Artificial Intelligence (AI) for Satellite Systems

SatNEx V School 2023

Tuesday 24th Oct 2023 – Thursday 26th Oct 2023

Norcroft Centre, Tumbling Hill Street, University of Bradford, Bradford, West Yorkshire, United Kingdom, BD7 1DP

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Interest in the application of AI in various aspects of society has exploded within the last decade, and the field of satellite systems (and more generally space technologies) is no exception. AI enables optimal decisions and resource management to be achieved within a complex and dynamic space environment. AI facilitates the detection of historical patterns to predict what is likely to happen next (for example solar storms, intense rain events, traffic demand, etc). This is important because it enables the instigation of proactive rather than reactive measures to avoid disruption and ensure service reliability and quality as well as system resilience. In-orbit deployment of AI to extract essential information from the huge amount of raw data collected in space provides the option of transmitting only the most relevant data subset down to earth. This would greatly reduce the amount of signal power and radio spectrum required for data transmission from space to earth, thus enabling us to use space more sustainably and intelligently. These and other benefits and applications of AI in satellite systems (e.g., for ground segment operations and payload design) will be explored in detail along with discussions of related topics of federated learning, edge computing, and distributed satellite systems.

This SatNEx V School, organised by the Bradford-Renduchintala Centre for Space AI on Tuesday 24th to Thursday 26th October 2023, is focused on the applications of AI in satellite systems. The School brings together highly qualified speakers from industry, research, and academic institutions to discuss emerging applications, computing technologies, and dynamic design/processing techniques relevant to AI in various aspects of satellite systems operation. The content is designed to provide PhD students, early career researchers, and industry professionals with a firm grasp of the start-of-the-art and emerging trends in the subject.

Registered School participants were also given the option to attend the 40th ICSSC Colloquium on Direct Satellite to Cellular Mobile Services on Monday 23rd October at a highly reduced student rate. The School program also includes a visit to the facilities of Filtronic, a UK designer and manufacturer of high-performance RF, microwave and mmWave solutions for various markets, including space.

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AI for Satellite Systems: Programme

Day 1 (24 October 2023)

8:45 – 9:20	Registration & Welcome Coffee
9:20 – 9:45	School Opening: **Harris Beider, Pro Vice-Chancellor-Research/Innovation, University of Bradford** **Kersten England, CBE, Chair, Bradford City Company** Welcome by the SatNEx V Team: **Daniel Da Costa Dinis, European Space Agency** **Miguel Angel Vazquez, Centre Tecnològic de Telecomunicacions de Catalunya**
9:45 – 10:45	Future Concept of Distributed Satellite Systems **(Paul Febvre, CTO, Satellite Applications Catapult)**
10:45 – 11:00	Coffee break
11:00 – 12:00	Evolution of AI in Satellite Systems **(Tomas Navarro, Future Projects Engineer, ESA)**
12:00 – 13:00	AI Enhancement in Satellite Communications **(Hector Fenech, Formerly Eutelsat)**
13:00 – 14:00	Lunch Break
14:00 – 15:00	AI in Active Electronically Steerable Array (AESA) Antennas for MIMO Satellite Communications **(Marco Lisi, Italian Space Agency, Formerly ESA)**
15:00 – 16:00	Not Only Image Exploitation: Applications of AI in Satellite Ground Segment **(Mario Profili, Head of Ground Segment Systems – Domain Observation and Navigation, Thales Alenia Space)**
16:00 – 16:15	Coffee Break
16:15 – 17:15	AI Applications in Satellite Systems: Future Horizons **(Class Discussion)**
17:45 – 19:00	Dinner @ Richmond Eatery, Richmond Building, University of Bradford

Day 2 (25 October 2023)

