Speakers

Dr. Leon Alkalai

NASA JPL, Pasadena, USA

Leon Alkalai is a JPL Fellow (2014) and is a Full Member of the International Academy of Astronautics (2005). He is currently the Manager of the JPL Office of Strategic Planning, responsible for developing a long-term vision and strategic plan for NASA's Jet Propulsion Laboratory, developing and maintaining strategic partnerships and developing new pathways for the future of the laboratory.

Leon Alkalai received his PhD in Computer Science from UCLA in 1989 and has been working at JPL ever since. For the first 14 years of his career Leon was a leader in Advanced Avionics Systems, Micro-Systems, Micro/Nano Spacecraft and related technologies. He led JPL's Center for Integrated Space Microsystems (CISM) which was developing highly integrated "Systems on A Chip" and pioneering new micro and nano satellites. For the past 15 years, Leon has been in the forefront of JPL's competed mission's project formulation as a Manager and a Business Capture Lead. Leon was the successful Capture Lead for both the GRAIL mission to the Moon: awarded in 2007 and launched in 2011; and then the InSight mission to Mars: awarded in 2012 and launched in May of 2018. Both competitions were part of NASA's Discovery Program in Solar System Exploration. In 2012, Leon received the NASA Individual Distinguished Achievement Medal for the successful formulation of the GRAIL mission to map the gravity field of the Moon. Leon also led JPL's Discovery proposal (2016) to explore and map the surface of Venus using advanced radar technology. In the past 3 years, Leon has also been leading a new pioneering effort at JPL to formulate the next robotic mission to explore the Interstellar Medium (ISM), following the detection of the solar Heliopause by the Voyager-1 robotic spacecraft (2013). Leon also leads JPL's Medical Engineering Forum (MEF) a pilot project to apply space technology to medical engineering.

Dr. Fred Hadaegh

NASA JPL, Pasadena, USA

Dr. Fred Hadaegh is the NASA Jet Propulsion Laboratory's (JPL) Chief Technologist. He joined JPL in 1984 after receiving his Ph.D. in Electrical Engineering from the University of Southern California. For over two decades, he supervised the Guidance & Control (G&C) Analysis Group. He also previously led the development of G&C technologies for spacecraft formation flying, autonomous rendezvous, and docking for NASA missions and Department of Defense programs.

Dr. Hadaegh is a JPL Fellow and Senior Research Scientist, Fellow of the Institute of Electronics and Electrical Engineers (IEEE) and Fellow of the American Institute of Aeronautics and Astronautics (AIAA). He has received numerous awards including NASA's Exceptional Service and Exceptional Achievement Medals. His research interests include optimal estimation and control as applied to distributed spacecraft. He has published extensively on mathematical modeling of uncertain systems, parameter identifiability of dynamical systems, identification and control of large space structures, and autonomous control of distributed spacecraft systems.

Prof. Klaus Schilling

University of Würzburg, Germany

Prof. Dr. Schilling had in space industry responsibility in Earth observation and interplanetary satellites (such as HUYGENS to the Saturnian moon Titan and ROSETTA for exploration of comets, where adaptive control technologies were applied to handle uncertainties), before he was appointed professor and chair for Robotics and Telematics at University Würzburg. In parallel he is president of the research company „Center for Telematics (ZfT)". His team built the first German pico-satellite UWE-1, launched 2005 to optimize Internet in space. He published more than 350 papers and received several awards, including the Walter-Reis-Award for Robotic Innovations 2008 (in mobile robotics) and 2012 (for medical robotics), as well as an ERC Advanced Grant for research on control of networked distributed satellite systems. He is full member of the International Academy of Astronautics and was Consulting Professor at Stanford University 2002-2006. In IFAC (International Federation on Automatic Control) he serves as Coordinating Chair for the area "Computers & Control", after having been TC chair for „Telematics: Control via Communication Networks" and for "Aerospace".

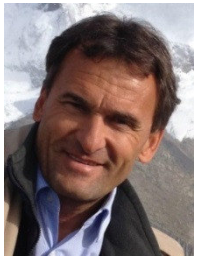
Dr. Dmitriy Shutin

DLR, Oberpfaffenhofen, Germany

Dmitriy Shutin received his Master degree in Computer Science in 2000 from Dniepropetrovsk State University, Ukraine, and the Ph.D. degree in electrical engineering from Graz University of Technology, Graz, Austria, in 2006. During 2001-2006 and 2006-2009, he was a Teaching Assistant and an Assistant Professor, respectively, with the Signal Processing and Speech Communication Laboratory at Graz University of Technology. From 2009 to 2011 he was a Research Associate with the Department of Electrical Engineering at Princeton University, Princeton, NJ, USA. Since 2011 he is with the Institute of Communications and Navigation, German Aerospace Center, where he is currently a leader of the Swarm Exploration Group. His current research interests include machine learning for signal processing and statistical signal processing over networks and Bayesian theory. Dr. Shutin was a recipient of the Best Student Paper Award at the 2005 IEEE International Conference on Information, Communications and Signal Processing (ICICS). In 2009 he was awarded the Erwin Schroedinger Research Fellowship. From 2012 to 2014 he acted as a selected advisor of German air navigation service provider, within the Navigational System Panel of ICAO. He is Senior Member of IEEE.

