Gripper for in-orbit servicing operations

PIAP SPACE

Proc. 8th European Conference on Space Debris (virtual), Darmstadt, Germany, 20–23 April 2021, published by the ESA Space Debris Office
Ed. T. Flohrer, S. Lemmens & F. Schmitz, (http://conference.sdo.esoc.esa.int, May 2021)

“At PIAP Space, we believe that we can make Space and Earth cleaner, safer, and sustainable, by designing, engineering, and delivering top-quality robotics solutions”.

EROSS

EROSS (European Robotic Orbital Support Services) objective is to demonstrate the European solutions for the Servicers and the Serviced LEO/GEO satellites, enabling a large range of efficient and safe orbital support services. The project will assess and demonstrate the capability of the on-orbit servicing spacecraft (chaser) to perform rendezvous, capturing, grasping, berthing and manipulating of a collaborative client satellite (target) provisioned for servicing operations including refuelling and payload transfer/replacement.
In this project, PIAP Space is responsible for providing the LAR Gripper for the berthing operation, the F/T sensor for the robotic arm and satellite mock-ups for demonstration purposes.
Consortium led by Thales Alenia Space France (TASF) consist of 10 partners: GMV, NTUA, PIAP Space, SENER, SINTEF, SODERN, SPACEAPPS, TASI, TASUK.

ovation

Credit: ESA

EROSS

PIAP Space – providing LAR Gripper for the berthing operation, F/T sensor for robotic arm and Satellite mock-ups for demonstration purposes

EROSS+

Continuation of the EROSS project. EROSS building blocks are to mature to TRL 6.

This project has received funding from the European Union's Horizon 2020

Thales Alenia Space

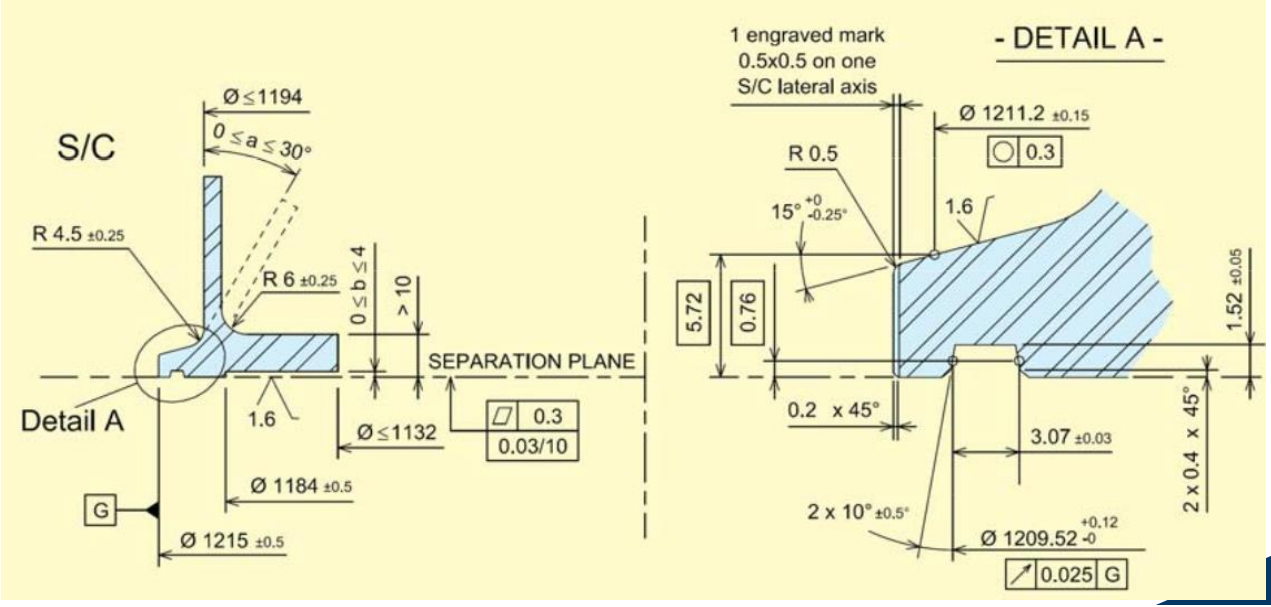
FUNCTIONALITY

The LAR Gripper is developed to ensure capture, berthing and stabilizing the Client Satellite. This design will be compatible with multiple models of spacecrafts Launch Adapter Rings (LAR) to enable grasping/berthing to both monolithic and designed for servicing target satellites, since LAR interface occur in most spacecrafts, has standard dimensions, high stiffness and no thermal blankets.