09:00 – 10:00	Applications of AI in EO Data Analytics **(David Petit, Head of EO Applications, Deimos Space)**
10:00 – 11:00	Applications of AI in Space Mission and Space Weather Events **(Rami Qahwaji, University of Bradford)**
11:00 – 11:15	Coffee Break
11:15 – 12:15	Application of AI in Rain Fade Mitigation on Satellite Links **(K'ufre Ekerete, University of South Wales)**
12:15 – 13:15	High Bandwidth mmWave Feeder Links for LEO Constellations for Future 5/6G Telecommunications Networks **(Tudor Williams, Director of Technology, Filtronic)**
13:15 – 14:15	Lunch Break
14:15 – 15:15	How the Experimentation Mindset Fosters Innovation **(Yasrine Ibnyahya, Senior Director, Advanced Concepts Technologies, Viasat)**
15:15 – 17:15	Company Visit (Filtronics @Yeadon, Leeds LS19 7ZA, by coach)
17:30 – 19:00	Dinner @ MyLahore, 52 Great Horton Road, Bradford, BD7 1AL

Day 3 (26 October 2023)

09:00 – 10:00	Federated Learning in Satellite Systems **(Hassan Ugail, University of Bradford)**
10:00 – 11:00	AI and Edge Computing for 6G NTNs **(Tomaso de Cola, Project Manager, DLR)**
11:00 – 11:15	Coffee Break
11:15 – 12:15	Intelligent Spacecraft Payload Design **(Joseph Atkinson, Independent Consultant)**
12:15 – 13:15	Lunch Break
13:15 – 14:30	PocketQube Design Workshop **(Viktor Doychinov, Muhammad Ali, University of Bradford)**
14:30 – 14:40	Closing

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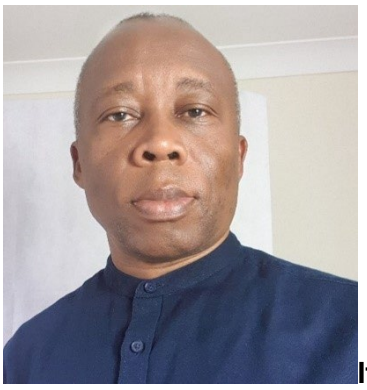
Organising Committee

Lead Organiser	Prof. Ifiok Otung, Bradford-Renduchintala Centre for Space AI, University of Bradford  **Ifiok Otung** is a Chartered Engineer, Professor of Space Engineering, and Director of the Bradford-Renduchintala Centre for Space AI, University of Bradford, UK. He was formerly Professor of Satellite Communications at the University of South Wales where he established PhD training and research as well as two professionally accredited and highly successful MSc degrees in the subject. Prior to that, he was a Research Fellow at the University of Surrey where his work was focused on satellite link measurements and channel modelling. He holds a PhD in Satellite Communications from the University of Surrey, UK.
Local Organisers	Dr Vuong Mai, Dr Viktor Doychinov, Dr Muhammad Ali, Prof. Hassan Ugail, Prof. Rami Qahwaji, Bradford-Renduchintala Centre for Space AI, University of Bradford, UK
Publicity Organiser	Xiaolei Wang, Bradford-Renduchintala Centre for Space AI, University of Bradford, UK
Administrator	Micah Jinar, Bradford-Renduchintala Centre for Space AI, University of Bradford, UK

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Abstracts & Speaker Bio

Future Concept of Distributed Satellite Systems	
Time	**Day 1: Tuesday 24 October 9:45 –10:45**
Abstract	Satellite networks are increasingly complex and capable, and this brings into focus the need for innovation in the design, delivery, and operation of systems. This talk outlined the architectures and capabilities of both earth observation and communications systems and the opportunities and challenges for exploitation of novel fragmented constellations and how these might be enabled by emerging AI capabilities. Finally, consideration of the implications of GPT on future connectivity demand will be explored together with the potential for future multi-functional satellite and terrestrial navigation networks.
Speaker	**Paul Febvre** is the Chief Technology Officer at the Satellite Applications Catapult. Paul is responsible for establishing a future vision for the sector and directing the technology strategy for the Catapult. He leads a small team of solutions architects and technologists that work across the Catapult to provide industry support in the creation and realisation of technologically innovative solutions to real world challenges. Paul was previously System Design Authority at Inmarsat for 19 years and a satellite telecommunications research engineer at BT Research Labs for 12 years. 

