projects aimed at advancing automated driving system capabilities. Her research interests lie in the field of automated driving systems, with a particular focus on developing advanced algorithms for path planning and decision-making. She is engaged in enhancing the safety and reliability of these systems in complex urban environments. She is currently a Researcher with the Mobility Platform Research Center, Korea Electronics Technology Institute (KETI), South Korea.
11:20 - 12:00	Open-ended discussion & Closing Remarks

V. Short biography of the co-chairs

Lounis Adouane has been a Full Professor since September 2019 at Heudiasyc – UTC (Université de Technologie de Compiègne, France), and he was Associate Professor between 2006 and 2019 at the Institut Pascal (IP) - Polytech Clermont-Ferrand. In IP, he led between 2018 and 2019 the ISPR group (80 persons, Images, Perception Systems and Robotics). Dr. Adouane is an active member of the international community of mobile robotics/autonomous vehicles, he is a member of the Technical Committee of Intelligent Autonomous Vehicles – IFAC (as Industry Vice Chair) and he serves as a Senior Editor Board Member of the Journal of Intelligent and Robotic Systems. Dr. Adouane had the opportunity to visit several institutions/laboratories, such as 6 months in 2014 at Cranfield and Kingston Universities (United Kingdom) and 2 months in 2018 at KIT (Karlsruhe Institute of Technology, Germany). In 2015, he obtained from Blaise Pascal University an HDR (habilitation to steer research in Robotics). He has participated in more than 70 program committees of international conferences and workshops. Further, Dr. Adouane supervised (or currently supervising) 18 PhD Thesis (all linked to mobile robotics and/or intelligent vehicles). Dr. Adouane's current research focuses on **Intelligent Vehicles**, more specifically; he is working on two main topics: **1. Autonomous navigation of mobile robots/vehicles in complex environments** and **2. Cooperative control architectures for multi-robot/vehicle systems**. He is the author/coauthor of more than 150 refereed papers and 2 books on these topics. More specifically, his main research includes planning and control, hybrid (continuous/discrete) and hybrid (reactive/cognitive) multi-controller architectures, Lyapunov-based synthesis and stability, obstacle avoidance, cooperative multi-robot systems, navigation in formation, artificial intelligence for optimization and control (e.g., Markov decision process, Bayesian decision network and Multi-agent systems), energy management (optimal control and Neuro-Fuzzy approaches), ADAS (Advanced Driver Assistance Systems, ecoACC, ecoStop&Go) and multi-robot/agent simulation.

Philippe Martinet graduated from the CUST, Clermont-Ferrand, France, in 1985 and received the Ph.D. degree in electronics science from the Blaise Pascal University, Clermont-Ferrand, France, in 1987. From 1990 til 2000, he was assistant Professor with CUST in the Electrical Engineering Department, Clermont-Ferrand. From 2000 until 2011, he has been a Professor with Institut Français de Mécanique Avancée (IFMA), Clermont-

Ferrand. He was performing research at the Robotics and Vision Group of LASMEA-CNRS, Clermont-Ferrand. In 2006, he spent one year as a visiting professor in ISRC at the Sungkyunkwan university in Suwon, South Korea. He was the leader of the group **GRAVIR** (over 74 person) from 2001 til 2006. From 1997 until 2011, he led the **Robotic and Autonomous Complex System** team (over 20 persons). From 2008 until 2011, he co-lead a Joint Unit of Technology called "Robotization in meet Indutry", and the Korea France Joint Research Center on Cognitive Personal Transport Service Robot in Suwon (South Korea). In September 2011, he moves to **Ecole Centrale de Nantes** and make his research at **IRCCYN** in the robotics team. Until 2015, he stayed associated researcher to Pascal Institute in Clermont-Ferrand. Since 2017, IRCCyN becomes LS2N. He was deputy head of the ARMEN Team. Since November 2017, he moved to Inria Sophia Antipolis in the Lagadic Project for a 5 years period. From April 2018 til March 2020, he was the leader of the new team called CHORALE (Collaborative and HeterOgeneous Robots interActing in Live Environment). Since May 2021, he is member of the new INRIA/CNRS joint Team named ACENTAURI. He was coordinator of the EMJMD EMARO+ from 2014 until 2016. He was in charge of the robotics speciality in the ARIA master. From 2015 til 2019, he was deputy head of the French robotics research Network. His research interests include : **VISIR : VIsual ServoIng of Robot** *Visual Servoing (Position, Image and Hybrid Based, Omnidirectional), Multi-Sensor Based Control, Force-Vision Coupling, Robots (Manipulator, Mobile, Aerial),* **AGV : Autonoumous Guided Vehicle** *Control (Non Linear, Adaptive, Predictive, Robust), Enhanced Mobility (Sliding and Slipping), Uncertain Dynamics, Monitoring, Robots (Mobile, AGV, All Terrain vehicles, Agricultural Vehicles, Platoon, Multi-Robot System),* **MICMAC : Modeling, Identification and Control of complex MAChines** *Kinematic Identification, Dynamic Identification, High Dynamic Modeling, Dynamic Control, Vision based Control of Parallel Robot, Robots (Parallel Robot, High Speed Machine Tools)* , **RCA : Redundancy, Control and Autonomy** *Humanoid robot control, Multi Arms control, Redundancy and polymorphism, Robots (Humanoid robots, Service Robots, Polymorph Robots)*, **Others interests** *Active Vision and Sensor Integration, Visual Tracking, and Parallel Architecture for Visual Servoing Applications*. From 2012 til 2023, he was the corresponding chair of the RAS-TC on AGV & ITS. From 1990, he has driven four habilitations, 27 (+ 13 as co-supervisor) past Ph.d students, plus 3 (+ 4 as co-supervisor) in progress, 34 Master students and 6 Post-doc. For the same period, he is author and co-authors of more than three hundred sixty references **62 IJ**, **2 NJ**, **226IC**, **27 NC**, **52 IW**, **1 NW**, and **8 book Chapters**.

