Mitigation, protection and remediation of space debris for sustainable orbital environment

Lion Luca- 37^{th} Cycle

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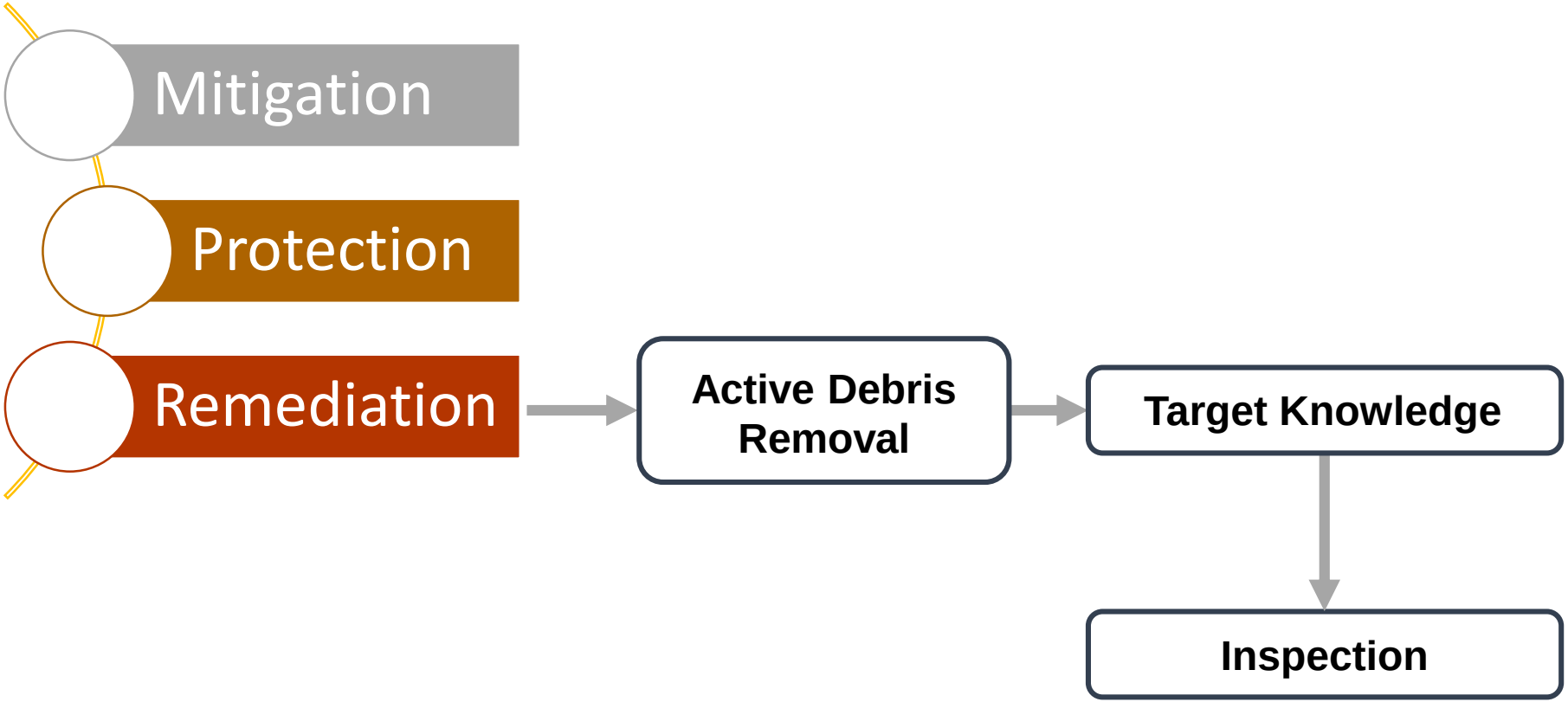
Co-supervisor: Prof. Alessandro Franesconi

