SWISS CAPTURE SYSTEM BASED ON

- Steward Platform
- Gripping System
- High precision space
- mechanism

CAPTURE SYSTEM FOR SERVICING AND DEBRIS REMOVAL (CRUSSADER)

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csem
FACING THE CHALLENGES OF OUR TIME

almatech

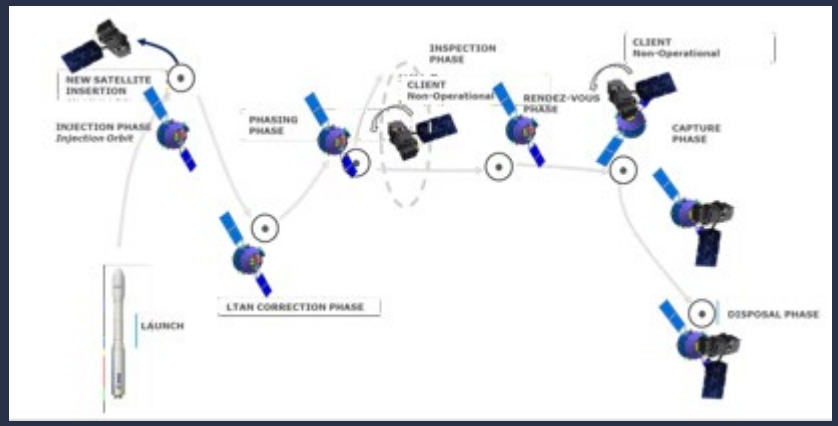
ESA Clean Space Industry Days 2022

Agenda

- Overview
- Key Specifications
- Design
- Next steps

CRUSSADER mission target

- CRUSSADER system will be able to catch Earth observation satellites up to 2 tons and equipped with a standardized interface "MICE". Main goal of the project is to achieve TRL6 for the system excluding the EGSE where TRL4 is requested.
- Objective: Catch and deorbit old spacecraft which are in an uncooperative state for replacing them with new ones which will take the same orbit.
- ESA funded activity



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Capture sequence

- The capture sequence is split into two phases:

- Phase 1: soft (topological) capture to ensure that the target cannot escape from the gripper during subsequence contact/capture phase. This shall be completed without transmitting a contact load to the target.

- Phase 2: hard capture/ rigidization phase to firmly secure the target.

Absolute Performance Errors (+/-) between Servicer and Chaser when the relative distance is < 1 m around any axis

	Maximum absolute error
Attitude [°]	3°
Attitude rate [°/s]	0.25°/s
Position [mm]	20 mm
Position rate [mm/s]	5 mm/s

- CRUSSADER is able to adjust the offset of the servicer and client face planes by ±5° post grasping.
- The rotation of the upper plate of the hexapod around Z-axis is ≥ 15° even completely deployed considering that the axis of the gripper and the hexapod are aligned with the Z-axis

CRUSSADER mass budget

Items	Quantity	Mass [kg]	Total Mass [kg]
Actuators	6	3.39	20.32
Mobile harness holder	3	0.75	2.25
Gripper actuator	1	2.92	2.92
Base plate	1	4.96	4.96
Top plate	1	3.20	3.20
Gripper	1	2.03	2.03
Harness (mobile + fix)	1	0.96	0.96
Total			***36.64***

