MICE

Mechanical Interface for Capture at End-Of-Life

Clean Space Industry Days
24th September 2021

avs added value solutions

gmv INNOVATING SOLUTIONS

Agenda

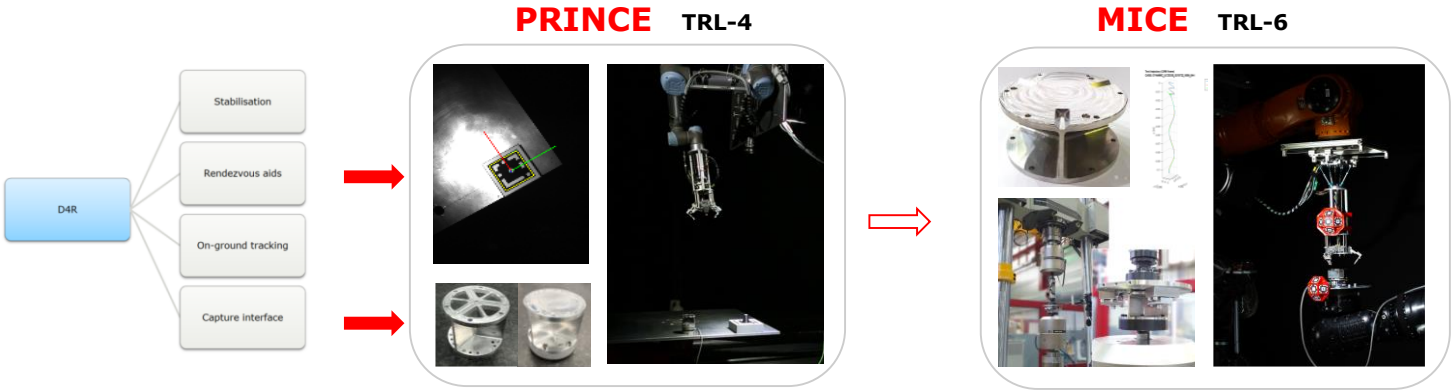
- Project Overview
- PIF / AIF concept, design and manufacturing
- Test Campaign & Results
- Conclusions
- Questions

MICE – project overview

- **Background:**
  - The activity is a follow-up of previous PRINCE activity, concerning the design, manufacturing and test of the passive mechanical interface to be embedded on future EO satellites for EoL capture and de-orbiting.
  - With this heritage, an iteration of the design was expected, as well as a complete test campaign up to **TRL-6**.

PROJECT facts:

- Target TRL: 6
- Budget: 150 K
- Duration: 1 year
- Ind. Consortium: GMV + AVS



MICE – project overview

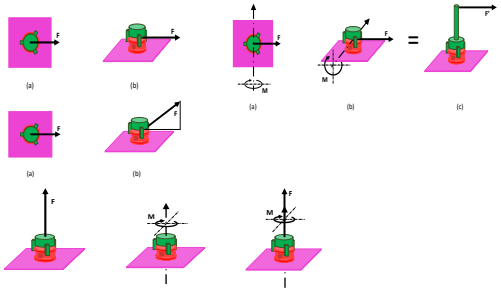
- **Objectives:**
  - **To iterate on the mechanical interface design**:
    - PIF design consolidation taking into account target platform constraints (PIF/AIF concept need to be considered together)
    - To provide for flexibility enough for future chaser system design
  - **To manufacture the PIF**
  - To perform a full **validation campaign up to TRL-6**. It included:
    - Structural analyses, contact stress analyses, capture verification.
    - Thermal analyses
    - Bonding tests
    - Functional and performance tests:
      - Quasi-static load tests
      - Misalignment accommodation tests