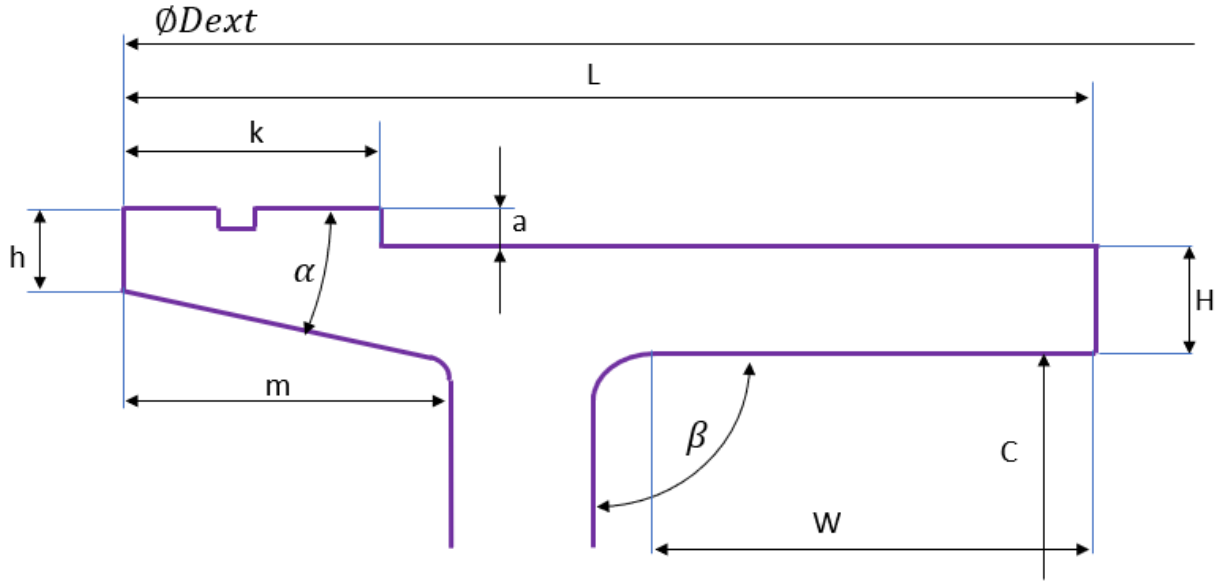
Main design drivers

- LAR interfaces
- Gripper load capacity
- Capture envelope
- Closure time
- Mass
- Envelope
- Power consumption
- Target LAR material

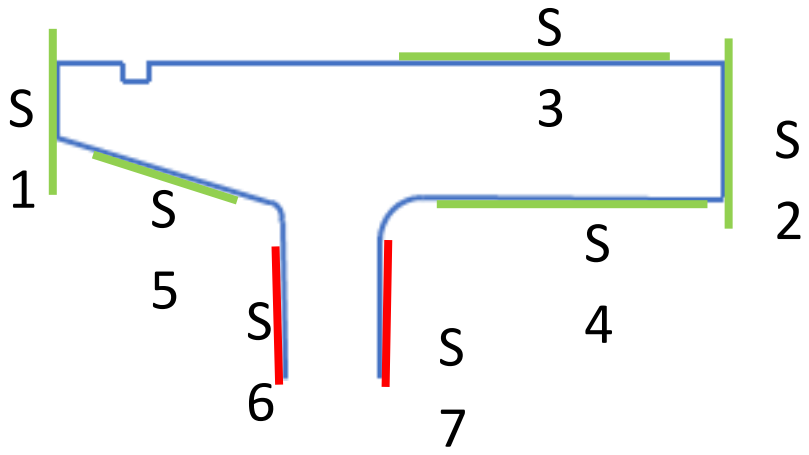
LAR cross section example
PAS 1194C – spacecraft side