Admission to the second year - 15/12/2022

Summary

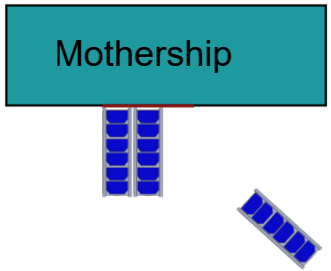
- Introduction
- Research project overview
- Research activities (first year)
- Future work

Introduction



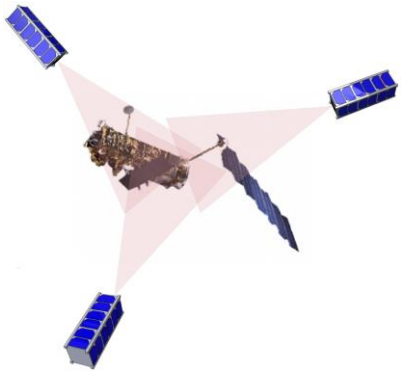
Mission outline

A



Deployment

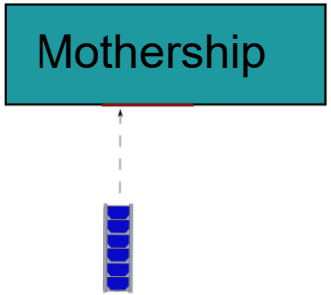
B



Inspection

- Image acquisition
- Raw data handling

C



Docking

- Data transfer
- Data processing
- 3D model generation

Research focus

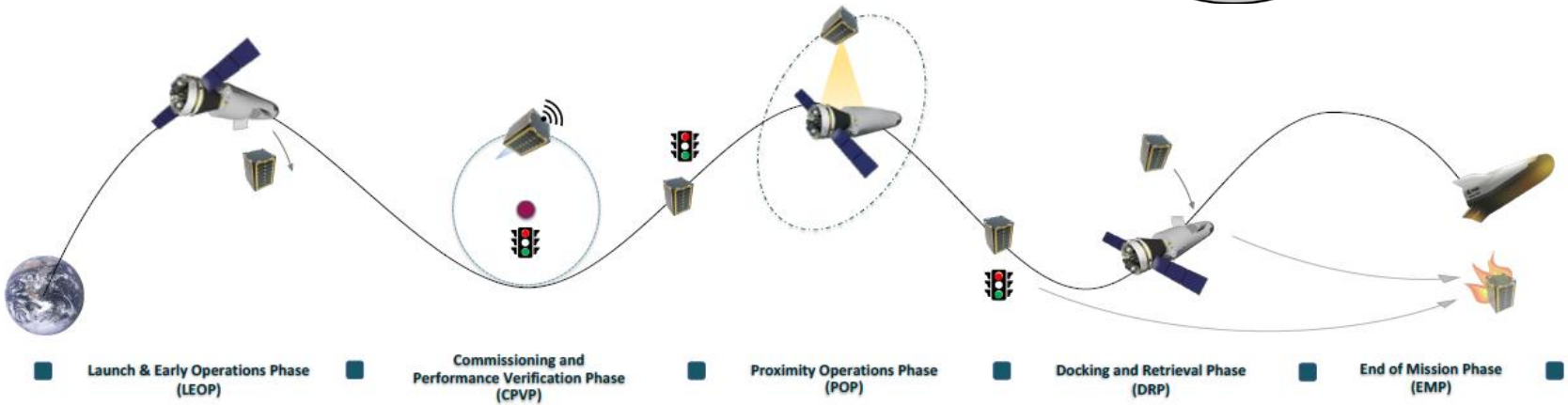
Small satellite preliminary design

- Requirements definition
- Preliminary design of the satellite
- Development of a docking system