MICE – test campaign

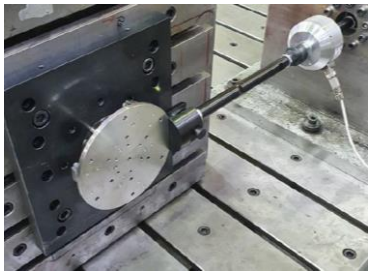
- **Quasi-static load tests**

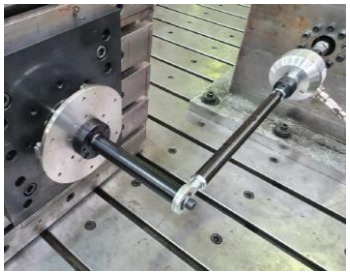
AIF load mock-up

To verify that no plastic deformations take place



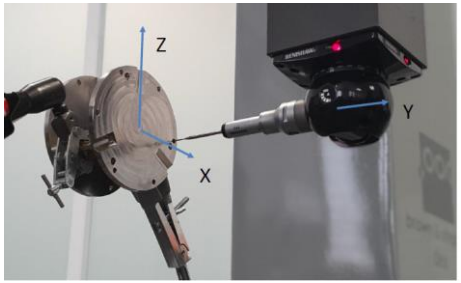
Multi-axial system set-up





Bi-axial system configuration

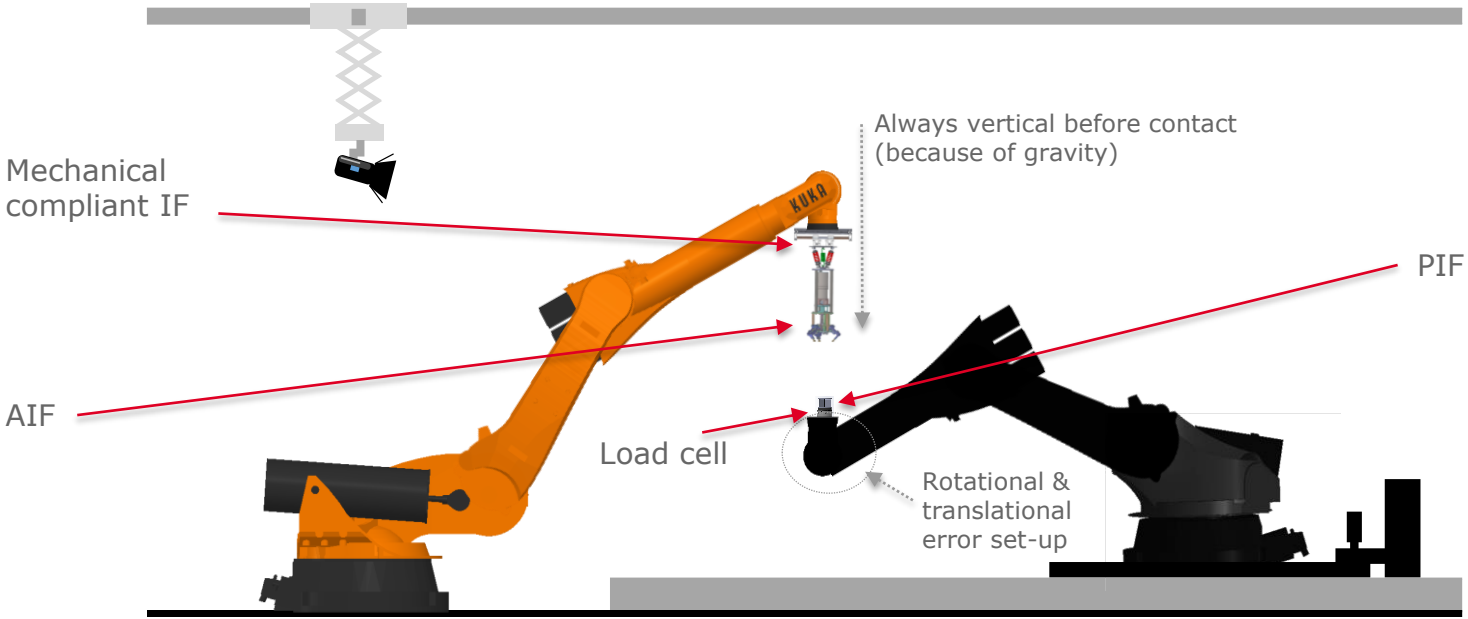
Pre and post-test metrology



MICE – test campaign

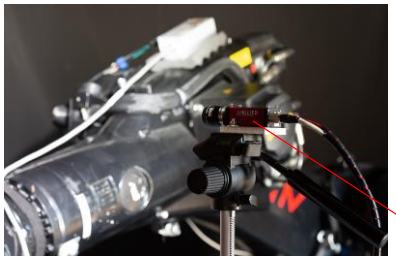
- **Misalignment accommodation tests**

Test set-up at GMV's ©*platform-arm* facility

