

MUNICH AEROSPACE

Munich Aerospace Summer School
22-24 June 2016 – Lake Ammersee

Programme

Flying Robots

Concepts and Challenges of Aerial Autonomy

Version as of 14 June 2016



Overview

Wednesday, 22 June 2016

Presenter: Professor Werner Staudacher

- 11.00 a.m.** **Dr Florence Gauzy, Bayerische Forschungsallianz**
RLS-Sciences Network Meeting (Conference Room #5)
- 12.00 p.m. Lunch
- 01.00 p.m.** **Dr Johann Bals, Munich Aerospace Executive Board**
Welcoming Remarks
- 01.30 p.m.** **Professor Matthias Gerdts, Munich Aerospace Research Group Leader**
Matthias Rieck, Munich Aerospace Scholarship Holder
- 02.30 p.m. Coffee Break
- 03.00 p.m.** **Professor Elmar Giemulla, Technical University of Berlin**
The Legal Situation of RPAS – Present Status and Future Perspectives
- 04.00 p.m.** **Professor João Tasso de Figueiredo Borges de Sousa, University of Porto**
Unmanned Air Vehicles for Maritime Operations: from Vehicles to Networked Systems
- 06.00 p.m. Dinner

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Thursday, 23 June 2016

Presenter: Professor Werner Staudacher

- from 07.30 a.m. Breakfast
- 09.00 a.m.** **Professor Gerhard Hirzinger, German Aerospace Center (DLR)**
Robotic Assistance for Aerospace – From Robonauts in Space to the Unmanned Aerial Vehicles
- 09.30 a.m.** **Dr Josef Mendler / Dr Hans Tönskötter, Acentiss**
ELIAS – Optionally Piloted UAS Technology Demonstrator
- 10.30 a.m. Coffee Break
- 11.00 a.m.** **Dr Tobias Kiesling, IABG**
Operational Cyber Resilience and its Role in Future Autonomous Flight Scenarios
- 12.00 p.m. Lunch
- 01.30 p.m.** **Professor Friedrich Fraundorfer, University of Graz**

- Camera Drones – Techniques, Applications and Possibilities
- 02.30 p.m.** **Meinrad Edel, Airbus**
Challenges of a Counter-UAV System
- 03.30 p.m. Coffee Break
- 04.00 p.m.** **Professor Maryam Kamgarpour, ETH Zurich**
Optimal Control for Fuel Efficient Aircraft Conflict Avoidance
- 05.00 p.m.** **Dr Emanuele Lubrano, Drone Adventures**
The Use of Commercial Drones to Accomplish Humanitarian, Conservation
and Cultural Missions
- 06.00 p.m. Dinner
- 07.30 p.m.** **Professor Gerhard Haerendel, Max-Planck-Institut für Extraterrestrische
Physik**
A Peek behind the Scenes of a Space Scientist's Life
- Presenter: Professor Bernd Häusler, University of the German Armed
Forces

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Friday, 24 June 2016

Special Campus Session for Selected Members of the Regional Leaders Summit

- from
- 07.30 a.m. Breakfast
- 08.30 a.m. Departure for Ludwig Bölkow Campus (shuttle bus)
- 10.00 a.m. Guided tour at Ludwig Bölkow Campus
- 01.00 p.m. Networking Lunch
- 01.30 p.m. Gunnar Wiegand, Bavarian State Chancellery
Closing Remarks

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Wednesday, 22 June 2016

Presenter: Professor Werner Staudacher

11.00 a.m. **Dr Florence Gauzy**
Bayerische Forschungsallianz

RLS-Sciences Network Meeting at Conference Room #5

12.00 p.m. Lunch

01.00 p.m. **Dr Johann Bals**
Munich Aerospace Executive Board

Welcoming Remarks

01.30 p.m. **Professor Matthias Gerdts**
Munich Aerospace Research Group Leader

Matthias Rieck
Munich Aerospace Scholarship Holder

title.

abstract.

bio.

02.30 p.m. Coffee Break

03.00 p.m. **Professor Elmar Giemulla**
Technical University of Berlin / Federal University of Applied Administrative
Sciences

title. *The Legal Situation of RPAS – Present Status and Future Perspectives*

abstract. In the EU the legislative responsibilities for RPAS rest mainly with the national legislatures. Only for RPAS of 150 kg and more the EU has competence. German law provides for operation permits rather than technical certification and personal licensing. Such generosity is counterbalanced by operational restrictions (e.g. a maximum weight of 25 kilos, mandatory visual line of sight). The BMVI plans to loosen these

restrictions by the end of 2017. Then again, the EU is about to take over legislative responsibilities in full. Following their “risk-based approach”, it is envisaged that future rules are tailored to three risk categories: open, specific and certified.

bio. **Elmar M. Giemulla** works as an academic aviation lawyer, author, lecturer and legal expert in aviation law. He is head of the subgroup “aviation law” of UAV DACH.

