

## Workshop/Tutorial-T6 (Half Day, 4 hours)

### ROBOTS IN THE WILD: THE ALGORITHMS USED AND THE EXPERIENCES GAINED FROM FIELD EVALUATION

#### Organizers and Presenters

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#### Tutorial Summary

Robotic systems are expected to have an unprecedented impact within the years to come, leading to a change in the fabric of civilization. But for this promise to become reality, the potential demonstrated in the laboratory environment has to be proven in practice. Robotics autonomy should be long-term and robust, capable of dealing with the multiple complex challenges of the real world.

This Tutorial aims to discuss the algorithms designed to enable robust autonomy of aerial robots, and the experiences gained during extensive field evaluation activities. Among others, the topics of robust control for multi-hour flight, localization and mapping in challenging degraded visual environments, path planning for autonomous navigation and mission execution, as well as vehicle design for long-endurance, versatile operation, or a balance between the two will be discussed.

In particular, the workshop aims to discuss the specific experiences collected from a) the AtlantikSolar project - demonstrating 81.5h continuous flight using a hand-launchable solar-powered UAV, b) the experience of the convertible WingTra platform, c) the experiences collected within many projects for aerial robotic structural inspection - including mapping in dark environments, d) the experience from the effort to develop robots for monitoring of nuclear sites, as well as f) the collected experience from field evaluation of unmanned aerial vehicles for search and rescue applications.

#### Workshop Scope

- Aerial robot design for long endurance
- Aerial robot design for versatile, dual flight envelope operation (rotorcraft and fixed-wing)
- Robust avionics and flight control for multi-hour flight
- GPS-denied Localization and mapping in challenging environments including degraded visual conditions
- Multi-modal sensor fusion for robustified localizability
- Path planning for autonomous navigation and collision avoidance
- Path planning for autonomous inspection and exploration operations
- Robotic search and rescue, monitoring and victim detection

**Intended audience**

- Researchers and academics, graduate students from all the relevant fields
- UAS technicians and system engineers
- UAS practitioners, program managers
- Entrepreneurs

**Workshop Material:** *To be delivered to participants via Dropbox invitation and USB jump drive swap.*

**Presenter Biographies****Dr. Kostas Alexis**

Kostas Alexis obtained his Ph.D. in the field of aerial robotics control and collaboration from the University of Patras, Greece in 2011. His Ph.D. research was supported by the Greek national-European Commission Excellence scholarship. After successfully defending his Ph.D. thesis, he was awarded a Swiss Government fellowship and moved to Switzerland and ETH Zurich. From 2011 to June 2015 he held the position of senior researcher at the Autonomous Systems Lab, ETH Zurich, leading the lab efforts in the fields of control and path planning for advanced navigational and operational autonomy. His research interests lie in the fields of control, navigation, optimization and path-planning focusing on aerial robotic systems with multiple and hybrid configurations. He is the author or co-author of more than 50 scientific publications and has received several best paper awards and distinctions, including the IET Control Theory & Applications Premium Award 2014. Furthermore, together with his collaborators, they have achieved world records in the field of solar-powered flight endurance. In July 2015, Kostas moved to the University of Nevada, Reno. Since then he has established the Autonomous Robots Lab with the goal to dedicate his efforts towards establishing true autonomy for aerial and other kinds of robotics. Kostas Alexis has organized several large-scale multi-million-dollar research projects with broad international involvement and collaboration.

**Sebastian Verling, PhD Candidate, Co-Founder of WingTra**

Sebastian Verling started his bachelor studies in mechanical engineering in 2010 at ETH in Zurich. In 2013, he got awarded the ETH Excellence scholarship and Opportunity award when he started his Master Studies in Robotics, System and Control. During his studies he was additionally working with a colleague on a side project with the goal to develop a VTOL tailsitter UAV. With this they were setting the foundation of Wingtra, a spin-off Company that raised 2.6 Mio in the seed round and by now has 26 employees. After finishing his Master's Degree with distinction he started his PhD at the Autonomous Systems Lab at ETH, where he continues to improve the control framework of the Wingtra system.