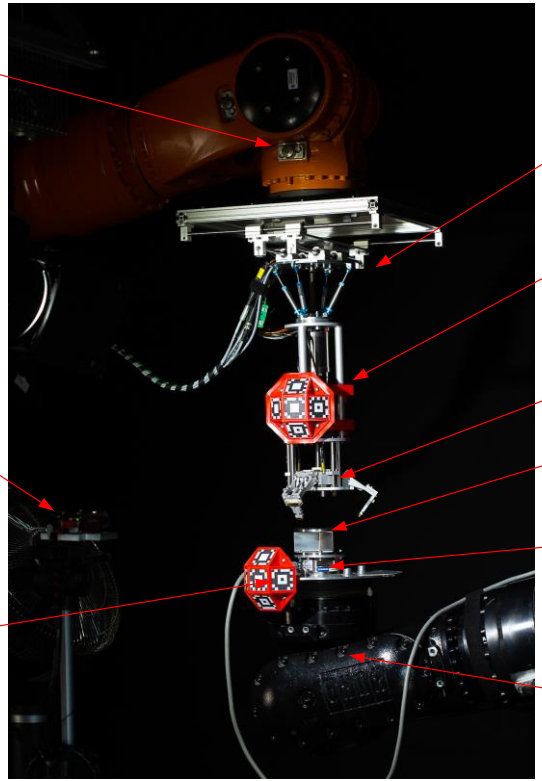


Misalignment accommodation tests

- **Test set-up implementation**

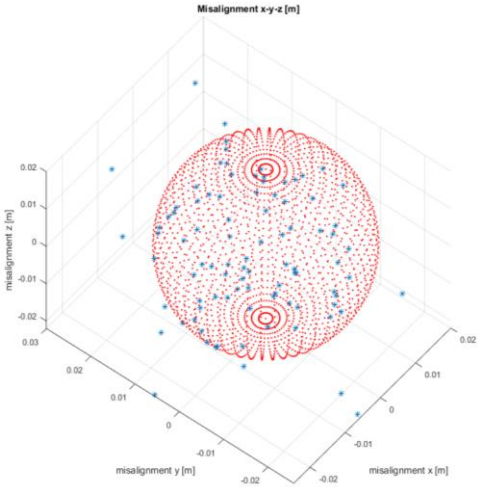


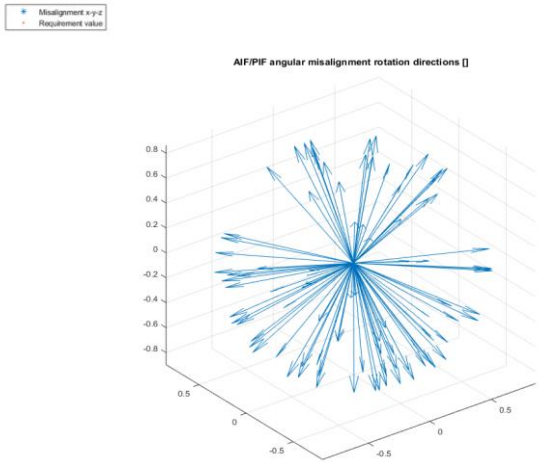
Mako G-419B NIR camera

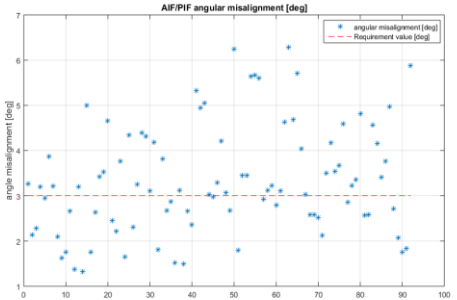


Misalignment accommodation tests

- **Test results – static cases**
  - Static capture tests in conditions covering misalignment around and outside requirements (±20 mm, 3 deg any axis).
  - Successful capture in 100% cases
  - Non violation of nominal KoZ for cases inside requirement bounds