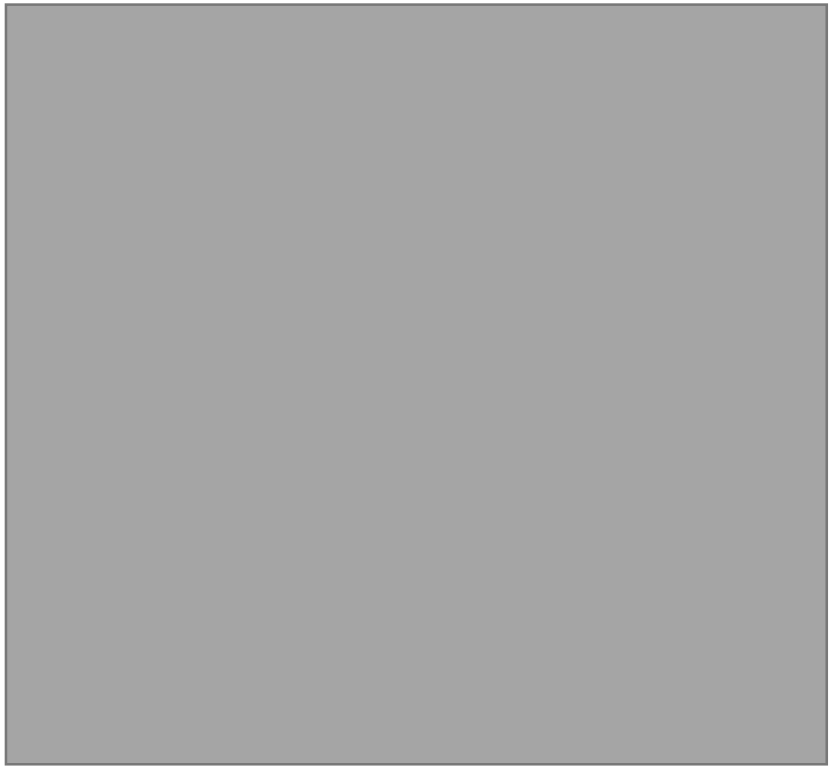
Target reconstruction

- Data handling
- Data transfer
- Data processing
- 3D reconstruction of the target

Space Rider Observer Cube



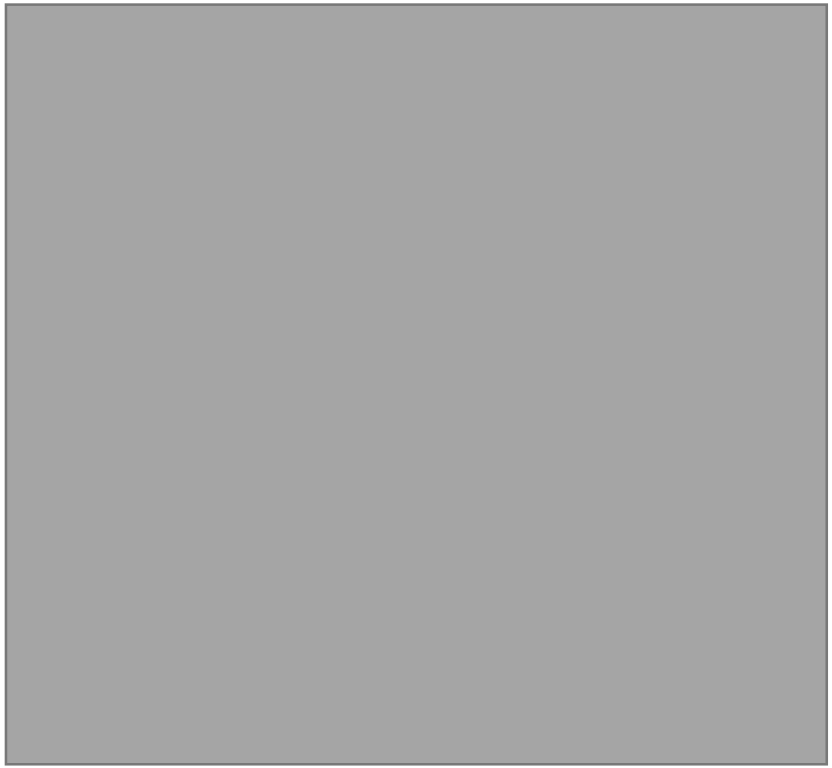
DOCKS - idea



Aims:

- Standalone system
  - Versatile
- One side of the system is passive
  - Non cooperative target
- Able to manage the docking phase from <1m until safe connection
  - Manage ultra close proximity navigation and docking

DOCKS - architecture



- DOCKS-A is equipped with a dedicated on board computer
- DOCKS-B is completely passive, only a power connection is required for the LEDs.
- DOCKS-A is equipped with a sensor suite able to retrieve the pose of the target under 1m
- The mechanism manages both soft and hard docking

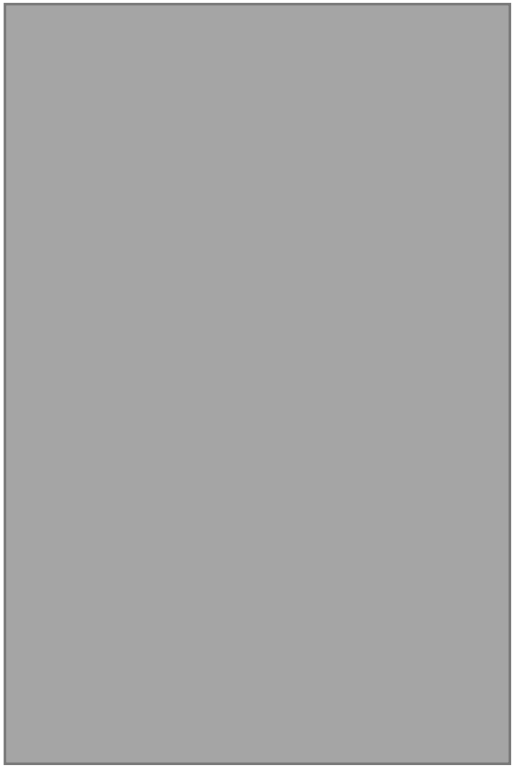
DOCKS - mechanism

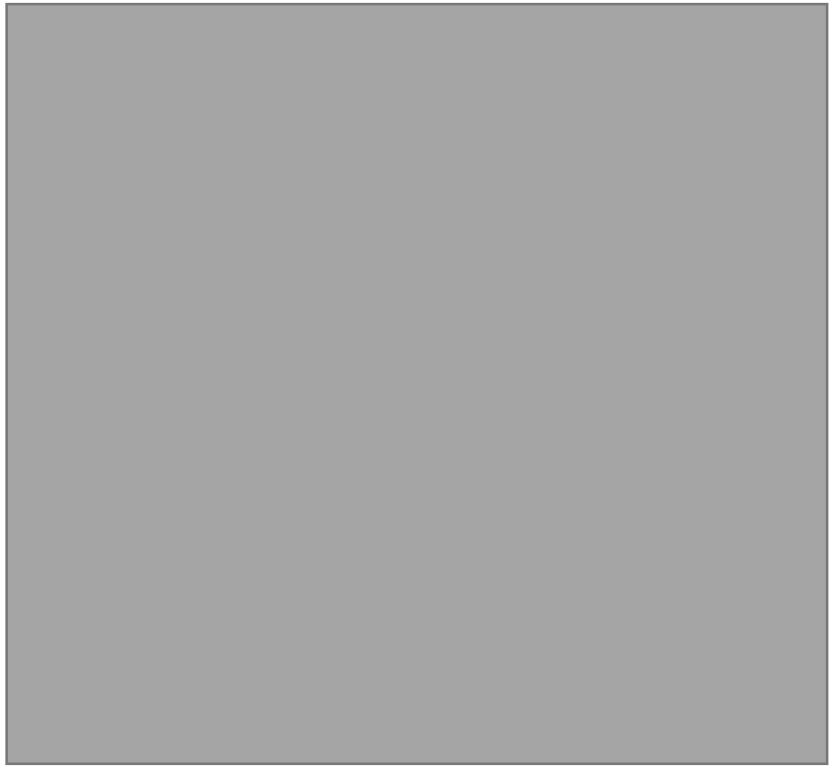
Functionality:

Self centring →

Soft docking →

Hard docking →



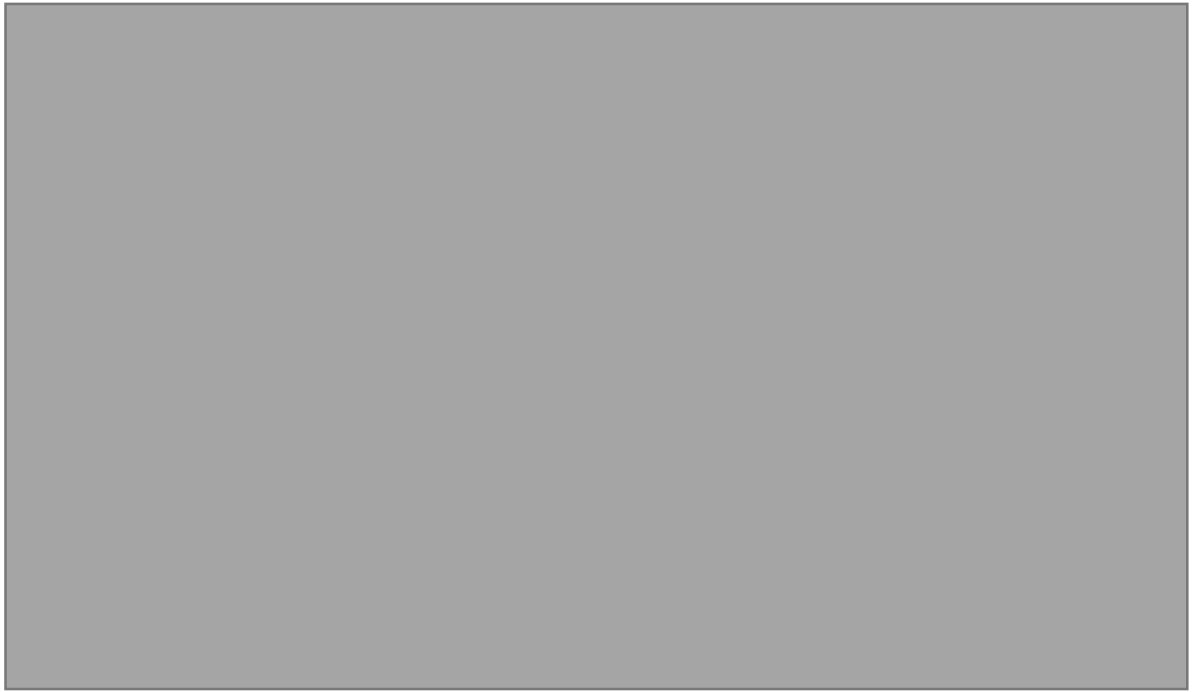


DOCKS – test campaign

- Kinematic test to evaluate the tolerance to misalignment
- Load test in difference conditions

Lateral (along y) | Roll (around z) | Yaw/Pitch (around x) | Axial (along z)

DOCKS – test results



Lateral misalignment	9 mm
Roll misalignment	8.5 deg
Yaw misalignment	9÷3 deg
Axial misalignment	2.5 mm

Future work

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Visiting student (~6 months) early 2023

- Planned activities:
  - Image processing
  - 3D model reconstruction
  - CubeSat design

STELLAR PROJECT

Internship (~6 months) late 2023/early 2024

- Planned activities:
  - Docking system development
  - Industrial experience

Thanks for the attention