09:30: Registration
10.00: Welcome and introduction *(David Bull, University of Bristol)*

10.05: MultiDrone: Video processing for autonomous multiple drone cinematography
(Nikos Nikolaidis, Aristotle University of Thessaloniki)
Recent mass commercialization of affordable drones, has significantly altered the media production landscape, allowing for the easy acquisition of impressive aerial footage. Intelligent drone cinematography aims to automate the media production process, while ensuring adherence to artistic and cinematographic constraints. This talk will provide an overview of how video processing and analysis, computer vision and machine learning can contribute in drone cinematography, focusing on results obtained in the MultiDrone project. Topics presented include object detection and tracking for target following (physically, by the drone, or by the drone camera), crowd detection for avoiding flying over the crowd areas, target pose estimation for obtaining appropriate aerial shots, potential landing site detection etc. Issues specific to drone video analysis such as the low complexity required for the respective algorithms in order to be able to run onboard the drone will be also highlighted.   https://multidrone.eu/   http://poseidon.csd.auth.gr/

10.30: Drones - Is the future of wildlife films up in the air? *(Phil Dalton, John Downer Productions)*
Philip has been making wildlife films for the last 20 years and has always explored new innovations to help immerse the viewers into the animal world. This talk will be geared around Phil's experiences using unmanned aerial vehicles in the early days and his thoughts on where the technology is heading now and how this will impact on the future of wildlife filming. He will show examples from iconic award-winning productions such as Earthflight which created a bird's eye view of the world using a host of aerial filming techniques including model gliders, octocopters and cameras on the backs of trained birds.   http://jdp.co.uk/

10.55: Coffee break

11.25: Audio-visual sensing from multi-rotor drones
(Lin Wang, Ricardo Sanchez-Matilla, Andrea Cavallaro, Queen Mary University of London)
In this talk we summarize our work on acoustic sensing from a multi-rotor drone, which is challenged by the strong ego-noise from rotating rotors and propellers. We proposed a time-frequency spatial filtering framework for sound enhancement and source localization with a microphone array mounted on the drone. The method works well in presence strong ego-noise by exploiting the time-frequency sparsity of the acoustic signals. We further proposed an audio-visual joint processing framework which additionally uses a camera mounted on the drone to detect and localize potential target sound sources, and to provide guidance to steer the time-frequency spatial filter. The audio-visual calibration problem is addressed in this framework, which aims to align the audio and visual streams temporally and geometrically. Finally, we collected an audio-visual dataset which was made publicly available to promote the research in flying robot audition.
http://cis.eecs.qmul.ac.uk/

11.50: Experiences of drone production at Deutsche Welle *(Nico Heise, Deutsche Welle)*
German public broadcaster Deutsche Welle regularly employs drones as key production tools for short formats such as "Daily drone" as well as for longer documentaries and features. Nico Heise will present some examples from the DW production portfolio and reflect on the underlying cinematographic principles.
https://www.dw.com/en/top-stories/s-9097

12.15: A planning and training environment for drone cinematography
(Aaron Zhang, David Hall, Stephen Boyle, Tao Xu, David Bull, University of Bristol)
This talk will describe a simulation-based tool built on the game development engine (UE4) that can support drone filming by enabling production teams to plan and rehearse shots in realistic geographically accurate environments. This is particularly important in high value filming and prior to live events with unpredictable outcomes (e.g. sports events). The environments are built using photogrammetric methods from Google Earth or custom images sets and support the incorporation of dynamically reconfigurable foreground assets as filming targets. The simulator enables both free flight and selection of standard shot types and shot parameters. Single or multiple drone flight plans can then be extracted to programme drones. Such 3D

reconstructions provide a valuable tool for rehearsal, planning and training for cinematographic drone operations. http://www.bristol.ac.uk/vision-institute/ https://vilab.blogs.bristol.ac.uk/

12.40: Lunch, demonstrations and networking

13.40: A director's dashboard for drone cinematography *(Maurizio Montagnuolo, RAI)*
This talk describes the director tool, namely the Dashboard, which has been developed within the EU H2020 MULTIDRONE project for autonomous media production with a team of drones. The director's Dashboard is a Graphical User Interface (GUI) designed specifically to allow the editorial team to define shooting missions in an easy manner during a preproduction phase and to interact with the drone fleet during mission execution. We designed this tool for media production in several steps. First, we defined the high-level interactions between the Dashboard and its users, to produce an UML diagram depicting use cases. Second, we created a database to store all information entities considered in our XML-based cinematography language. Third, we used UML activity diagrams to define the workflows that shall be supported by the Dashboard software and built upon them the GUI appearance and behaviour. http://www.rai.it/

14.05: Onboard video of volcanic emission using drones *(Tom Richardson, University of Bristol)*
Recent drone developments are having a significant impact on the way that volcanic emissions are being studied. This talk will show our most recent onboard drone footage taken from collaborations between Bristol University Flight Lab and Earth Science colleagues on field campaigns to a range of volcanoes worldwide. Beyond Visual Line of Sight (BVLOS) operations have enabled ash samples to be collected and gas measurements to be made at distances up to 14km and altitudes up to 14,000ft above take-off. Target volcanoes include Fuego which is an active stratovolcano in Guatemala and is almost constantly active at a low level. Small gas and ash eruptions occur every 15 to 20 minutes and multiple flights have been carried out to collect a range of ash samples from within the plume. Most recently, Dr Richardson has been part of the international collaborative multi-drone 'ABOVE' field campaign to Manam and Rabul volcanoes in Papua New Guinea - the objective of which was to achieve the first simultaneous inter-comparison of ground, aerial, and satellite-based measurement techniques for volcanic gas (SO2) emissions.
https://www.bristolroboticslab.com/ https://www.youtube.com/channel/UC0ukoOAw0kMbxEBWV-KxxKQ

14:30: Drones on Rails – Reducing control complexity for camera operators
(Samuel Oberholzer, Tinamu Labs)
To exploit the full potential of camera drones and fly complicated maneuvers in high speeds, skilled expert pilots are required – and even they can't exploit the full potential of drones without risking a crash. Moreover, controlling all degrees of freedom of a drone and additionally the camera gimbal is a two-man-job that requires a well-coordinated team. This talk will give an overview of our research conducted at ETH Zurich and the resulting startup Tinamu Labs. In our research, we worked towards reducing complexity of camera drones by letting the user define higher-level goals of the image, rather than controlling the drone himself. The underlying challenges range from self-localization of the drone over intelligent planning algorithms for camera trajectories up to controlling multiple drones simultaneously for mobile motion capture with flying cameras. The main concept emerging from this research – VirtualRails - is further refined and developed at the startup company Tinamu Labs. We develop a system that guarantees the exact repeatability of camera trajectories, works independent of GPS and is absolutely safe to use – even for the average user without drone pilot experience. https://ait.ethz.ch/people/naegelit/ http://tinamu-labs.com/

14.50: Tea break

15.15: On location: Our Planet and Seven Worlds *(Hector Skevington-Postles)*
Hector will talk about sequence building and how the drone aerial platforms have enhanced wildlife filming, bringing a new feel and new possibilities in building aerial spectacle as well as behavioural sequences. He will refer to his own personal experiences filming for the major BBC series 'Seven Worlds, One Planet' and the Netflix series 'Our Planet'. https://hectorskevington.com/

15.40: Discussion/panel session: The future of drone cinematography *(Chaired by David Bull)*
16.00: Close