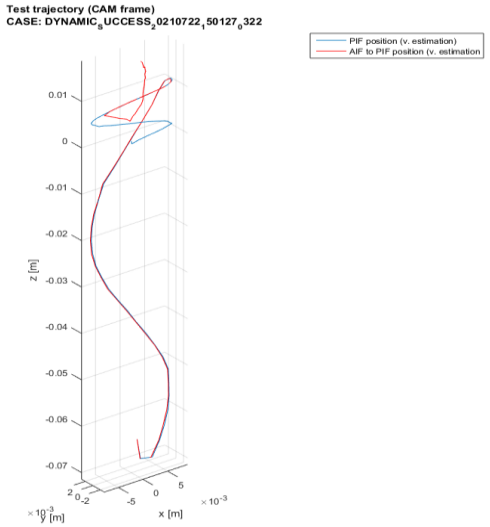


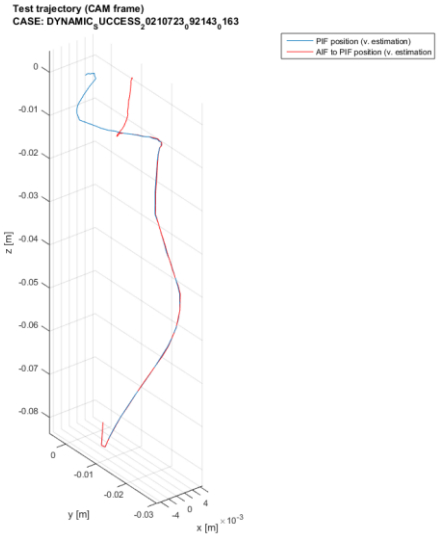


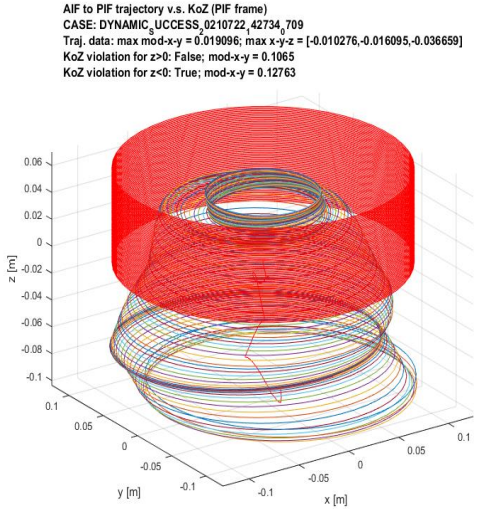


Misalignment accommodation tests

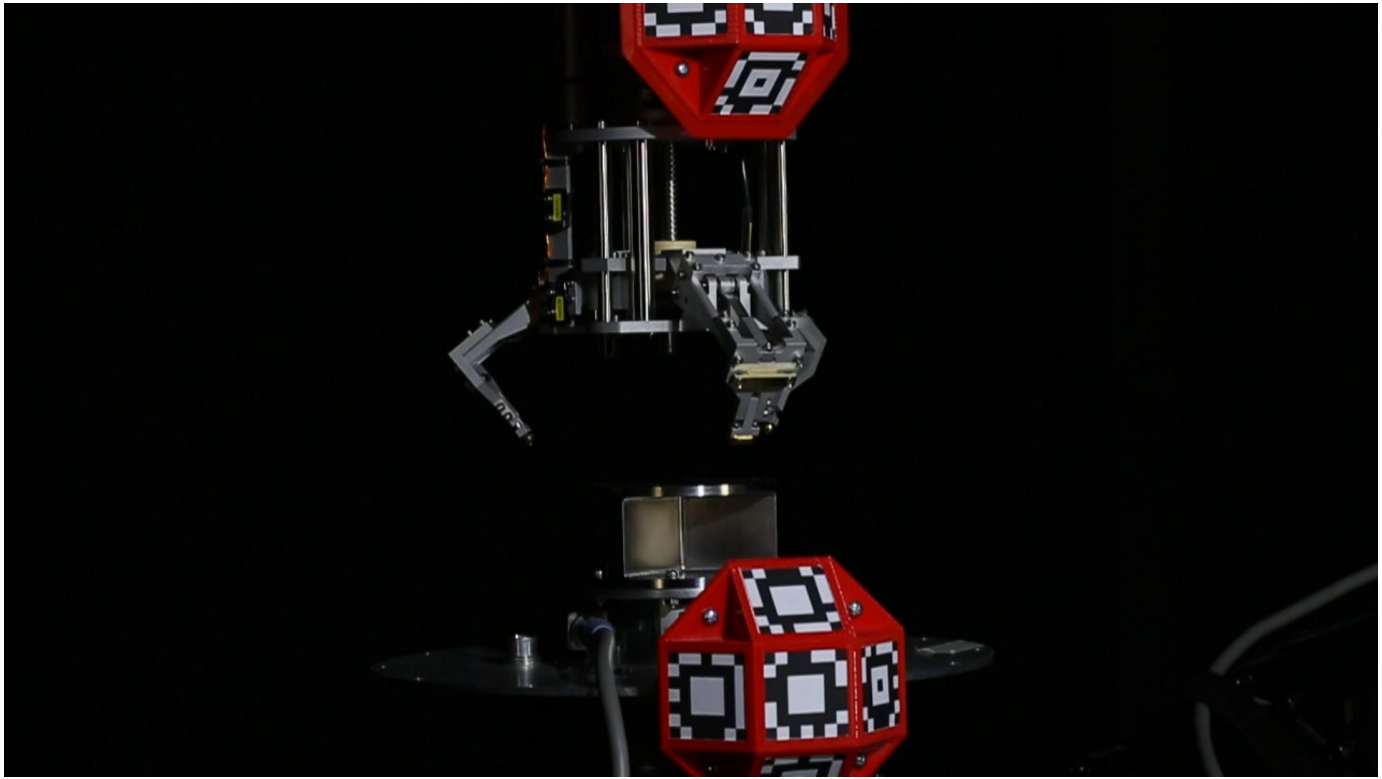
- **Test results – dynamic cases**
  - Dynamic capture tests with random sinusoidal trajectories covering misalignment around and outside requirements.
  - Successful capture in 100% cases
  - Non violation of nominal KoZ for cases inside requirement bounds