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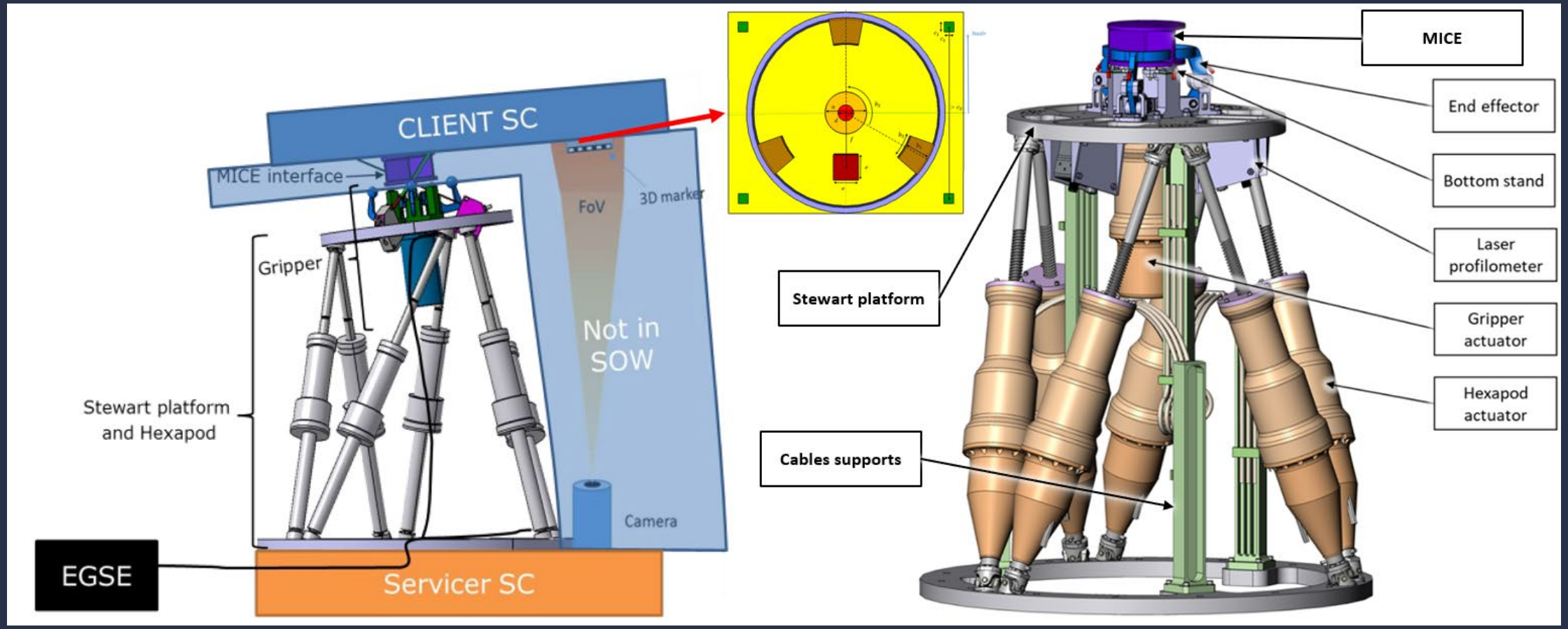
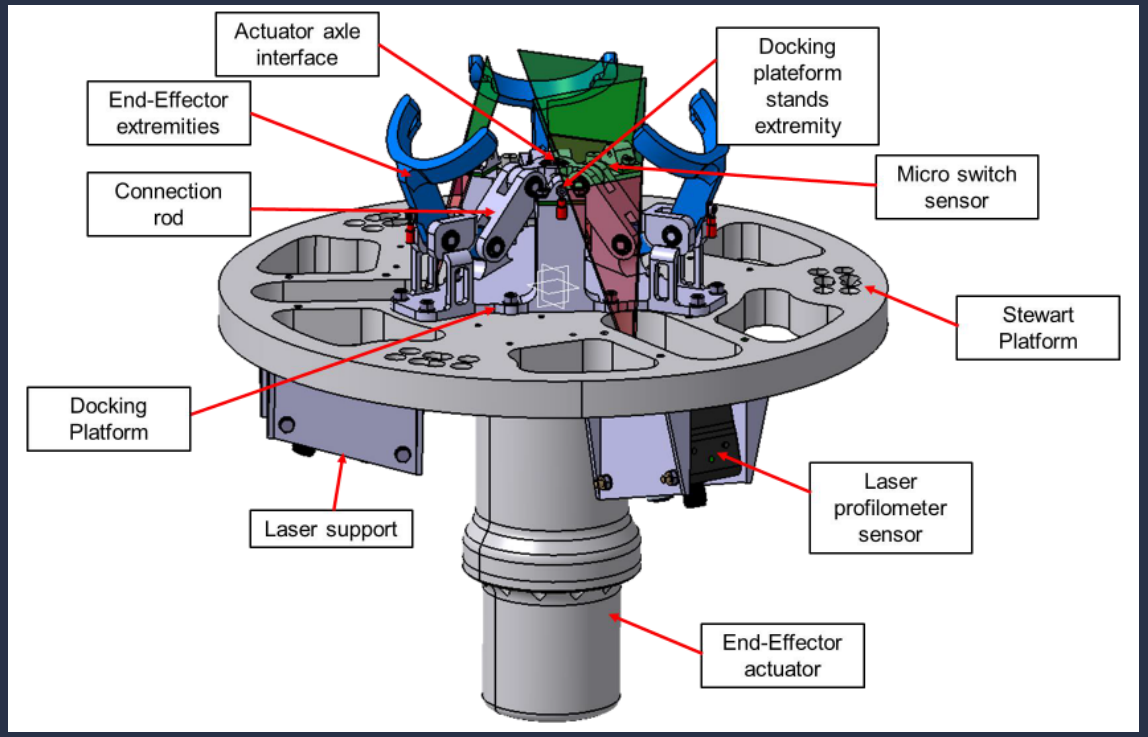
CRUSSADER concept