04.00 p.m. Professor João Tasso de Figueiredo Borges de Sousa

University of Porto

title. *Unmanned Air Vehicles for Maritime Operations: from Vehicles to Networked Systems*

abstract. Current practices and major trends in Unmanned Aircraft Systems (UAS) for maritime operations are presented along with projections of future UAS maritime applications. First various aspects of the UAS program management, including organization, operator responsibilities, program operation and overall program costs are reviewed. Next, maritime aircraft missions and required capabilities are outlined, and current practices feeeeeeeeeewrwqor both manned and unmanned aircraft are described. Technological trends relating to UAS are also discussed, focusing on developments relevant to maritime UAS operations. Finally, concepts for future UAS operations are presented, with emphasis on networked operations.

bio. **João Tasso de Figueiredo Borges de Sousa** is a Professor at the Electrical and Computer Engineering Department at the University of Porto (Portugal) and the head of the Underwater Systems and Technologies Laboratory.

06.00 p.m. Dinner

Thursday, 23 June 2016

Presenter: Professor Werner Staudacher

from
07.30 a.m. Breakfast

09.00 a.m. Professor Gerhard Hirzinger
German Aerospace Center (DLR)

title. *Robotic Assistance for Aerospace – From Robonauts in Space to the Unmanned Aerial Vehicles*

abstract. Robonauts in outer space – whether on moon, planets or in earth orbit – need one general, very important skill: to perceive their environment in 3D and to model it either in real-time or make use of a priori generated 3D models; and in case of free-floating to pre-calculate and master the recoil effect when grasping an object. Examples of this observation are given and related to the similar case of an unmanned helicopter with a robotic arm trying to autonomously grasp an object from the air. The topic 3D modelling of the world in real-time and offline is treated in more detail as well as problems which have to be solved when flying cameras with multicopters and planes, be it either for modelling landscapes and buildings or for autonomous collision avoidance in unknown environment, e.g. in caves or destructed buildings. Image-based sense and avoid approaches for preventing collisions with other flying objects in free sky, however, have to get along typically with 2D image information. Unmanned and optionally piloted solar-electric airplanes as developed by ELEKTRA UAS are typical users of the technologies mentioned.

bio. **Gerhard Hirzinger** is the former director (now advisor) of DLR's robotics and mechatronics center in Oberpfaffenhofen.

09.30 a.m. **Dr Josef Mendler / Dr Hans Tönskötter**
Acentiss, Munich

title. *ELIAS – Optionally Piloted UAS Technology Demonstrator*

abstract. In the context of the Ludwig Bölkow Campus project EUROPAS, technologies for all-electric unmanned aircraft systems have been developed and tested. For the final flight demonstration the ELIAS aircraft has been changed over to an optionally piloted system (OPV) which allows automatic, preprogrammed flying with safety pilot on board. The ELIAS OPV system consists of the electric UL aircraft, the new automatic flight control system (AFCS), the innovative electronic datalink and the ground control station (GCS). To minimize risk extensive aircraft-in-the-loop simulations (ACIL) have been carried out at IABG/ACENTISS before starting with the flight tests. The OPV system is designed such that the pilot can takeover flight control in case of failure of the AFCS at all flight situations.

bio. **Josef Mendler**, Managing Director of ACENTISS GmbH, contributes to certification related topics of RPAS within EUROPAS and joins national and international consortiums dealing with standardization and certification of UAS.

Hans Tönskötter, Senior Manager for Airborne Systems at ACENTISS GmbH, is the Technical Coordinator of the EUROPAS Consortium and in charge of the EUROPAS technology development at ACENTISS.

10.30 a.m. Coffee Break

11.00 a.m. **Dr Tobias Kiesling**
IABG, Munich

title. *Operational Cyber Resilience and its Role in Future Autonomous Flight Scenarios*

abstract. Digitalization is an enabler for new application areas such as autonomous flight. However, due to the increase in IT pervasion and autonomous

components, the back side is an increased vulnerability to cyber threats. To cope with the rising threat in complex interconnected infrastructures, we need to follow a resilience-oriented view and utilize suitable methods and tools to achieve understanding of the consequences in potential cyber threat situations. This presentation introduces the notion of cyber operational resilience and shows how this can be applied to the air transport infrastructure at large with a special focus on aspects related to future autonomous flight scenarios.

bio. **Tobias Kiesling** is a Program Manager for Cyber Defence at IABG in Ottobrunn near Munich since 2014, where he is responsible for Portfolio-Management and Business Development in the area of Cyber Defence.