LAR Interfaces

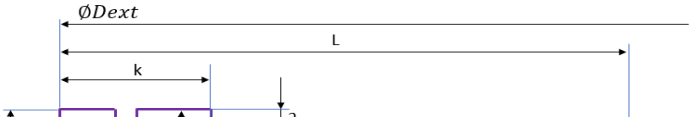


Common LAR interfaces

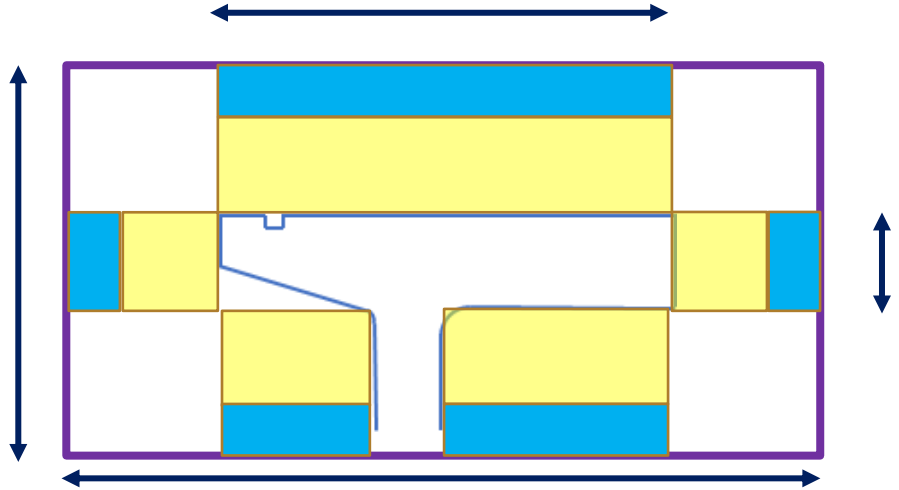


Common LAR interfaces cont'd

S1 – surface of the contact is defined by "h" dimension
S2 – surface of the contact is defined by "H" dimension
S3 – surface of the contact is defined by "a", "L" and "k" dimensions
S4 – surface of the contact is defined by "a", "H", "L" and "W" dimensions
S5 – surface of the contact is defined by "alfa", "h" and "m" dimensions
S6 & S7– surfaces of the contact are defined by "beta", "m" and "W" dimensions