Evolution of AI in Satellite Systems	
Time	**Day 1: Tuesday 24 October 11:00 –12:00**
Abstract	In the upcoming years, there will be an increased emphasis on advancing Artificial Intelligence (AI) in satellite communications. This is driven not only by the need for enhanced communication and data transfer to support more efficient satellite networks, but also by the requirement to develop, manage, and sustain new satellite systems in a completely different way in order to cope with the demands of future seamless, ubiquitous and integrated satellite-terrestrial communications. Moreover, as AI technology progresses, future satellite communication systems are expected to evolve into more self-reliant, dependable, and efficient systems. This presentation will discuss specific trends in Artificial Intelligence that are to be explored in the upcoming years for enhancing or enabling new SatCom applications. More specifically the presentation will focus on bio-inspired Machine Learning algorithms, Deep learning-assisted Generative Design, advanced Reinforcement Learning algorithms and on-board Continual Learning. The presentation will finally give a broader view on the potential benefits of using these emerging AI technologies for a selected number of SatCom applications.

Speaker	 **Tomas Navarro** is a Future Projects engineer at ESA working on the exploration of new advanced mission concepts and systems for future Satellite Communications systems. He is also responsible for coordinating Artificial Intelligence activities for SatCom applications. Before joining ESA, Tomas worked in the space industry in satellite operations and as an R&D engineer for satellite and payload optimisation systems, focusing on genetic and machine learning algorithms used in operational geostationary communications satellites. Tomas is also the co-inventor of an Artificial Intelligence-powered Space architecture able to improve response times in systems based on a centralised topology.

AI Enhancement in Satellite Communications	
Time	**Day 1: Tuesday 24 October 12:00 – 13:00**
Abstract	Communication satellite have seen a considerable evolution since 1963 when Intelsat 1 aka Early Bird was launched. These satellites have shown enormous growth from one transponder to several tens of transponders. High throughput satellite (HTS) have pushed the envelope further by increasing the capacity by orders on magnitude. (Mega-)Constellations is pushing the capacity and coverage envelopes by delivering 10's of Tbps globally. Traditionally bigger systems required bigger satellites, but artificial intelligence (AI) offers better resource management that increase the efficiency of the available resources. This means that for a given satellite (and associated resources), AI could make the system capable of responding to bigger demands. It brings sellable capacity closer to system capacity, increasing the number of users. AI can also make the system more agile to changes since it could identify trends and therefore the system could adapt to the changes in a seamless fashion. This helps make communication satellites more economically viable and an even more compelling and accessible solution.
Speaker	 **Hector Fenech** is a Satcom Satellite Payload & Systems Expert with over 40 years in satellite communications. He served as the Director of Future Satellite Systems at Eutelsat between 1989 and 2020, overseeing mission definition for multiple satellites and contract negotiations. Hector has collaborated on various projects with ESA and the EU, focusing on system studies and future satellite systems. He holds a PhD in Information System Engineering from the University of Bradford. He is a fellow of IEEE, a fellow of IET, a fellow of AIAA and a Correspondent of the Air and Space Academy.

