

Assurance of Resilient Autonomy

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Program: FY22 R&TD Strategic Initiative

Strategic Focus Area: Model Based Assurance of Autonomy - Strategic Initiative Leader: Harald Schone

Objectives:

Investigate the role of autonomy in the context of a scenario representative of a wide range of space mission concerns, and address how its correct and effective operation may be assured (fig. 1).

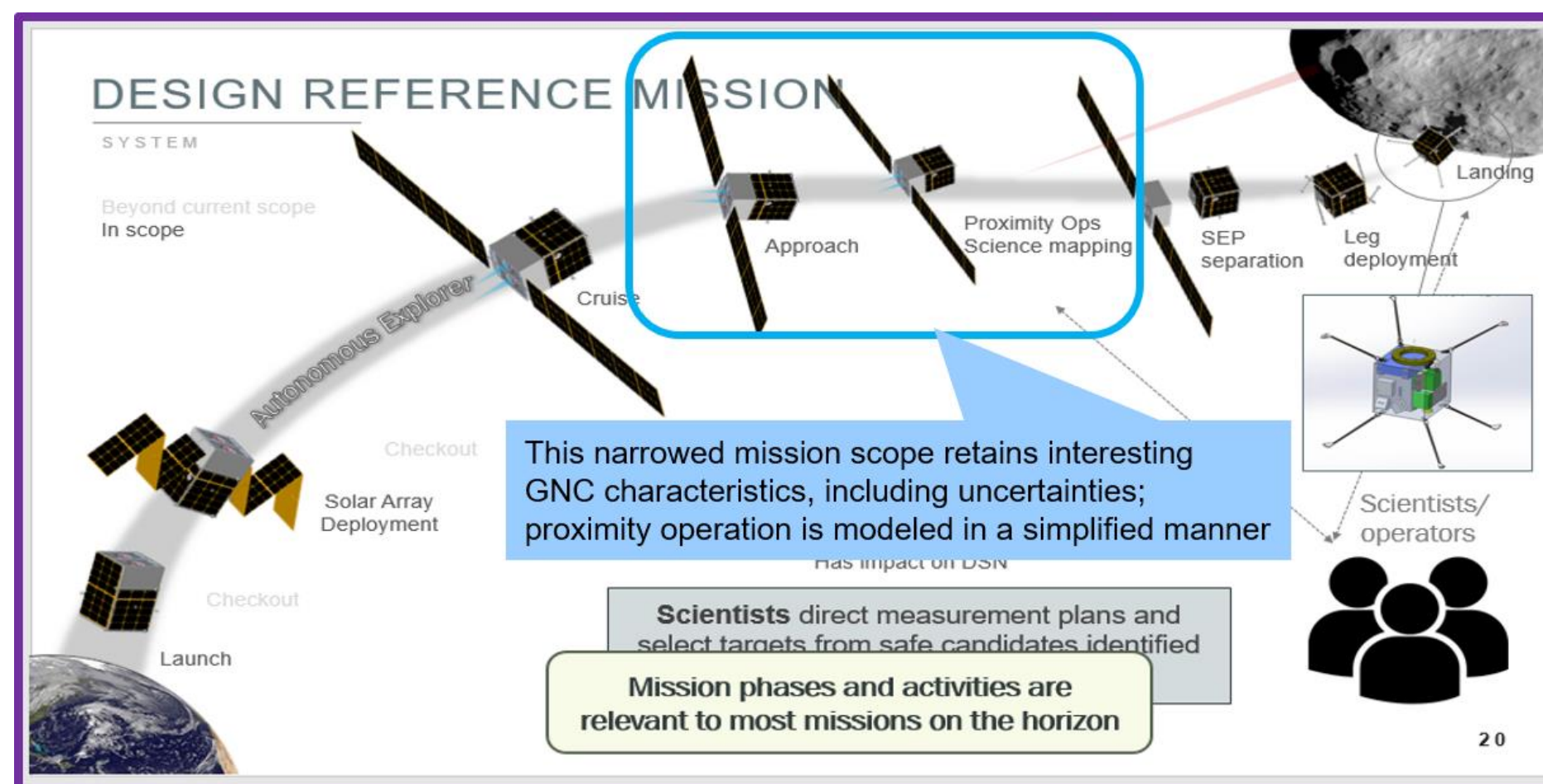


Figure 1 Mission scenario, and focus of this study

Background:

On-board autonomy is recognized by JPL and across NASA as a key enabler for the next generation of robotic missions. Adoption of autonomy by flight projects hinges on their willingness to have trust in its correct operation – i.e., confidence that it will not harm the space asset(s) it controls, and that it will support the accomplishment of mission objectives.