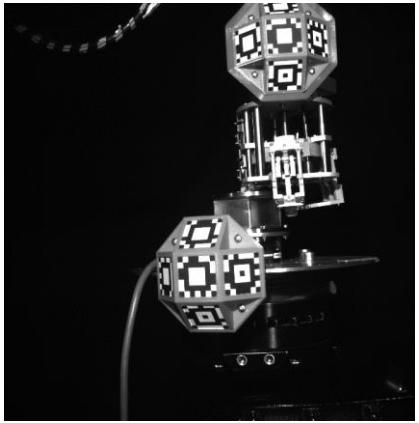


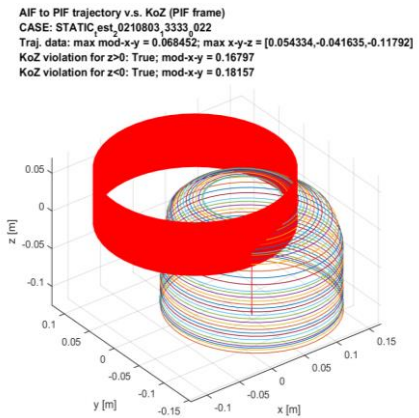
Misalignment accommodation tests

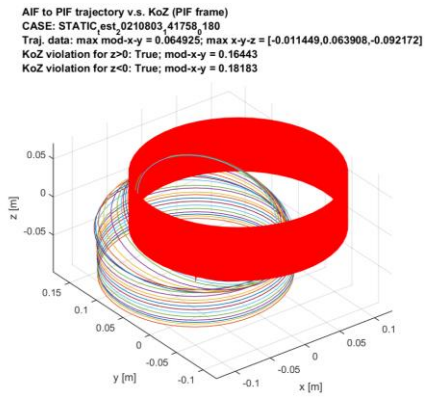


Misalignment (capture) tests review

- **Additional test cases to experimentally assess misalignment accommodation limits (far off-nominal capture fails)**







Conclusions

- **PIF/AIF concept** has been matured providing a design that copes with requirements and at the same time provides the required flexibility for future implementation of the active capture system.
- The PIF has been manufactured and validated up to **TRL 6**. Along the MICE Test Campaign all MICE requirements traced to Tests have been **successfully verified**.
- The results have shown evidence (PIF metrology) that **no plastic deformation** has taken place on the PIF. Maximum deviation registered among all the controlled dimensions at the end of test plan: 0.017 mm (in the order estimated repeatability between dimensional measurements).
- All static and dynamic **misalignment accommodation** test cases (already including a significant number of cases close and outside the requirement values) produced **successful captures**. Some far off-nominal test cases were also run in order to produce failed captures. The results show very good robustness and significant margins with respect to the misalignment conditions defined by the requirement (with successful captures up to 4 and even 5 cm position offsets).

Conclusions

- No test cases defined within the requirement maximum misalignment condition have produced violation of the nominal **KoZ** (assumed to be of the same height of the PIF). Violations of the KoZ are produced for test cases whose misalignment conditions are outside the requirement boundary (since current margins to accommodate for combined position and angular misalignments of the AIF are very tight).
- Relocation movements of the AIF around the PIF once in contact and up to the final closure are very contained and violations of the KoZ do not happen at this stage.
- The thermal performance of the PIF has been assessed. The baseline configuration corresponds to 'bare material' thermo-optical conditions & bare preloaded contact at the whole PIF base. The thermal performance could be improved by means of:
  - Increase/reduce solar absorptance (black paint/white paint respectively)
  - Increase/reduce thermal contact conductance (thermal filler/thermal insulation respectively)

Questions?

Thank you

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