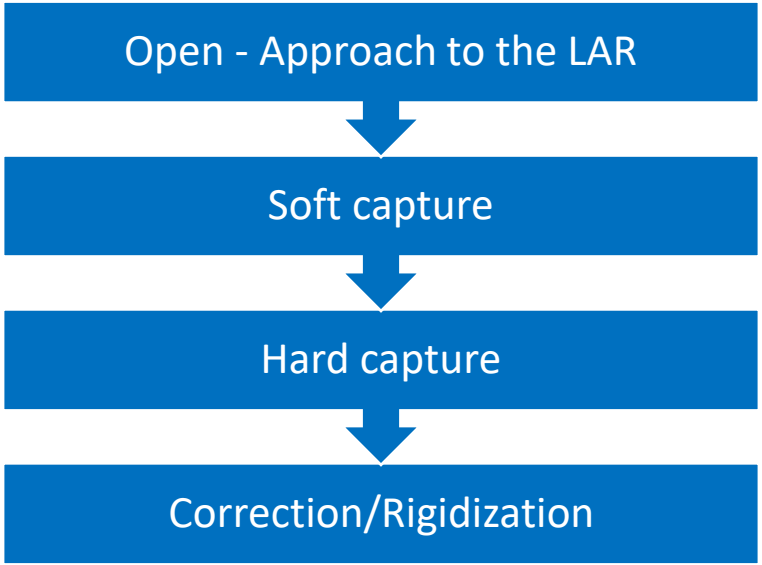


Capture envelopes

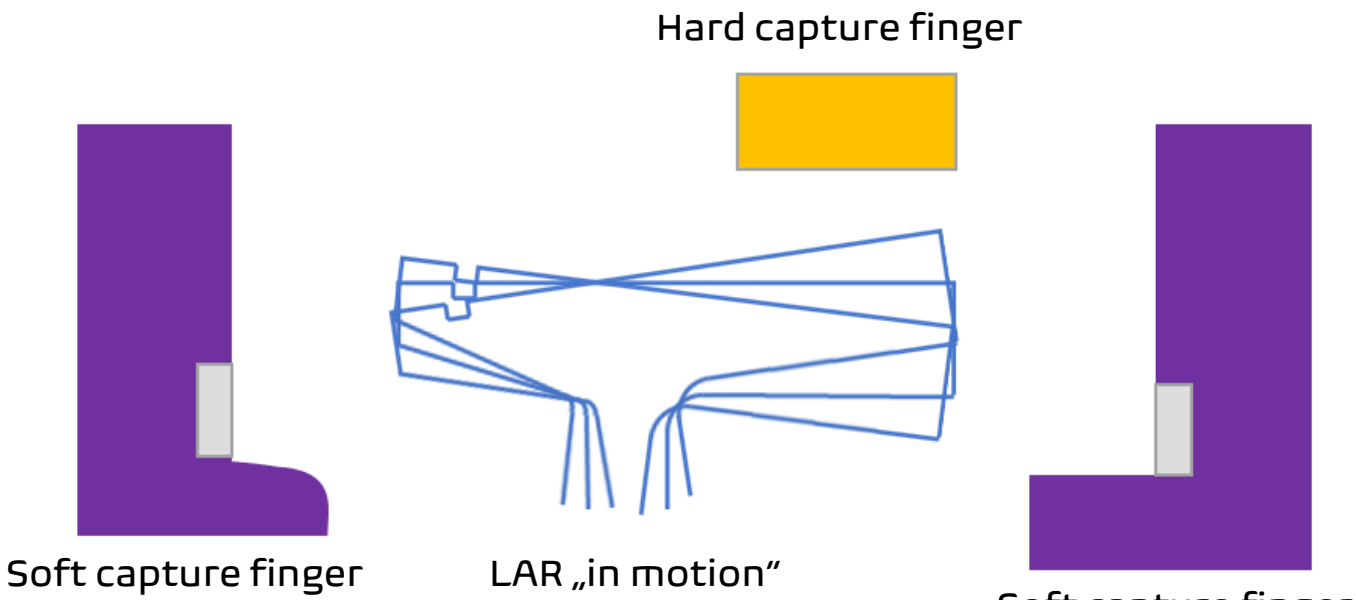


Capture envelope based on geometric deviation

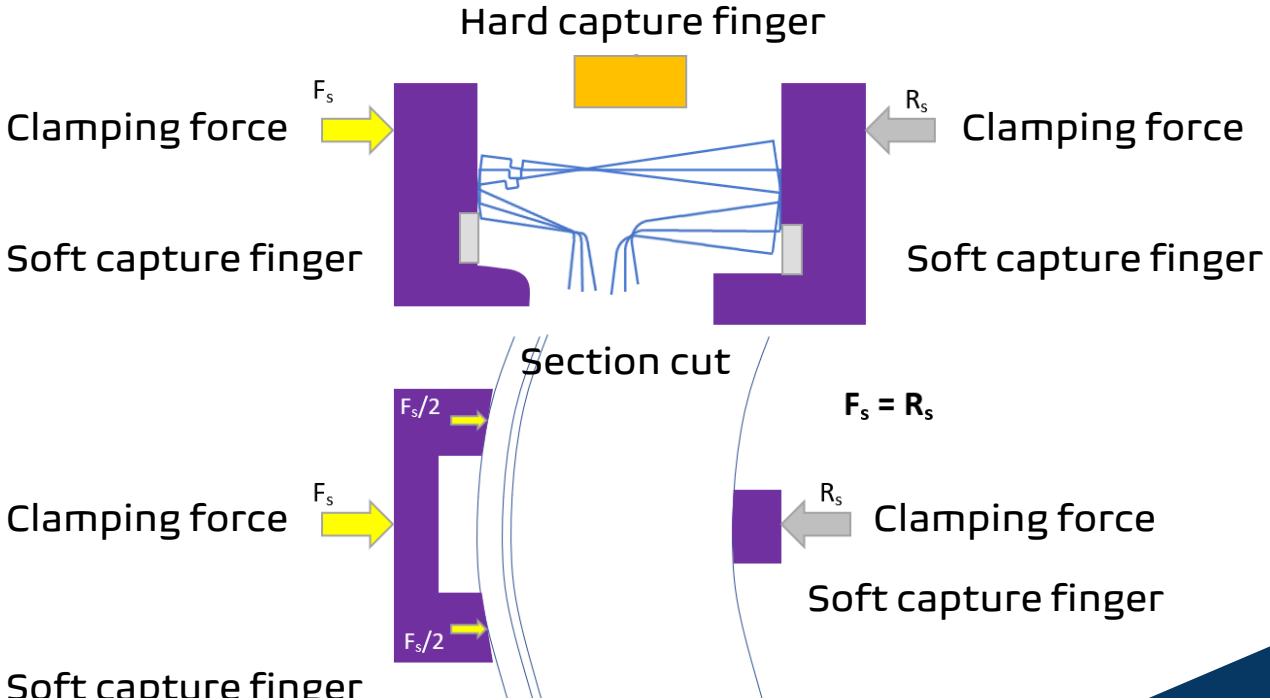
Capture phase



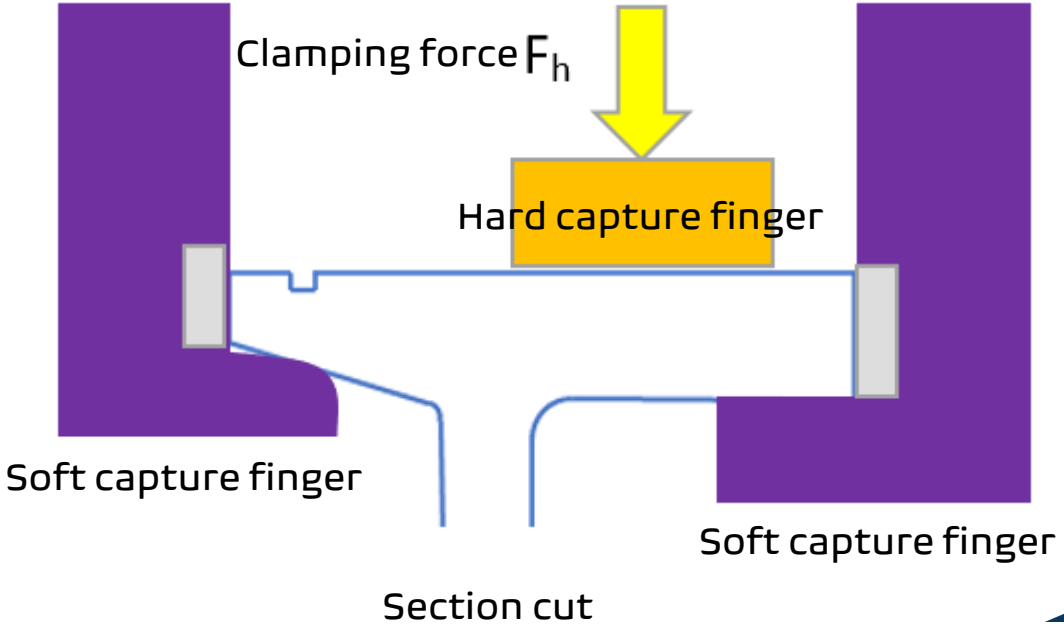