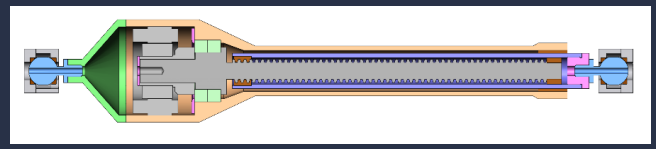


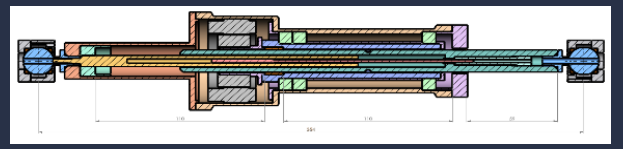
CRUSSADER end-effector

- Concept design highlights:
  - Use of the same actuator architecture as in hexapod
  - Embedded encoder sensor allow to retrieve exact opening status of the gripper
  - End position switches allow to confirm closed and open final positions of gripper for hard capture and release phase
  - Micro switches sensors to confirm presence of MICE and good Capture

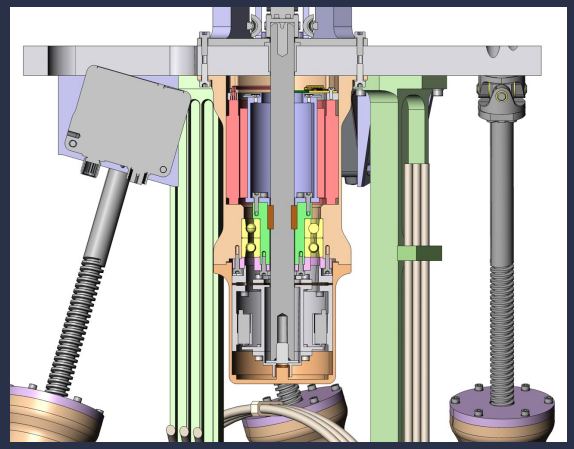


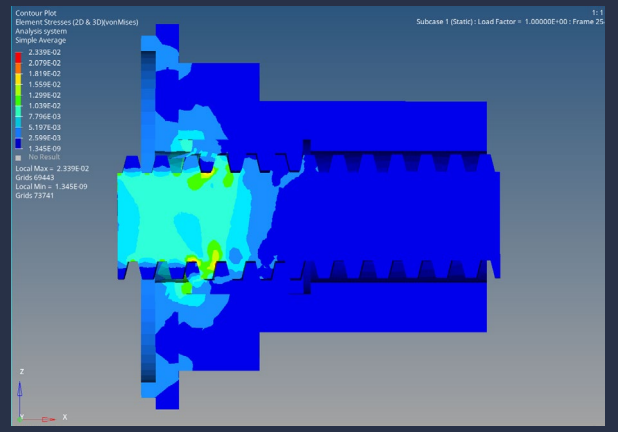
CRUSSADER actuators

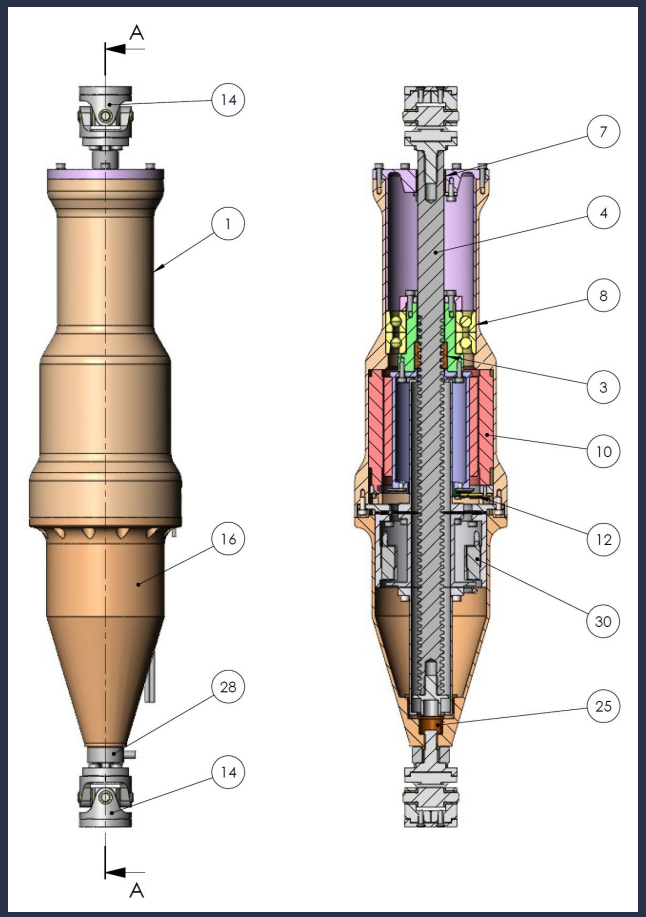




- Trade-off consolidation
- Actuator design :
  - Motor selection (brushless)
  - Plain bearing
  - End-switch / end stops
  - Driving nut and lead screw
  - Gimbal
  - Magneto-resistive encoder