AI in Active Electronically Steerable Array (AESA) Antennas for MIMO Satellite Communications	
Time	**Day 1: Tuesday 24 October 14:00 – 15:00**
Abstract	The field of satellite communication is advancing at an unprecedented pace, with an ever-increasing demand for higher data rates, greater flexibility, and improved signal quality. Active Electronically Steerable Array (AESA) antennas have emerged as a critical technology to address these demands. AESA antennas offer the ability to dynamically steer beams, track multiple targets, and adapt to changing communication scenarios. However, their optimal performance relies on complex beamforming algorithms and real-time control, making them inherently challenging to operate efficiently in the harsh and dynamic space environment. This presentation explores the application of Artificial Intelligence (AI) techniques in improving the functionality and performance of AESA antennas for onboard satellite applications. AI-powered solutions can enhance the adaptability, resilience, and energy efficiency of these antennas, ultimately revolutionizing satellite communications. The integration of AI involves the development of intelligent algorithms for beamforming, interference mitigation, and resource allocation.
Speaker	 **Marco Lisi** is a member of the Italian Space Agency (ASI) Board of Directors. He formerly worked at ESA as Special Advisor in the Navigation Directorate and supported the Executive Director of the European GNSS Agency as Chief Technical Advisor. From 2012 to 2014, he was Special Advisor of the European Commission on European space policies. Marco has worked for more than 40 years in the aerospace, defence, and telecommunications sectors, holding managerial positions in R&D, engineering, and programmes, both in industry and in institutional organizations. Marco has 5 international patents and authored more than 300 technical papers. He holds a doctorate in engineering. He is a professor at UNPHU University, Santo Domingo (Dominican Republic) and Honorary Visiting Professor at University of Bradford (UK).

Not Only Image Exploitation: Applications of AI in Satellite Ground Segment	
Time	**Day 1: Tuesday 24 October 15:00 – 16:00**
Abstract	The utilization of artificial intelligence (AI) and deep learning techniques in the support of satellite ground segment operations has gained significant attention in recent years. This lecture aims to provide an extensive overview of the diverse application areas where AI and deep learning are employed in satellite ground segment operations, with a particular focus on earth observation. These applications encompass data analysis and integration, anomaly detection, signal processing, as well as satellite mission planning and multisensory constellation planning. Upon conducting an analysis of the prevailing ground segment operation scheme and identifying areas that would benefit most from AI support in terms of automation, workload optimization, and reduction of human errors, this lecture underscores the substantial potential of AI in optimizing the determination of optimal imaging parameters. Additionally, intelligent scheduling of satellite activities facilitated by AI can lead to enhanced resource utilization, reduced operational costs, and improved overall mission performance. Furthermore, this lecture sheds light on the role that AI can play in planning activities for a multisensory earth observation satellite constellation. Using diverse inputs as analysis of user and service requests, coverage requirements, satellite performances, external support data, or corresponding product analysis, AI algorithms can dynamically propose correlated requests at constellation level or automated fast re-planning schemes, thereby maximizing coverage, reducing latency, and adapting to changing user needs.
Speaker	**Mario Profili** is the Head of Ground Segment Systems - Domain Observation and Navigation Italy at THALES ALENIA SPACE, and a Visiting Professor at the University of Bradford. He has more than 20 years of experience in large scale space programmes, spanning from system engineering to Project Management of complex systems with a particular focus on end-to-end system architecture, operations and performance topics. He also has experience in integrated logistic support and maintenance for Space Program. 

Applications of AI in EO Data Analytics	
Time	**Day 2: Wednesday 25 October 09:00 – 10:00**
Abstract	Over the past decade, Artificial Intelligence has transformed Earth Observation Data Analytics practices from a manual task requiring expertise in Remote Sensing, Computer Vision and Geographical Information Systems to an automated task that users without knowledge about Earth Observation can perform using only natural language. This transformation was enabled and necessary because of the availability of large quantities of free satellite imagery (Sentinels, Landsat...) and commercial imagery with high resolution and frequency. The transformation occurred in two major phases. In 2015, Convolutional Neural Networks, which were widely used in Computer Vision, were applied to Earth Observation to replace the previous techniques for image classification, segmentation and interpretation. In 2022, Large Language Models were introduced, which altered the practices for image indexing and querying, creating connections between images, text, numbers and eliminating the need to manipulate satellite imagery to obtain information. However, despite the operational achievements, the sector still faces several challenges, lacking foundation models to help scale up local results and allow Earth Observation Analytics to reach its full potential.
Speaker	**David Petit** is the Head of EO applications at Deimos Space. He has more than 20 years of experience in applications and software development for Earth Observation, Image and Signal processing, involving innovative technologies such as AI (neural networks), GPU, UAV. David obtained a Ph.D. degree in Computer Science and Image Processing from Université Paul Sabatier Toulouse III. 