Capture phase Step #1



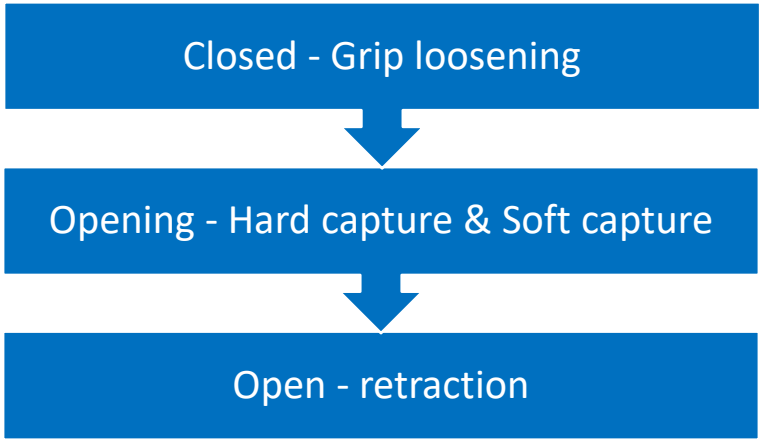
Capture phase Step #2



Capture phase Step #3



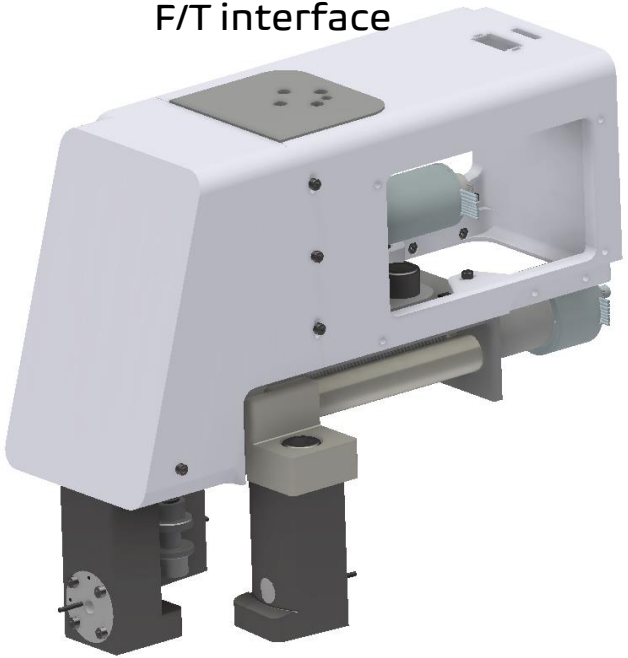
Release phase



Design overview

Remark:
Some elements not shown

F/T interface

