~ ADCSS2023 ~
Closing

Joachim Fuchs - Head of Software System Division
Benedicte Girouart - Head of GNC, AOCS and Pointing Division
Ali Zadeh - Head of Data Systems, Microelectronics and Component Technology Division

Wednesday 15/11/2023

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Some Facts & Figures

31 Countries

70 Affiliations

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ADCSS2023 – 5 Sessions/40 Presentations

|	Monday 13/11	Tuesday 14/11	Wednesday 15/11
08:00		Registration	Registration
09:00		Data Handling	Modern techniques for software verification and validation
13:00	Registration	Lunch Break	Lunch Break
14:00	SAVOIR Space AVionics Open Interface aRchitecture	Towards zero-debris AOCS and GNC systems	Artificial Intelligence applied to fault detection on-board spacecraft
18:00	Welcome Drink	End of Day 2	End of ADCSS2023

All presentations are online!

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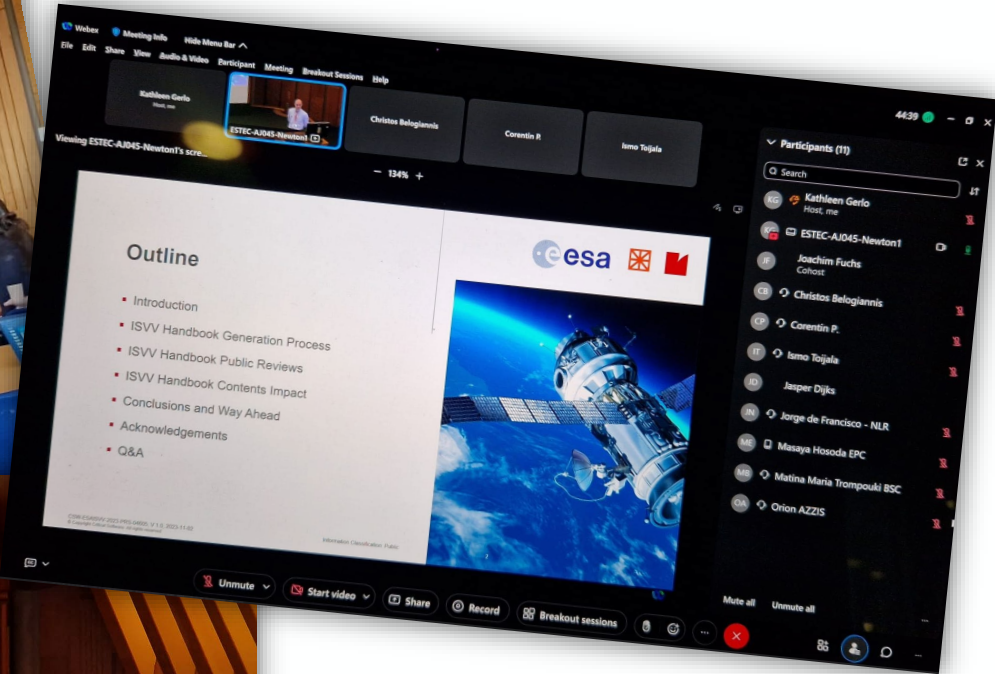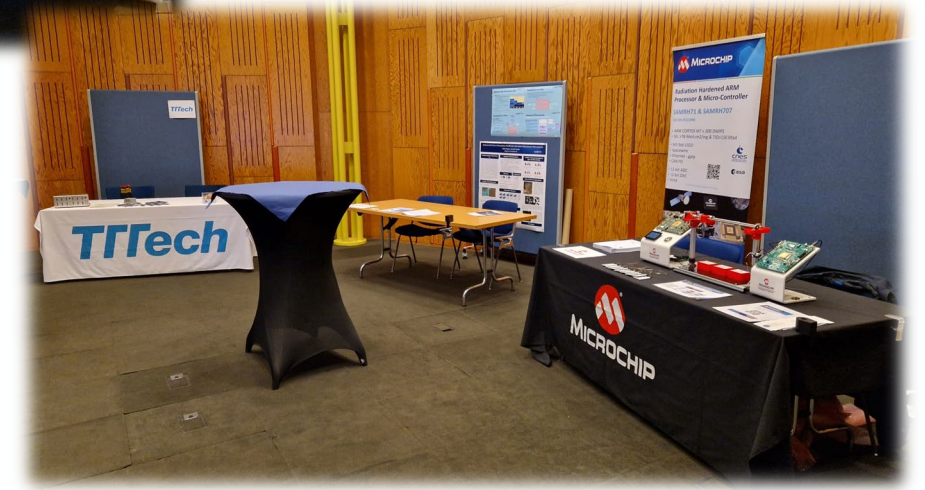
ADCSS2023 – Plenty of coffee & cookies

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Key Observations

SAVOIR Session

The **SAVOIR** session has shown that it is still very active and relevant for the coordination of the technical domains involved in avionics and is extending its initial perimeter to cover the interactions with **Ground** (Space-Ground communications) and **Payload**.