Johannes Betz studied automotive engineering at Coburg University of Applied Sciences (B. Eng., 2013) and at the University of Bayreuth (M. Sc., 2013) with a focus on electric drive systems and software development. From 2013 to 2018, Johannes was a research assistant at the Technical University of Munich where he received his Dr.-Ing. degree in 2019 on the topic of "Evaluation of an intelligent fleet dispatching for mixed vehicle fleets". From 2018-2020 he was a postdoc at the Department of Automotive Engineering at TUM where he founded the TUM Autonomous Motorsport Team, which successfully participated in the autonomous racing series Roborace and Indy Autonomous Challenge. From 2020 to 2022, he was a postdoctoral fellow at the University of Pennsylvania, USA, where he worked in the xLab for Safe Autonomous Systems. In 2023, he was appointed as Rudolf Mößbauer Professor at the Technical University of Munich where he holds the Autonomous Vehicle Systems Professorship as part of the Department of Mobility Systems.

Xuebo Zhang received the B.Eng. degree in Automation from Tianjin University in 2006, China, and the Ph. D. degree in Control Theory and Control Engineering from Nankai University in 2011, China. From July 2011, he joined the Institute of Robotics and Automatic Information Systems (IRAIS), Nankai University, China. In December 2018, he was promoted to Professor, and he is currently the vice dean of College of Artificial Intelligence, deputy head of IRAIS and also the deputy head of Tianjin Key Laboratory of Intelligent Robotics (TJKLIR), Nankai University, China. His research interests include autonomous robots, including robust localization and mapping, planning and control with focus on time-optimal planning and visual servo control, reinforcement learning and intelligent game. In these areas, he published more than 100 journal papers. He was awarded the Tianjin Science Fund for Distinguished Young Scholars. He has also won the First Prize for Tianjin Science and Technology Progress, the First and Second Prizes for Tianjin Natural Science Award and the First Prize for WU WEN JUN AI Natural Science

Award, the Second Prize for National Teaching Achievements, and the Baosteel Outstanding Teacher Award. He is a senior member of IEEE, and member of ASME. He serves as the Technical Editor of IEEE/ASME Transactions on Mechatronics, Associate Editor for ASME Journal of Dynamic Systems, Measurement and Control. He serves as the organization chair of IEEE-CYBER 2018, General Co-Chair of IEEE-CYBER 2017, and he will serve as the program chair of IEEE RCAR 2019.

Argyrios Zolotas is Professor of Autonomous Systems and Control in the Centre for Autonomous and Cyber-physical Systems, Faculty of Engineering and Applied Sciences at Cranfield University, UK. Previously he held academic positions at University of Lincoln, University of Sussex and Loughborough University, as well as a Post-Doctoral Fellowship post in the Dept. of Electrical and Electronic Eng. at Imperial College London.. received the B.Eng. degree (Hons.) from the University of Leeds, the M.Sc. degree from the University of Leicester, and the Ph.D. degree from Loughborough University, U.K. Prof Zolotas's expertise is in Autonomous Systems and Control, with a core background on Robust and Fault Tolerant Control. He has spent more than two decades researching and developing engineering applications for dynamically complex systems in the transportation and aerospace industries. Prof Zolotas is heading the Autonomous Systems & Control research group, and his research work involves autonomous systems and control, systems architecture, green persistent platforms (net zero). Prof Zolotas was one of the leading committee members on the EPSRC funded network: New-ACE- A Network for New Academics in Control. He was Associate Editor on the IEEE Trans Control Systems Technology (2012-2018), on the IET Proceedings Control Theory Applications (2013-¬2018) and on the IEEE Control Systems Society Letters (2017-2020). He is Associate Editor on the Engineering Science and Technology, an Int' Journal, Associate Editor on the journal of Sustainability and other journal venues. He also served on the Conference Editorial Board of the IEEE Control Systems Society (2008-2018), on the IEEE Control Systems Society UK and RI chapter Committee. He has served on numerous committees of international conferences, and has presented keynote lectures at various events. Prof Zolotas is Senior Member IEEE, a Fellow HEA, and a Fellow of the Institute of Measurement and Control (InstMC).

Antonios Tsourdos obtained an MEng on Electronic, Control and Systems Engineering from the University of Sheffield (1995), an MSc on Systems Engineering from Cardiff University (1996) and a PhD on Nonlinear Robust Flight Control Design and Analysis from Cranfield University (1999). He is a Professor of Autonomous Systems and Control with Cranfield University. He was appointed Head of the Autonomous Systems Group in 2007, Head of the Centre of Autonomous and Cyber-Physical Systems in 2012 and Director of Research - Aerospace, Transport and Manufacturing in 2015. Professor Tsourdos was member of the Team Stellar, the winning team for the UK MoD Grand Challenge (2008) and the IET Innovation Award (Category Team, 2009). Professor Tsourdos is chair of the IFAC Technical Committee on Aerospace Control, and member of the UK Autonomous Systems National Technical Committee. He is editorial board member for the IEEE Transactions on Aerospace and Electronic Systems, the Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering, the Aerospace Science and Technology, the International Journal of Systems Science and the Journal of Intelligent and Robotic Systems.