12.00 p.m. Lunch

01.30 p.m. Professor Friedrich Fraundorfer
University of Graz

title. *Camera Drones – Techniques, Applications and Possibilities*

abstract. Cameras and computer vision algorithms play a major role for many drone applications, ranging from image analysis of data acquired by drones to on-board flight control and navigation. This talk will discuss the potential of drones for 3D mapping using computer vision techniques and will give examples of applications ranging from mining to archaeology. In addition, the talk will also examine the possibility of using computer vision to create autonomous small scale drones, which are able to see and interpret their environment.

bio. **Friedrich Fraundorfer** is an Assistant Professor at Graz University of Technology, Austria. His research focuses on algorithms for drone image analysis and autonomous drone operation.

02.30 p.m. Meinrad Edel

Airbus, Ulm

title. *Challenges of a Counter-UAV System*

abstract. Incidents of UAVs violating security perimeters at airports, power plants, borders and prisons are covered in the news almost daily. The presentation will depict the threat of UAVs today and in the future, focusing on critical infrastructure, mass events and espionage. In order to characterize systems needed for protection against UAVs, there will be an analysis of UAV espionage and attack patterns for various defense scenarios. Consequently, a set of requirements for protection systems can be deduced. In conclusion, a theoretical example of a Counter UAV system for enhanced security of a soccer stadium will be discussed.

bio. **Meinrad Edel**, Dipl.-Ing., PMP, has been with Airbus since 1997. A former Project/Bid Manager for Electronic Warfare, he is now Director Sales Protection and Reconnaissance.

03.30 p.m. Coffee Break

04.00 p.m. Professor Maryam Kamgarpour

ETH Zurich

title. *Optimal Control for Fuel Efficient Aircraft Conflict Avoidance*

abstract. Air Traffic Management (ATM) is responsible for safe, efficient and sustainable operation in civil aviation. Currently, ATM imposes certain trajectory restrictions to guarantee safety and to ease the task of air traffic control (ATC) operators. Some of these restrictions result in non-minimal fuel consumptions and hence higher operating costs and emissions. We formulate fuel optimal conflict free aircraft trajectory planning as a hybrid optimal control problem. The discrete modes of the hybrid system capture the air traffic procedures for conflict resolution, e. g., speed and turn advisories. In order to solve problems of realistic dimensions arising from air traffic sector planning, we formulate a numerically tractable approach to

solve the hybrid optimal control problem.

bio. **Maryam Kamgarpour** is an Assistant Professor at ETH Zurich Automatic Control Laboratory. Her research is on safety verification and optimal control of large-scale uncertain dynamical systems with applications in air traffic and power grid systems.

05.00 p.m. **Dr Emanuele Lubrano**
Drone Adventures, Geneva

title. *The Use of Commercial Drones to Accomplish Humanitarian, Conservation and Cultural Missions*

abstract. Drone Adventures is an NGO that wants to change the reputation of drones by using them for good purposes. We will present the missions that have been done in the last three years in areas like humanitarian aid, nature conservation and culture in many places around the World. Giving practical examples, we will show how to set up a drone to create 2D or 3D maps or to simply take pictures from the sky. The data gathered by the drones is then used to help people after a catastrophe, save animals from extinction or to preserve our cultural heritage.

bio. **Emanuele Lubrano** is the founder of Drone Adventures. He took part in several humanitarian drone missions in Haiti, Armenia, Tanzania, Namibia and Peru.

06.00 p.m. Dinner

Fireside Chat

07.30 p.m. **Professor Gerhard Haerendel**
Max-Planck-Institut für Extraterrestrische Physik, Garching

title. *A Peek behind the Scenes of a Space Scientist's Life*

Presenter: Professor Bernd Häusler, Excellent Emeritus
University of the German Armed Forces

abstract. Professor Haerendel will speak about his experiences made as a space scientist throughout many decades and about his pioneering work in applying sounding rocket and satellite technology to study space plasma and magnetospheric physics identifying important processes associated with the formation of auroral arcs, artificial and natural comets.

bio. **Gerhard Haerendel** studied physics in Tübingen and Munich. In 1972 he became Director of the Max Planck Institute for Extraterrestrial Physics (MPE) in Garching and retired from the latter at the end of 2000. He is Honorary Professor at the Technical University, Braunschweig and Distinguished Professor of Space Physics at the International University Bremen (IUB)/Jacobs University. His teaching activities included Visiting Professor at the University of California, Berkeley and at the University of Iowa. He served in many positions in international space research organizations, among these for many years as Vice-President of the International Academy of Astronautics (IAA), as President of the Committee on Space Research (COSPAR), as chairman of several ESA advisory committees, and also as Dean of the Faculty of Engineering and Science at the Jacobs University. His awards and honours include the Theodore von Karman Award (2002) and the Jean Dominique Cassini Medal (2010).

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10.00 a.m.	Guided tour at Ludwig Bölkow Campus
01.00 p.m.	Networking Lunch
01.30 p.m.	Gunnar Wiegand, Bavarian State Chancellery Closing Remarks

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