SAVOIR documents are available ([ESSR - Landing Page (esa.int)](https://essr.esa.int/) - https://essr.esa.int/)

The updated SAVOIR FDIR Handbook and the SAVOIR Communications Technical Note will soon be available on ESSR.

A new SAVOIR Working Group on **Electronic Data Sheet** is being initiated, reflecting the growing reality of model-based approaches in all domains and the need for increased interoperability between different organisations to get the full benefit.

The proposed **roadmaps** demonstrate also the recognized importance to advance the design and verification of avionics for future systems. Standardisation efforts capture and formalise the reklevant methods and approaches, including firsts covering AI and ML.

Data Handling Session

The contemporary landscape of **space digital electronics** diverges significantly from that of 25 years past. In this context, it is evident that the industry is actively pushing for the adoption of **novel methodologies** that allow shorter developments and bigger designs. Notably, the solutions grounded in **MBD coupled with HLS**, emerge as predominant choices for specific applications within the European Space ecosystem.

The recent endorsement by **ECSS** for the development of a **Handbook on auto-coding for Space FPGAs** would provide a singular opportunity to convene experts from ESA's space digital electronics suppliers. This gathering would facilitate the exchange of ideas and the collaborative establishment of guidelines and techniques, ultimately fostering the creation of reliable HDL code generation.

The MBD approach to space digital electronics for implementing spacecraft functionality supports the MBSE approach to space system development. Standardized interfaces between HW and SW would facilitate the MBD partitioning of the spacecraft functionality over these two domains.

GNC and AOCS Session

Overview of debris mitigation needs and solutions in relation with AOCS/GNC/Avionics Systems
New policy, GNC for Active Debris Removal, AOCS & Operations for re-entry, Hardware resources, from sensor suite to detumbling device
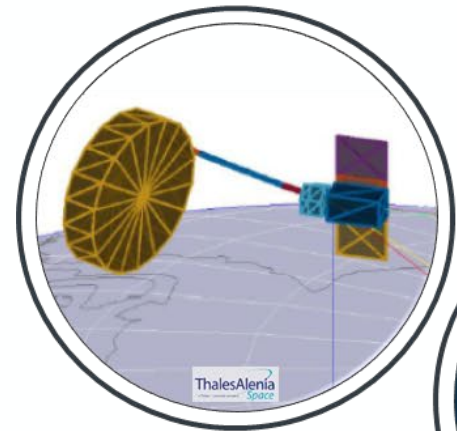
Controlled re-entry (example here of Copernicus / **CIMR**) and the associated development features in terms of propellant, thruster configuration, specific modes design and verification
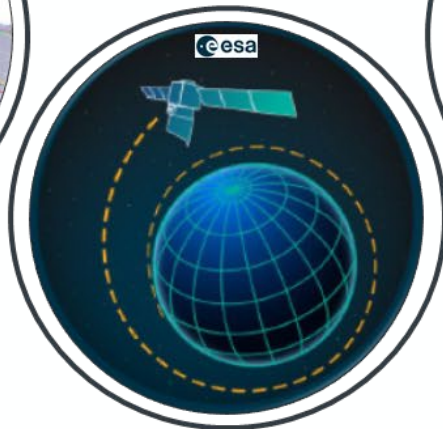
Successful example of **assisted re-entry**, for a spacecraft not designed initially for this end-of-life option (**AEOLUS**), however final **Operations** demonstrating significant gain in terms of casualty risk reduction
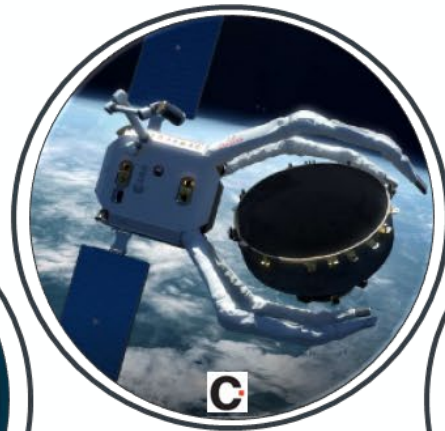
Active debris removal for non-cooperative target/spacecrafts, to prevent space debris generation example of **CLEARSPACE-1**