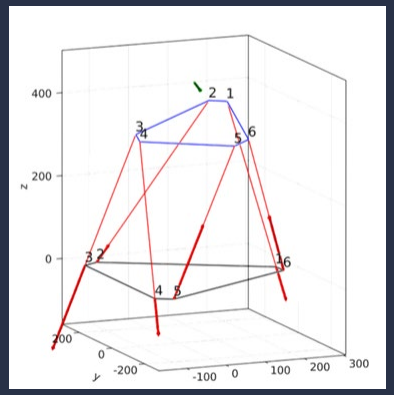


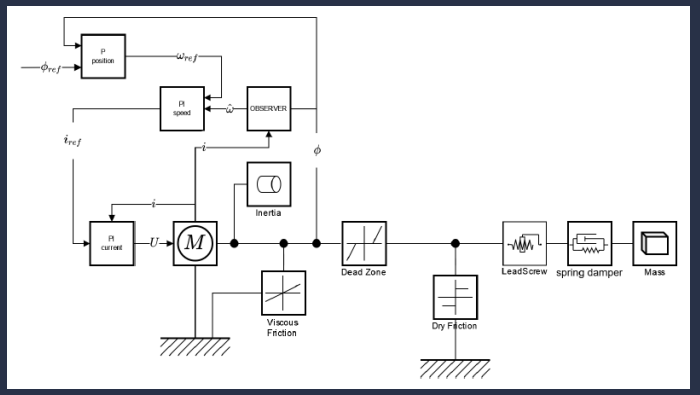
- Actuator analysis :
  - Load determination
  - FEM on detailed parts
  - Part preliminary sizing and analysis (motor, etc..)

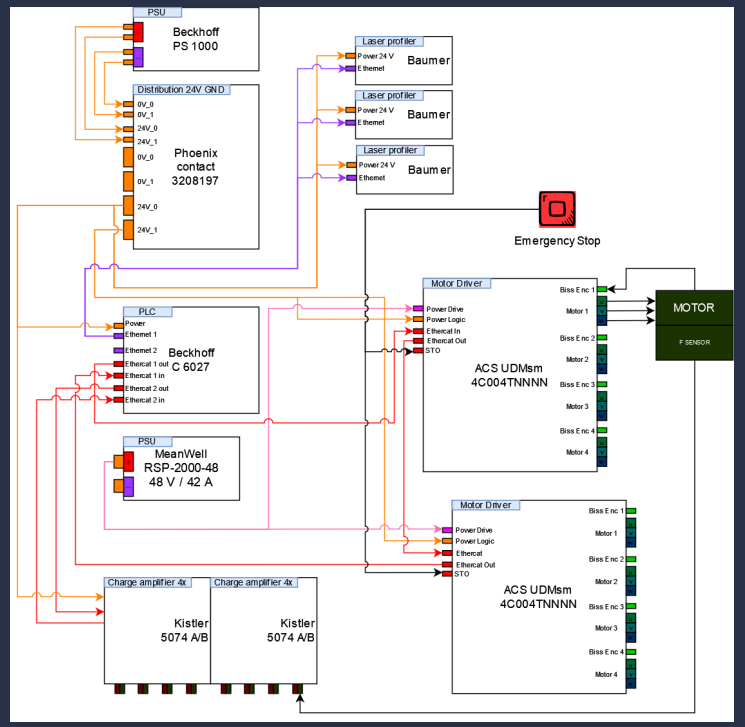
→ Near CDR level achieved

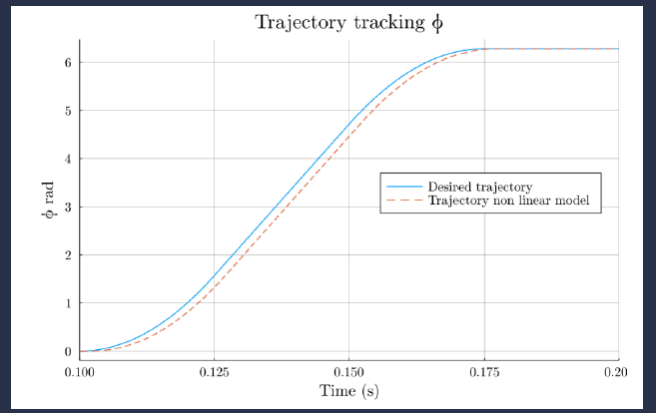
CRUSSADER EGSE

- Control law:
  - Inverse kinematic
  - State space controller
- EGSE:
  - Schematics
  - Based on Beckhoff drivers









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NEXT STEPS

- Gripper End Effector BB → Q4 2022
- Actuator Bread Board → Q1 2023
- CRUSSADER CDR → Q1 2023
- Environmental and Functional Tests Q3 → 2023
- DRB Q4 → 2023

THANKS !

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