Workshops, 26.03.2021

Manufacturing and Assembly in Space (On Orbit and Planetary Surface)

Time: 26.03.2021, 09:00 - 12:00 am

Chairman: Dr. Advenit Makaya (ESA), advenit.Makaya@esa.int

Advenit Makaya is an Advanced Manufacturing Engineer at the European Space Research and Technology Centre of the European Space Agency. He supports the development of advanced materials and processes for space applications and provides Materials and Processes support to ESA missions. In this context, Advenit is coordinating the Out-of-Earth Manufacturing initiative, aiming to foster the development of technologies for on-orbit and on-planet manufacturing. Advenit is also supporting the definition and implementation of the ESA Space Resources strategy. Advenit previously worked in industry in the U.K., on lifing of critical parts for large civil aircraft engines. His background is in research on advanced metallic materials, conducted in academic and national institute laboratories in Sweden and Japan.

Chairman: Dr. Sebastian Bartsch (Airbus Defence and Space), sebastian.bartsch@airbus.com

Sebastian Bartsch is Robotics Systems Engineering Expert at the Advanced Projects and Robotics department of Airbus Defence and Space. He is focusing on On-Orbit Servicing, Assembly and Manufacturing activities with responsibility for the definition and development of required robotic operations, capabilities, technologies and architectures to realize these kind of future robotic applications also w.r.t. the company's space robotics roadmap.

He studied computer science and robotics engineering, completing his doctorate in 2013. From 2007 till 2019 he worked at the German Research Center for Artificial Intelligence – Robotics Innovation Center (DFKI RIC) as senior researcher and team leader for space robotics and mobility with responsibility for the development of numerous robots for a wide range of applications.

Manufacturing and Assembly in Space (On Orbit and Planetary Surface)

Abstract:
The ability to manufacture spacecraft and associated hardware in space is expected to profoundly transform a wide range of space activities. On-orbit manufacturing can lead to larger spacecraft components (e.g. antennae reflectors, solar arrays, radiators), not limited by fairing size and launch load structural requirements, thereby enabling higher performance, higher power available for payloads and lighter structures, while reducing the launch costs. This can result in novel servicing and maintenance logistics, including eventually repair and recycling of spacecraft parts, lifetime extension and new business models for space assets. These benefits can enhance mission scenarios for various applications, including Telecommunications, Earth Observation, Navigation and Science.
In-situ manufacturing and recycling capability can also enable on-demand production of tools and hardware used during long-term Exploration missions. This will help reduce the dependence on cargo missions and the amount of supplies to be carried from Earth.
Orbital environmental conditions, such as microgravity, offer new possibilities for material processing that are not feasible on Earth and therefore could make the orbital fabrication of new high-tech products, even for designated use on Earth, a reality.
Recent developments in relevant manufacturing and assembly technologies, as well as ongoing progress towards on-orbit servicing and active debris removal have generated a vibrant context for the development of in space manufacturing technologies, with several processes being tested and on-orbit demonstrations of spacecraft parts manufacturing scheduled for the next few years.
The Symposium will be an ideal opportunity to exchange and help build a shared approach to this disruptive domain in Europe.

Objective of the workshop:
Identify Technology Gaps and Development needs to enable future applications

T**hree categories of applications** of in-space manufacturing will be covered:
- Manufacturing of large structures and spacecraft parts in space
- Manufacturing for long-term exploration missions (to build and support Lunar and Martian infrastructure)
- Using the space environment to manufacture high-value products

For each category, the following will be discussed:
- Motivation and envisaged applications, mission scenarios
- Quick review of the state of the art: past achievements, ongoing projects, planned missions
- Discussion on the remaining technology gaps and development needs

As discussed, it would be good to ask the workshop participants to prepare input (at least think about it) to be discussed during the workshop.

Thermo-Elastic

- **Time:** 26.03.2021, 09:30 – 12:30 (TBC)

- Chairman Simon Appel: simon.Appel@esa.int

Simon has been supporting several spacecraft and technology development projects for the European Space Agency. Thermoelastic problems were a recurring topic in the career of Simon. Besides his work on methods for general spacecraft structural engineering simulations, he shared his developments on tools and methods for thermoelastic problems during conferences and workshops. Simon Appel is supporting the coordination of developments and events in the frame of the “European Working Group on Thermo Elastic” aiming to develop guidelines for the European space industry for thermoelastic verification.