Approach and Results:

- Scoping, focus and mechanism:
 - Demonstration scenario subset (fig. 1): drawn from the Design Reference Mission concept of a 3x SRTD, and DARE)
 - Autonomy focus: characterization of a small body in preparation for landing, covering the phases and their interdependencies (fig. 2)
 - Planning and control software: MEXEC (JPL's Multi-mission EXECutive)
- Achievements:
 - Orchestration of small body characterization steps using MEXEC
 - Investigated alternative “styles” of MEXEC tasknets
 - Fully prescheduled (fig. 3)
 - An M2020 “simple planner” like approach
 - An iterative “while loop” like approach
 - A survey of the state of the art & practice of using analysis and testing techniques in the V&V of autonomous systems
 - Current V&V practices on spacecraft missions
 - “Static verification”
 - “Dynamic verification” (testing techniques)
 - Supporting tools

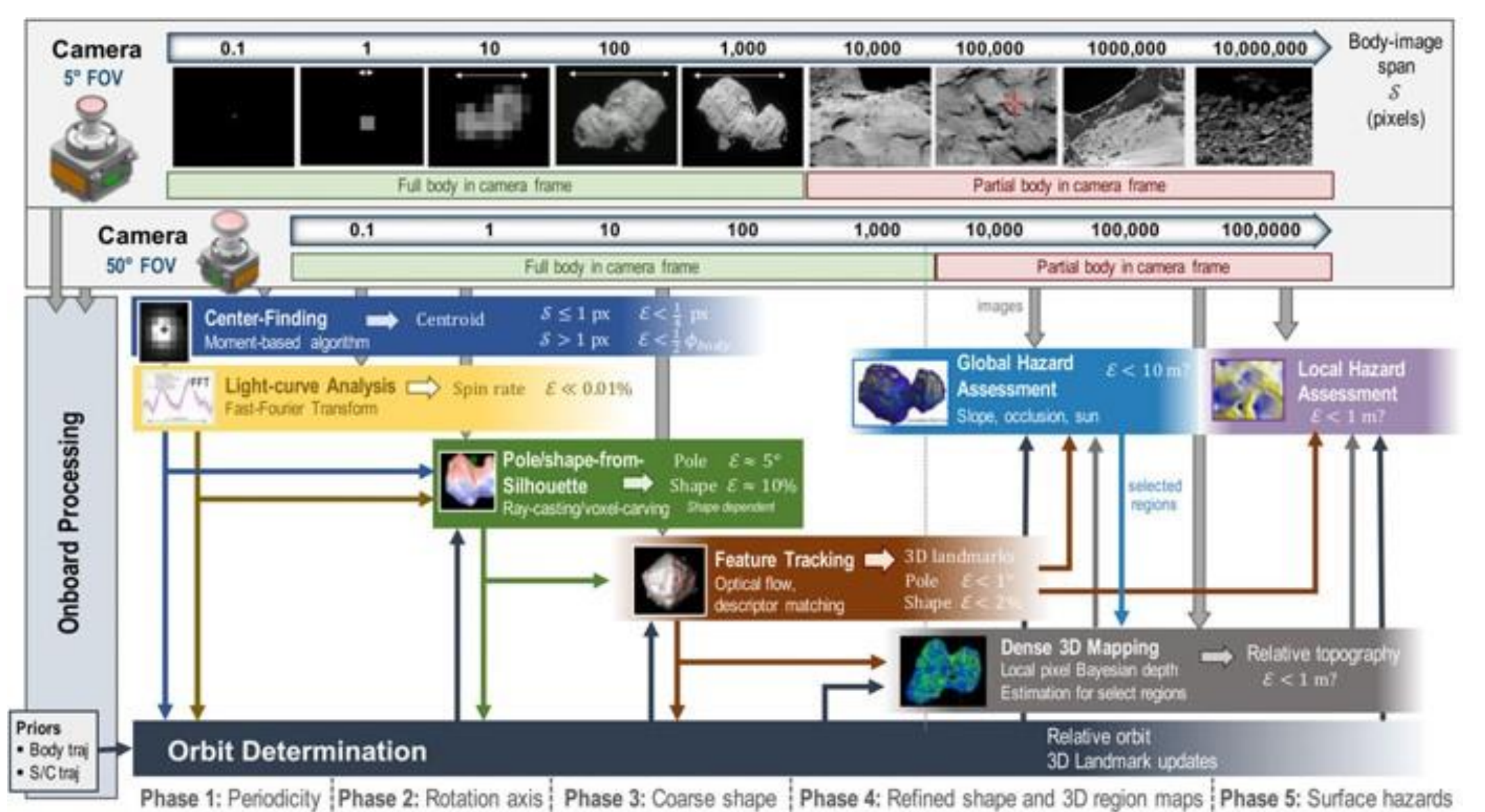


Figure 2 Small body characterization phases

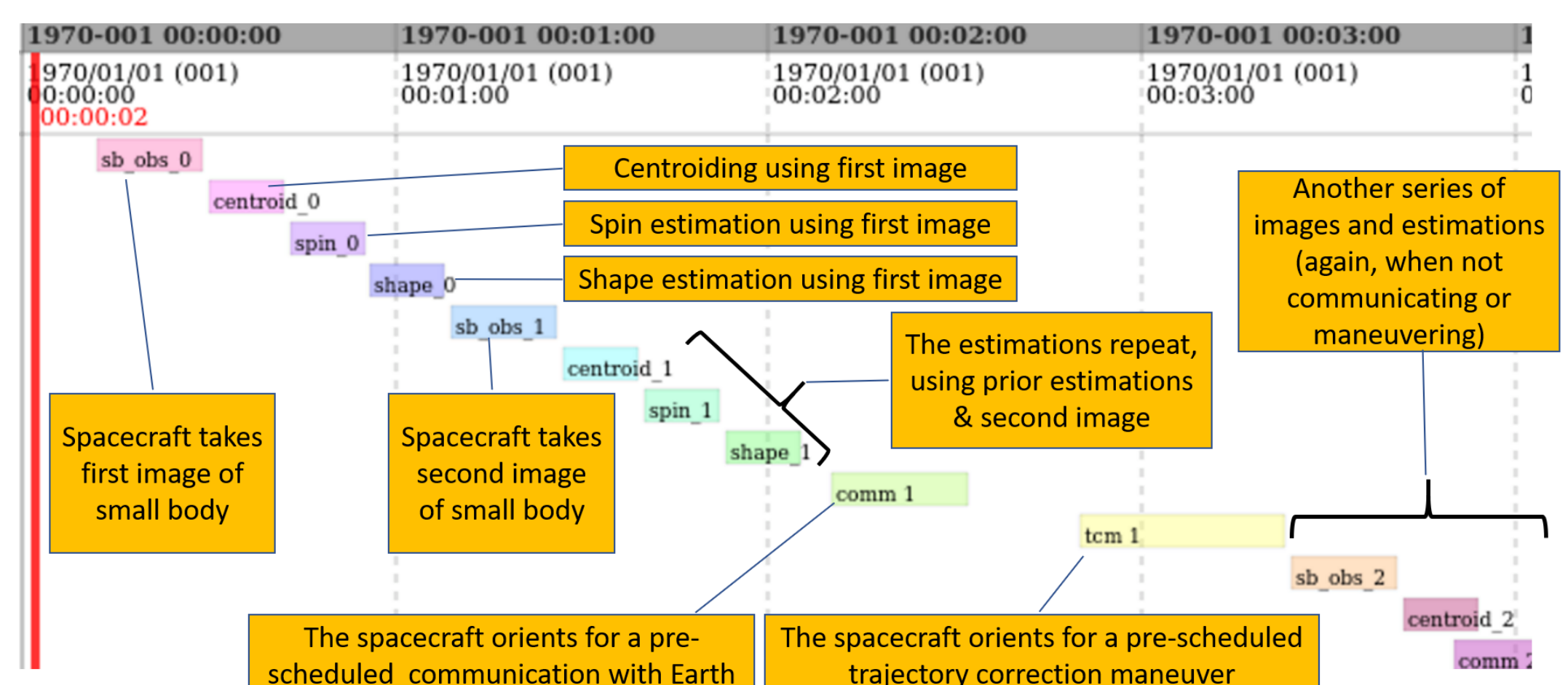


Figure 3 MEXEC-performance of a prescheduled tasknet

Significance/Benefits to JPL and NASA:

V&V of autonomy through analysis and testing allows JPL to trust it more in future ambitious NASA missions. Driving this are upcoming mission concepts (e.g., Endurance-A) need for improved autonomy. As NASA's FFRDC, this gives JPL the charter to lead in this vital area.

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