To support the active debris removal and close proximity operations of a chaser, a **passive detumbler system** was presented by AIRBUS **IOD early 2024**

A number of **AOCS/GNC equipment** are ready to support missions aiming at **limiting and/or reducing space debris**, have been presented by JenaOptronik for Close Proximity Operations and Object Detection in the vicinity of spacecraft

The **ESA Space Debris Mitigation Requirements (ESSB-ST-U-007)** has been presented, highlighting its evolution in several areas, including the probability of successful disposal, collision avoidance and debris removal.

SW Session

The session on "**modern techniques for software verification and validation**" highlighted the importance of incorporating modern SW V&V techniques into the current software development life cycles.

Indeed, **verification and validation activities** in the space software standards (E40/Q80) are quite extensive, and the **SW systems are becoming quite large and complex**, from a functional and architectural point of view. The corresponding SW artefacts are huge, and more systematic methodologies, and the corresponding tooling, are needed.

Examples of verification activities are e.g. the use of Model-Based approaches, the verification of test suites, schedulability analysis, static code analysis, dynamic code analysis, extra verification activities for category A SW, …. Example of validation activities are e.g. multi-core approaches, RTOS – Hypervisors; address complex architectures, use other testing methodologies e.g. model-based testing, fuzz testing, …). Also, the fact of adopting modern software approaches may help in the V&V of the SW systems (e.g. by using modern coding languages).

The session introduced a set of activities that have been concluded, noting that those are part of a wider set of activities/roadmap on the SW V&V domain.

AI for FDIR Session

The session highlighted the results of activities aiming at developing Artificial Intelligence for detecting failures in spacecraft.

The three activities **demonstrate the feasibility and interest** of the approach even in **very constrained systems**. They also identified the limits of this approach compared to traditional FDIR in some cases.

The underlying uncertainty related to the AI techniques calls for new validation and qualification process with respect to standard software applications. An ECSS Handbook has been prepared and went through a public review.

Some gaps and issued have been identified as availability of consolidated KPI to evaluate the results, availability of representative data sets with sufficient number of failures). The final evaluation of such AI-based system can only be done on the real system, calling for **In-Orbit Demonstration.**
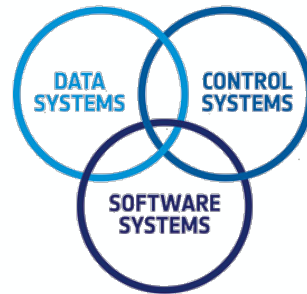
Future Events

18ᵗʰ Workshop on Avionics, Data, Control and Software Systems
~ ADCSS 2024 ~

22-24 October 2024 | ESA/ESTEC | The Netherlands

Data Systems, Microelectronics & Component Technology Division (TEC-ED)

GNC, AOCS & Pointing Division (TEC-SA)

Software Systems Division (TEC-SW)

Remaining Events 2023

- **4th Model Based Space Systems and Software Engineering ~ MBSE2023**
  - Tomorrow, Thursday 16 November (Newton Conference Area)
  - Event website: https://indico.esa.int/event/472/

- **Space System Ontology Developer Workshop**
  - 23-24 November (ESA/ESTEC)

- **NanoXplore's 5th BRAVE Days**
  - 28-29 November (ESA/ESTEC)
  - Event website: https://indico.esa.int/event/456/

- **AR/VR for Space Programmes**
  - 11-12 December (ESA/ESTEC)
  - Event website: https://indico.esa.int/event/475/

2024/2025 Events

- **LING4S**
  - April 2024 (Location TBD)
- **10th International Workshop on Analogue and Mixed-Signal Integrated Circuits for Space Applications ~ AMICSA 2024**
  - 13-16 May 2024 - Event website: keep an eye on https://indico.esa.int/category/6/
- **DASIA 2024**
  - 7-9 May 2024 (Torremolinos, Spain)
- **5th Model Based Space Systems and Software Engineering ~ MBSE2024**
  - 28-29 May 2024 (Bremen, Germany) - Event website: https://mbse2024.welcome-manager.de/
- **5th Space Passive Component Days ~ SPCD 2024**
  - 15-18 October 2024 (ESA/ESTEC) - Event website: https://www.spcd.space
- **6th SpacE FPGA Users Workshop ~ SEFUW2025**
  - 25-27 March 2025 - Event website: keep an eye on https://indico.esa.int/category/6/

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