Applications of AI in Space Mission and Space Weather Events	
Time	**Day 2: Wednesday 25 October 10:00 – 11:00**
Abstract	Artificial Intelligence (AI) and Big Data technologies are leading innovations in a variety of space-related applications dealing with challenging satellite and space missions' data that could be complex, big, multi-dimensional, multi-wavelength, noisy, etc. This talk will briefly present our ongoing research and the development of intelligent systems for space weather prediction, remote sensing and Mars space exploration, and computer vision in collaboration with variety of industrial partners. The talk will also focus on the data generated by satellites and their processing aspects, extraction of meaningful information and knowledge representation, and the journey to develop useful AI applications for prediction, modelling, navigation, visualisation, etc.

Speaker	**Rami Qahwaji** is a Professor of Visual Computing at the University of Bradford. He has been working with different industries in the fields of satellite/space imaging, remote sensing, digital health and imaging, Biometrics, AI and data visualisation developing intelligent systems in collaboration with NASA, ESA, NHS and different SMEs. Rami attracted millions of pounds in research funding from various UK and European funding agencies. Rami is originally trained as an Electrical Engineer and had MSc in Control and Computer Engineering and PhD in AI and Visual Computing. 

Application of AI in Rain Fade Mitigation on Satellite Links	
Time	**Day 2: Wednesday 25 October 11:15 – 12:15**
Abstract	Rain fade is a significant challenge in satellite communication, causing signal attenuation and degradation in link quality. This lecture presents a comprehensive review of the application of Artificial Intelligence (AI) techniques in mitigating rain fade effects on satellite links. AI-based solutions have demonstrated remarkable potential in predicting, monitoring, and compensating for rain fade, ultimately improving the reliability and performance of satellite communication systems. This work explores the key AI approaches and technologies employed in this domain. It looks at an example application of machine learning in the forecasting of rain fade when a preset threshold is breached for a space diversity implementation. It discusses the advantages of these AI approaches, challenges, and future prospects.
Speaker	 **K'ufre Ekerete** is a researcher (Erdős #5), chartered engineer, satellite communications engineer, data scientist, and ICT professional. He holds academic degrees in Artificial Intelligence, Satellite Communications, Mobile Communications, Computer Science, Mathematics, and Statistics from several universities, including Oxford. His current interest in satellite communications research is focused on fade-mitigating techniques for rain fade by developing AI models for fade prediction and testing novel models for rainfall drop size distributions. He has published and reviewed several journal and conference papers in satellite communications, focusing on using machine learning techniques to develop new rainfall drop size distribution models for predicting rain attenuation.

High Bandwidth mmWave Feeder Links for LEO Constellations for Future 5/6G Telecommunications Networks	
Time	**Day 2: Wednesday 25 October 12:15– 13:15**
Abstract	The rapid proliferation of large constellations, spearheaded by industry giants like Space-X Starlink, Amazon Kuiper, and OneWeb, is set to lead to an unprecedented surge in Low Earth Orbit (LEO) satellites, with projections reaching 50,000 units within the next decade. With Space-X Starlink alone already deploying 4,500 satellites, the focus shifts to mainstream broadband connectivity and extending coverage to underserved areas, making it a cost-effective alternative to traditional fibre and fixed wireless networks. Moreover, these constellations are deemed crucial for supporting emerging applications, including autonomous vehicles, that rely on ubiquitous coverage. Presently, the deployed constellations are predominantly utilizing the Ka-band for both end user and feeder links. However, as data demands and the number of subscribers escalate exponentially in the future, there arises a need for higher bandwidth data-links back to ground stations. Consequently, a transition to higher frequency spectrum becomes imperative to prevent congestion and to facilitate improved data rates. This presentation aims to delve into the prospective downlink bands, particularly the Q band and E-Band, that hold promise for the future of satellite backhaul. The investigation entails baseline link budget calculations and explores likely scenarios for these higher frequency bands. Furthermore, the current state of technology is scrutinized to assess its feasibility for deployment in satellite backhaul operations.