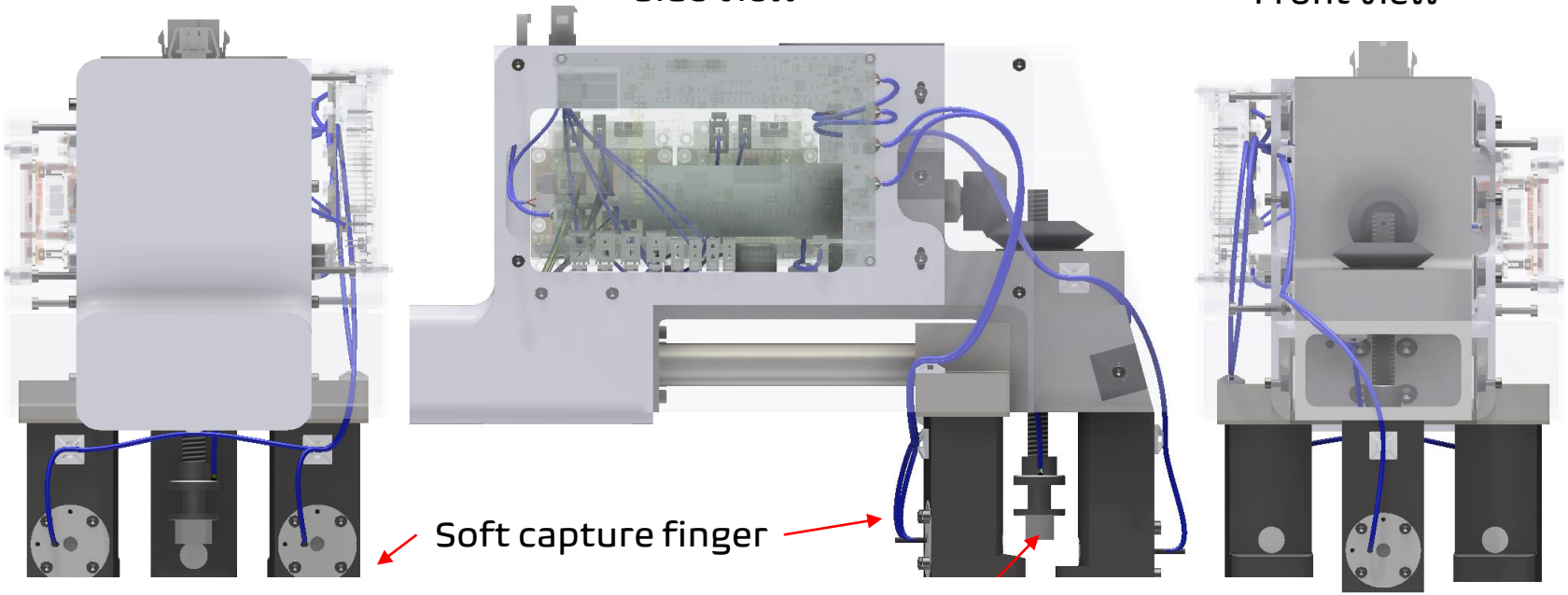


Design overview

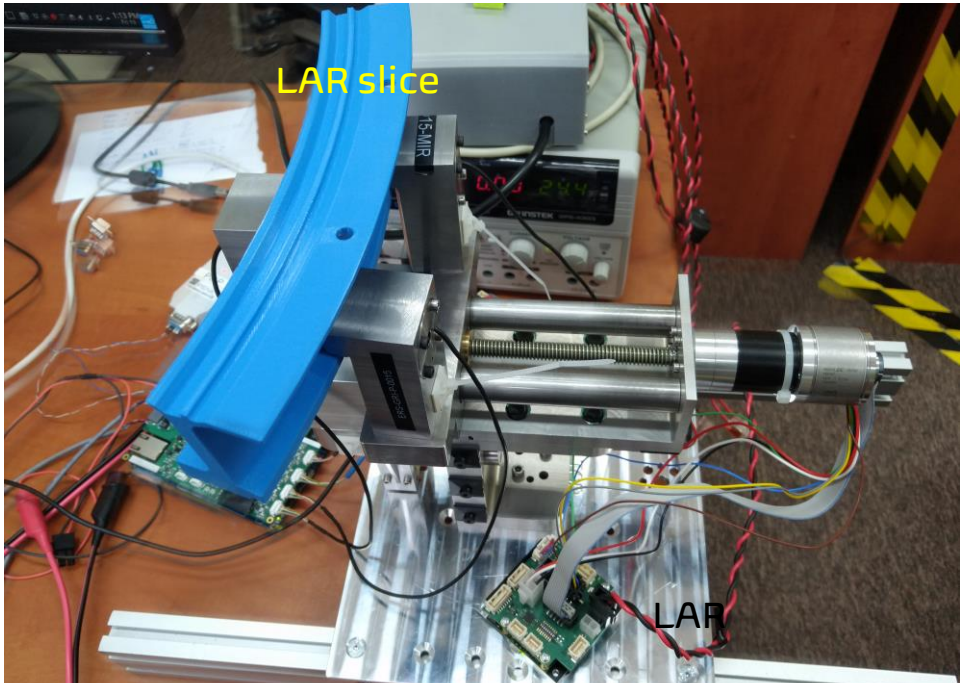
Remark:
Some elements not shown

Side view

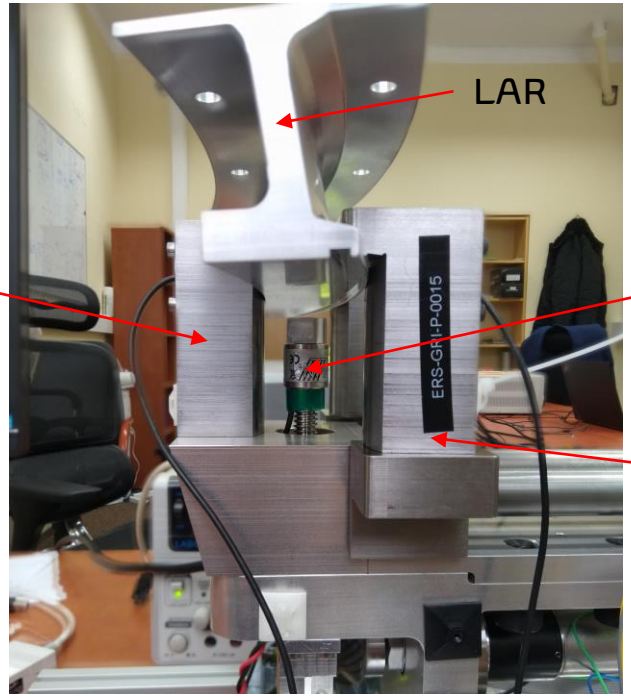
Front view



Capture overview

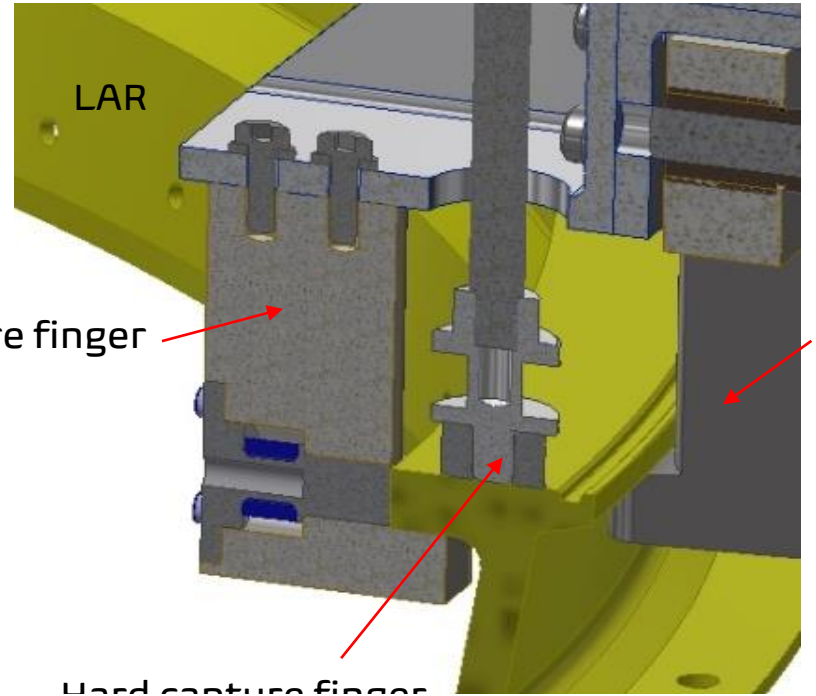


