



2024

IAF SPACE SYSTEMS COMMITTEE

Introduction

The Space Systems Committee addresses space systems as a whole from a system concept and system engineering perspective. The Committee's aim is twofold. Firstly, to focus on the enhancement of system development and reliability, including collection of lessons learned, development of tools, processes and training in the field of systems engineering to further improve the efficiency, risk management, reliability and coordination across disciplines and all the functions necessary to build any space systems. Secondly, to highlight future developments, especially in the fields of innovative and mission-enabling technology, future system architectures and innovative and visionary system concepts.

Highlights

Space Systems are evolving fast, leveraging new technologies and architectures aiming not only to reach new frontiers, but also making it in a sustainable way. New applications, new business models and disruptive changes in the global space ecosystem all contributes to such evolution.

In 2024, the following trends were identified in what concern future architectures and innovative systems:

- Reducing resource usage and pollution on Planet Earth. Examples: space-based solar power, ecodesign such as the combined service of spacebased solar energy and climate engineering via orbiting solar reflectors
- Preservation of space environment and rational utilization of space resources. Examples: space circular economy, Active Debris Removal (ADR), In-Orbit Service and Manufacturing (IOSM), inorbit recycling, reusable satellites.
- Withstanding the harsh space environmental effects caused by factors such as solar flares,

cosmic rays, space debris, meteoroids, and lunar dusts.

 Reducing/minimizing side effects of space activities on life on Earth. Those side effects include but are limited to pollution of optical astronomical observations, casualties caused by uncontrolled reentries and back-contamination of planetary missions.

In addition, the Committee registered an increased interest on Artificial Intelligence (AI) and cyber security in space. AI and cyber security are poised to massively shape future space systems. As an example, the European Space Agency (ESA) is engaged in studies for developing Cognitive Synthetic Aperture Radar (SAR) systems. Such systems, leveraging on-board processing hardware and advanced algorithms, would be able to analyse data on the fly and command autonomously acquisition of higher resolution pictures over areas of interest.

On the systems engineering side, Model-Based System Engineering (MBSE) methods in the space ecosystem continues to be of high interest and, in the long-term, as well time saving, even if their implementation remains a heavy task and tools are complex. In this regard, machine learning has been proven to optimise the design of mechanisms demonstrating the ability to generate feasible designs in a shorter period of time than the incumbent process. Moreover, large language models (LLMs) such as GPT-4 has been using to connect elements embedded in the requirements with artifacts described in the design description keep track of design changes throughout the life cycle.

One element of challenge is the difficulty in creating a systematic or complementary view of lessons learned out of a large number of engineering practices as most of the research currently available is based on single cases or very limited engineering practice.

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Future Outlook

Among the many fields of focus and trends pertaining to Space Systems, very low Earth orbit (VLEO) missions was identified as one of the emerging and most interesting space systems. Therefore, the committee will make sure to offer under D1.3 a space for authors working on VLEO to present their work at the next IAC in Sydney, Australia.

Committee Activities

The Committee welcomed four new members: Cristian Bank, Director Programme Preparation & Development at Eumetsat, Sybren De Jong, Senior R&D engineer Royal Netherlands Aerospace Centre, Ryan Demny Configuration Lead for Crew Lander at Blue origin and Daniel Wischert, Systems and Concurrent Design Engineer at ESA.

Moreover, the committee elected Matteo Emanuelli as Coordinator and Dr Mamatha Maheshwarappa as Co-Coordinator. Jill Prince, who has successfully led the committee for the past 6 years will remain as Co-Coordinator, while Reinhold Bertrand, and Tibor Balint, who held the post of Co-Coordinators, are returning to become members after many years at the service of the committee.



Matteo Emanuelli is Program Manager for Earth Observation (with a focus on Synthetic Aperture Radar) at Airbus Defence and Space. In his role, he works specifically towards enabling Airbus' next generation radar services and investigate how to implement new technologies and external data sources in a servicedriven system of systems. Matteo is also active on regulatory aspects of Earth observation, leading an international industry effort to protect remote sensing frequencies from interferences caused by deployment of future terrestrial mobile networks. Before joining Airbus, Matteo worked as senior systems engineer at Gomspace, where he designed and launched several small satellite missions.



Dr Mamatha Maheshwarappa is the Head of Research & Development within Office of the Chief Engineer (OCE) at the UK Space Agency. In her role, she is responsible for directing and overseeing the R&D activities for the Office and ensuring the OCE continue to deliver technical evidence to provide thought leadership at a range of national and international forums. Previously, as a Payload Systems Lead, she provided technical leadership on various UK Space Agency programmes and projects, by offering technical oversight/assurance. At RAL Space, she was the technical lead on SPEQTRE (Space Photon Entanglement Quantum Technology Readiness Experiment) satellite project. Mamatha has worked on transceivers for ExoMars and Lunar Polar Sample Return projects while at QinetiQ. She has a PhD in Software Defined Radios for Multi-Satellite Communications from the University of Surrey, UK. Mamatha is the co-chair of the Women in Aerospace-Europe (WIA-E) UK Regional Network representing UK Space Agency.

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