Speaker	
	Tudor Williams is the director of technology at Filtronic, where he leads technical strategy and develops engineering roadmaps. Before joining Filtronic, Tudor was interim director of technology at the Compound Semiconductor Applications Catapult, where he built a team of skilled engineers and an advanced measurement and characterization facility from scratch. Tudor also worked as engineering manager at Mesuro, a startup company spun out of Cardiff University and sold to Focus Microwave, and as a MMIC design engineer at Selex Sensors and Airborne systems. He has a Ph.D. in RF Engineering from Cardiff University. 

How The Experimentation Mindset Fosters Innovation	
Time	**Day 2: Wednesday 25 October 14:15 – 15:15**
Abstract	Fostering innovation is a challenge all corporations face, including in the space sector. Through the development of the experimentation mindset, inspired from the lean startup methodologies, organisations can be propelled beyond traditional boundaries towards novel and effective solutions. Various strategies exist to overcome the obstacle of failure which will be covered during the session. The focus will be on the practical proven methodologies and the psychological aspects required to enable innovation.
Speaker	 **Yasrine Ibnyahya** is a Senior Director of Advanced Concepts and Technologies at Inmarsat. She leads breakthrough innovations, early-stage mission concepts, and start-up and entrepreneurship engagement initiatives. With previous experience at satellite manufacturer SSTL and the French National Space Centre subsidiary CLS, Yasrine brings expertise in project management, satellite design, and user terminal development. She holds an Executive MBA from the University of Cambridge, as well as two Masters of Science degrees in Communication Systems and Signal Processing from the University of Bristol and Telecommunications Engineering from École Nationale Supérieure des Télécommunications in France.

Federated Learning in Satellite Systems	
Time	**Day 3: Thursday 26 October 09:00 – 10:00**
Abstract	Satellite constellations amass vast amounts of data, presenting opportunities for novel machine learning (ML) applications. However, transmitting all satellite data for ground-based ML model training is increasingly impracticable. Federated learning (FL), a machine learning paradigm which facilitates model training across multiple nodes whilst retaining data locally, offers a potential solution for leveraging satellite data. Nevertheless, prevailing FL algorithms struggle to reconcile the inherent balance between intermittent connectivity and the freshness of local models. The focus of this session is to explain and discuss the current state of the art methods in FL in satellite systems, the challenges and the potential future of it.
Speaker	 **Hassan Ugail** obtained his BSc degree in Mathematics from King's College London in 1995, followed by a PGCE in 1996. He completed his PhD in geometric design at the University of Leeds in 2000 and continued as a post-doctoral researcher at the School of Mathematics there until 2002. Hassan then joined the School of Informatics, University of Bradford, where he is currently a full professor of Visual Computing and the Director of the Centre for Visual Computing at Bradford. His principal research interests include geometric design and visualisation, computer-based physical analysis, design optimisation and machine learning.

AI and Edge Computing for 6G NTNs	
Time	**Day 3: Thursday 26 October 10:00 – 11:00**
Abstract	The forthcoming convergence of 6G and non-terrestrial network is introducing technical challenges in what regards the overall performance optimization of the end-to-end system, which cannot be easily tackled with the existing and well-consolidated mathematical frameworks such as convex optimization (and related techniques), whereby resorting to AI/ML approaches is a necessity. In particular, the convergence of communication and computation domains in an holistic network framework introduces furthermore challenges from an optimization standpoint given the nature of satellite systems and the deployment of cloud and edge functionalities possibly in space, hence further making the use of AI-based techniques an important use case. In this light, this talk will survey the ongoing initiatives around integrated 5G/6G-NTN networks with special focus on the case of cloud/edge computing scenarios, by introducing some key optimization problems. Then, a special emphasis will be given to the current trends to address these optimization problems and the advantages possibly offered by AI/ML solutions in that respect. Some notes will also be drawn with respect to the complexity aspects that have to be duly taken into account in the process of deploying AI-native solution in space networks, notably in the case where AI functionalities are expected to be run directly onboard satellites.
Speaker	**Tomaso de Cola** received a master's degree and a PhD from University of Genoa (Italy) in 2001 and 2010 respectively. He worked from 2002 to 2007 with the Italian Consortium of Telecommunications, University of Genoa Research Unit, as scientist researcher. Since 2008, he has been with DLR, where he has been involved in several projects funded by EU and ESA programs, focusing on different aspects of DVB standards, CCSDS protocols, emergency communications, and testbed design. He is currently leading the integrated satellite systems group at the satellite networks departments, as part of the DLR institute of communications and navigation. 