- Chairman Benoit Laine: benoit.Laine@esa.int

Benoit evolved between structures and thermal both in industry and at ESA. He is now in charge of the Thermal Analysis and Verification Section in the mechanical department at ESA.
Particular interests: verification, methods & tools, combining analysis and testing, innovative measurement techniques, mostly in mechanical and thermal domains, digitalization / digital twin, data analysis and fusion, as well as in gathering lessons learned towards continuous improvement, including learning from flight data.
Convinced there is work to be done on thermo-elastic methods, he has supported studies on the topic and strives to foster collaboration and knowledge sharing, together with the structures colleagues - Simon Appel, e.g. setting up and animating the European thermo-elastic working group.

Thermo-Elastic

- **Objectives:**
  - Share information and raise awareness about recent and coming activities on the topic
  - Gather inputs for TDE activity “European Methods for Thermo-Elastic Verification”

- **Agenda:**
  - Developments since Workshop at ECSSMET 2018 on Thermo-Elastic (ESA)
  - Introduction to TDE activity “European Methods for Thermo-Elastic Verification” (TAS-F)
    - Consortium
    - Program of work
    - Community involvement
  - Challenges and suggestions for TDE activity shared by industry

- **Format of the Workshop**
  - The workshop will be held virtually, by remote connection
  - The workshop is part of ECSSMET 2021, hence open to registered participants only

- **Background**
  Following the workshop organised as part of ECSSMET 2018, a working group was created with the following objectives:
  - Foster exchanges on Thermo-Elastic analysis and verification methods
  - Coordinate the development of methods and tools for Thermo-Elastic verification
  - Prepare development of an ECSS style handbook on topic

Virtual Qualification

Time: 26.03.2021, 1:00 pm - 4:00 pm

Place: Link

Chairman: Dr. Javad Fatemi (Airbus Defence and Space)

Today's very competitive space market drives companies to significantly reduce their product development time and cost, without compromising quality. The traditional Engineering processes for development and qualification of space products have shown their limitations to achieve these challenging objectives.

Systems Engineer and Expert in composite structures, Dr Javad Fatemi is leading the development and implementation of new Engineering processes and methods at Airbus Defence and Space Netherlands. The new processes heavily rely on credible simulations for risk-informed engineering decisions and product qualification. The new approach not only results in significant reduction of product development time and cost, but also enables quantification of the design robustness with respect to material and manufacturing uncertainties. Javad has led the development of the Vega-C inter-stage 1/2, which resulted in a product qualified by simulation. He also leads the development of composite technologies for application in launcher structures.

Chairman: Dr. Graham Coe (ESA):

Head of Structural Engineering in the Mechanical Engineering department of ESTEC, the main technical centre of the European Space Agency, located in Noordwijk, the Netherlands. This follows a thirty-five year career in the aerospace industry in the field of lightweight structural engineering. Prior to working for ESA, career has included working in the civil aircraft field and satellite developers in the UK, USA, Netherlands, Germany and Italy. Within the domain of lightweight structural engineering, current responsibilities include participating in the design and development of spacecraft and launcher structures for ESA missions, and contributing to European R&D activities in space sector for lightweight structures and materials.

Virtual Qualification

Abstract:

Virtual Qualification by Credible Simulation will result in reduction of development time and cost by reducing the extent of physical qualification effort. The approach relies to a large extent on physics-based credible numerical simulations which are validated by dedicated characterisation tests. The credible simulation also enables risk-informed engineering decisions and prevents wrong programme decisions.

The objective of this workshop is to explore the interest of initiating a European wide space community working group to develop guidelines for Simulation Credibility Assurance framework for the purpose of creating credible simulation in support qualification of complex physical systems. This will also enable the space community to work together on the development and exploitation of credible simulation for more cost effective and credible design and qualification of future space products.