Capture overview

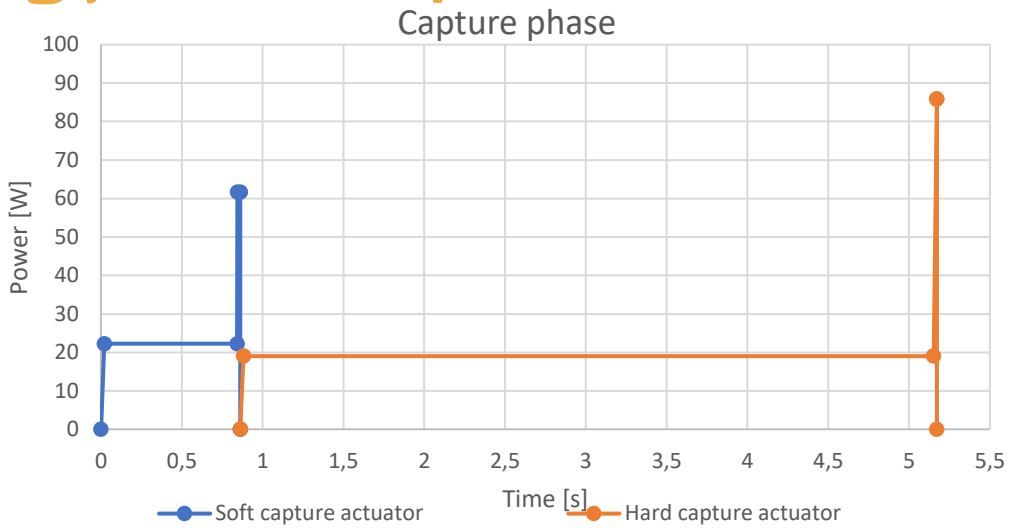


Capture overview

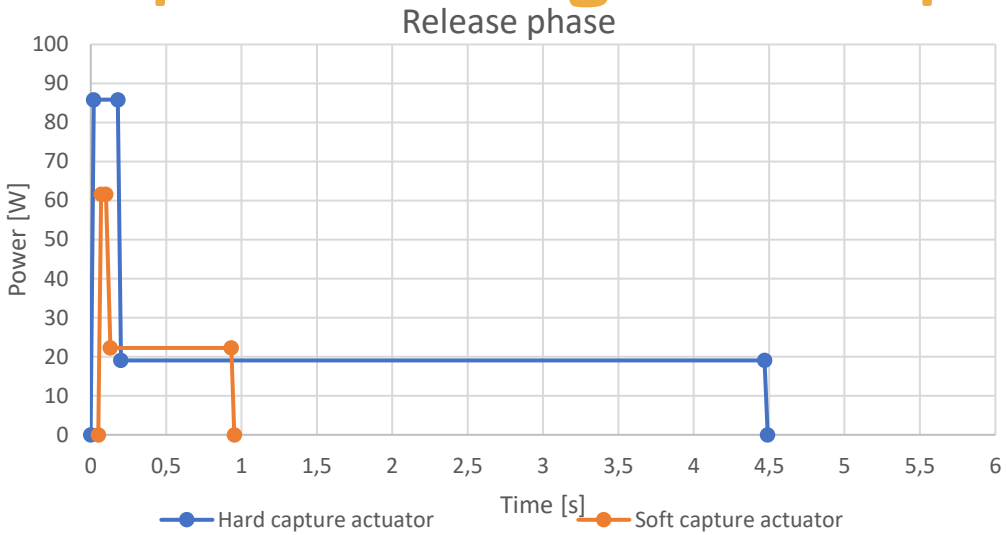
Capture overview cross section



LAR Gripper actuators power and energy consumption for one full cycle



Gripper actuators power consumption during release phase




PIAP
SPACE
TITAN
2,600,000 EUR
Robotic Arm Development
for On-Orbit Servicing Operations

Thank you!

Grzegorz Stachyra
Senior Engineer

grzegorz.stachyra@piap.space
www.piap.space

PIAP SPACE