Intelligent Spacecraft Payload Design	
Time	**Day 3: Thursday 26 October 11:15 – 12:15**
Abstract	The use of artificial intelligence as a tool for enhancing productivity has been gaining greater traction and acceptance by various industries worldwide. It is well established that artificial intelligence can help to optimize chosen parameters with given constraints. In the spacecraft industry, utilizing tailored artificial intelligence programs to reduce mass and power consumption in the design process can lead to reduced launch costs and increased utilization of a spacecraft's payload volume. While promising, this approach to spacecraft design has limitations. In this presentation, an overview of the general principles of spacecraft payload design and the current limitations of artificial intelligence as a spacecraft design tool are discussed.

Speaker		
	Joseph Atkinson is a Mechanisms Design Engineer at a private space company in the US. He has worked in academia and industry for over 15 years, teaching engineering students, designing spacecraft hardware, developing medical devices, and performing research.	

Pocketcube Design Workshop

Time	Day 3: Thursday 26 October 13:15 – 14:30
Abstract	PocketQubes are the next step in satellite miniaturisation, following the successful CubeSat platform specification. PocketQubes were first conceived in 2009, with the most current standard specification dating from 2018. Amongst the organisations who authored this standard is the Scottish Alba Orbital, who are also one of the largest services providers for PocketQubes. To this day, there have been tens of PocketQube launches on rideshare services, with close to a hundred successful orbital operations. Such satellites have been used as in-orbit technology demonstrators, to provide Internet-of-Things connectivity services, as Earth Observation platforms, and as scientific experiment platforms. PocketQubes have been instrumental in democratising access to space, providing schools, academia, and industry a low-cost opportunity to do so. In this workshop we will briefly introduce the PocketQube standard and associated specifications, including examples of deployers. We will review several existing PocketQube missions, representative of the capabilities of the platform. Our focus will then shift to the technology used in such satellites, including the widespread adoption of open-source tools for mission, system, and subsystem design. In the second half of the workshop, we will go through an example of a preliminary PocketQube design and its relevance to demonstrating novel space technology. We aim to foster an interactive and collaborative environment, and we will enthusiastically welcome participants to engage in discussions around potential future missions. We hope you will share our excitement for the possibilities that lie ahead.
Speaker	 **Viktor Doychinov** is a Lecturer in Electronics and Software Engineering, Faculty of Engineering and Informatics, University of Bradford. He received an MSc in Spacecraft Technology and Satellite Communications from University College London, and a PhD in Electronic and Electrical Engineering from the University of Leeds. He then spent several years there working as a postdoctoral researcher in the Institute of Robotics, Autonomous Systems, and Sensing. He has worked on a wide range of single- and multi- disciplinary projects, all of which have involved the use of RF and wireless technology in one form or another.  **Muhammad Ali** is a Post-Doctoral Research Staff at Future Ubiquitous Networks Lab, Faculty of Engineering and Informatics, University of Bradford. He completed his MSc and PhD in Mobile & Satellite Communications from the same university. In 2016, he worked as a Lecturer in Department of Electrical Engineering and Computer Science, University of Bolton. He also worked as lead software developer for a London based software house “Direct2Success” from 2016 to 2018.He has developed a diverse skill set through his involvement in EU/Innovative-UK/Industrial funded projects. His expertise lies in avionics communications/heterogeneous wireless/software-defined networks, artificial intelligence, embedded systems, network security, among others.

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CATAPULT Satellite Applications

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