e.Deorbit
symposium

Preparation of GNC activities for Clean Space

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Investigation of active detumbling solutions for debris removal (1/2)

- Identify the various classes of tumbling objects, investigate and trade for each class the possible de-tumbling strategies
- Evaluate their impact at system level, taking in particular into consideration the interfaces chaser/target, the operational aspect, develop models of a composite, the GNC design impacts, the propellant cost, the impact on the overall debris removal duration, the required technologies development
- Estimate the target motion and control the non-cooperative formation
- Class: GSP; Funding: 300K; ITT: Mid June

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Investigation of active detumbling solutions for debris removal (2/2)

- Propose a classification of space debris based on de-tumbling rates, mass, inertia, and size
- Perform a survey of possible de-tumbling strategies for each of the identified classes
- Perform a trade-off analysis of the de-tumbling strategies for each class (including chaser/target interface requirements), assessing the impact at chaser level
- Identify for each type of objects, the most suitable de-tumbling strategy
- For each strategy, derive a time varying model of the chaser to target relative motion based upon the existing relative motion equations.
- Design and demonstrate the performance of a modern robust control type chaser GNC system for one of the classes (to be agreed by ESA) and establish its boundaries of applicability.
- Identify the control design methods in order to generalize the GNC design to a broad range of classes.
- Formulate recommendations for future space vehicle system design.
- Provide inputs for an associated technology development roadmap.

Image Recognition and Processing for Navigation (1/2)

- Design, develop and verify the necessary capabilities in Image Recognition and Processing (IRP) for position, pose and angular motion detection on uncooperative targets in an Active Debris Removal (ADR) scenario
- Development of image processing algorithms and their corresponding testing in open and closed loop inside a Functional Engineering Simulator (FES) facility
- Algorithms shall be tested in the Avionics Test bed (ATB) environment and with hardware in the loop elements
- Class: GSTP; Funding: 600K; ITT: Mid June; Germany and Poland

Image Recognition and Processing for Navigation (2/2)

- Development of the IRP algorithms and navigation solution
  - feature detection, and feature matching and tracking
  - design, and development of the navigation solution achievement with estimation determination of range, speed, attitude, and attitude rate of the target in the target reference frame
- Preliminary testing of the IRP algorithms and navigation solution in an ATB environment with processor in the loop
- Development and/or procurement of a dedicated hardware EM unit and integration of IRP algorithms and navigation into the unit
- Testing in an ATB environment with hardware on the loop

Multispectral sensing for relative navigation (1/2)

- Asses, in a bottom-up approach, the potential use of near IR and near UV wavelengths for relative navigation sensing
- Review existing space-qualified detectors technology which could be used for such purpose and their response in the identified spectral bands, thanks if needed to specific bandpass filters
- To propose a preliminary architecture with the aim to design a multispectral sensing for relative navigation
- Main focus is ADR but other potential applications are considered
- Class: TRP; Funding: 300K; ITT: Mid June; SD9

Multispectral sensing for relative navigation (2/2)

- Assessment of the spectral bands and measurements
  - Spatial scanning, sequential capture of full spectra data, and the scanning of an image spectrally
- Assessment of detectors and techniques
- Establishment of a navigation solution and sensing device requirements
  - design and preliminary develop and verify the required estimation processes and algorithms to obtain a robust and reliable navigation solution out of the images
- Preliminary Design of a sensing device
- Recommendations and roadmaps

Thanks for you attention