Detlef Wilde

Airbus Defence and Space, Bremen, Germany



Detlef Wilde is working in European space industry for 30 years. His current position is program manager for suborbital missions incl. TEXUS/MAXUS at Airbus Defence & Space in Bremen. He holds a diploma in aerospace engineering and a master in space systems engineering. Starting as a flight dynamics and GNC engineer he has been mainly working as program manager and system engineer for orbital system and exploration programs like Inspector, IRDT inflatable reentry technology, reusable launch systems Phoenix/Pre-X, Mars and Lunar landing systems for Exomars/Lunar Lander, ARV, MPCV ESM as well robotic projects like DEOS or E-Deorbit. He is also currently leading the Airbus phase A/B1 study for the Gateway internal Habitat under ESA contract.

Topic

Space exploration – the final frontier of human endeavor – lures us with a promise to answer a fundamental question about our place in this Universe. In-situ exploration of nearby planets and the Moon, as well as remote sensing technologies have dominated our approaches towards exploration of other worlds. Yet, advancements in microelectronics, sensor technology, wireless data communications, and artificial intelligence, enable emergence of technology that offers a completely new perspective on future space exploration. **This technology is multi-agent systems or swarms, which build upon cooperation and decentralized data processing to achieve higher robustness, autonomy, efficiency and increased sensing aperture.** A swarm, consisting of 5 to 20 sensing platforms (either identical or having complementary functionalities) that are able to communicate with each other becomes more than just a collection of robots or sensors. Through information exchange, the agents in a swarm can cooperatively navigate, share resources, and reason on the sensed data to accelerate exploration or support humans in in-situ missions.

Purpose

This special session brings together experts in swarm exploration technology from research institutions, space agencies and space industry. The aim of the session is to identify opportunities for applying swarm technology in future space exploration missions, to initiate a network of experts, which drives the planning of a swarm exploration mission, and to inspire the space community for swarm technology in future space exploration missions.

Expected Outcomes

Swarm systems have the potential for a paradigm change in future space exploration missions. By bringing together experts from research institutions, space agencies and space industry, we intend to come up with a unified view on the potential of swarm systems for space exploration, to discuss applications, and to identify challenges. It is planned to summarize the results of the discussion in a white paper that outlines a possible technology roadmap towards swarm-based space exploration missions.

Schedule

16:30 Welcome and Introduction

16:35 **Pico-Satellite Formations for Innovative Observation Approaches**
Prof. Klaus Schilling
University of Würzburg, Germany

16:45 **Swarms in Lunar Exploration and Synergies with Terrestrial Applications**
Detlef Wilde
Airbus Defence and Space, Bremen, Germany

16:55 **Autonomous Swarm Systems for Deep-Space Exploration**
Dr. Leon Alkalai
NASA JPL, Pasadena, USA

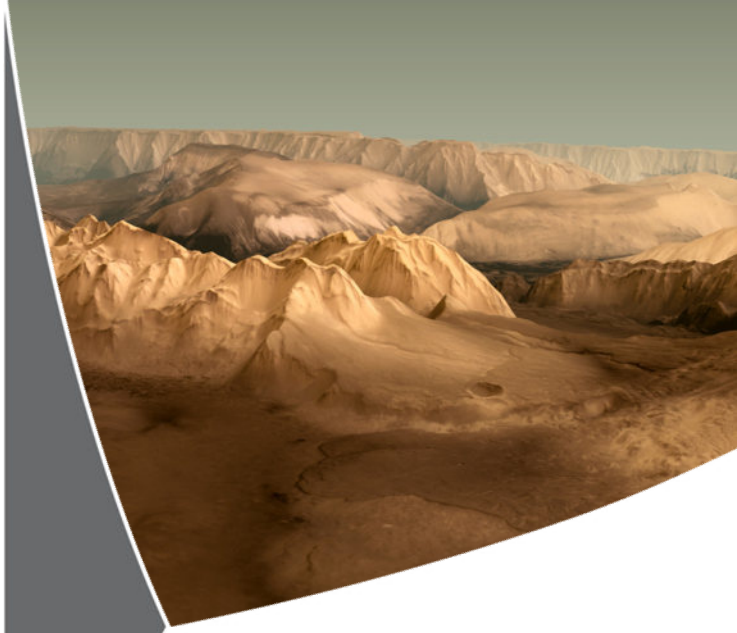
17:05 **Swarms: An Enabling Capability in Responding to the Exigencies of Future Space Exploration**
Dr. Fred Hadaegh
NASA JPL, Pasadena, USA

17:15 **Swarm Solutions for Future Planetary Space Exploration Applications**
Dr. Dmitriy Shutin
DLR, Oberpfaffenhofen, Germany

17:25 Discussion

Share your ideas!

18:00 End of Session



69th International Astronautical Congress

Special Session

Swarm Systems for Future Space Exploration

Tuesday, 2 Oct 2018, 16:30 – 18:00

Focke-Wulf-Saal

Congress Centrum Bremen