2018 Workshop on Autonomy for Future NASA Science Missions

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Small-Body Design Reference Mission (DRM)

Issa Nesnas and Tim Swindle

Small-Body DRM Participants

Name	Affiliation
Sarjoun Skaff	Founder /CTO **Basso Nova**
Shyam Bhaskaran	Supervisor, Outer Planet Navigation Group, **JPL/Caltech**
Julie Castillo (remotely)	Research Scientist, **JPL/Caltech**
Michelle Chen	Software Systems, **JHU/APL**
David Gump	Former CEO, **Deep Space Industries**
Issa Nesnas	Robotics/Autonomy Technologist, AS-SCLT, **JPL/Caltech**
Lute Maleki	Senior Distinguished Engineer, **Cruise Automation**
Jay McMahon	Assistant Professor, **University of Colorado**, Boulder
Carolyn Mercer	Manager, Planetary Exploration Science Technology Office, **NASA**
Harry Partridge	Chief Technologist, **NASA ARC**
Marco Pavone	Assistant Professor, **Stanford University**
Andrew Rivkin	Principal Professional Staff, **JHU/APL**
Timothy Swindle	Director, Lunar and Planetary Laboratory, **University of Arizona**
Bob Touchton	Chief Autonomy Scientist, **Leidos Advanced Solutions Group**
Felix Gervits	Graduate Student Researcher, **Tufts University**

Scope, Drivers and Platforms

Scope:

- Missions to small bodied: *comets*, *near-Earth objects* (NEOs), *main-belt asteroids*, and *other bodies*
- Emphasis on bodies closer to Earth

Small-body Drivers:

- Science objectives *
- Planetary defense *
- Resources extraction *
- Human exploration

Platforms

- Fly-by spacecraft and orbiters
- Landers
- Surface or near-surface mobile platforms
- Below-surface access and sampling systems
- Others?

Questions to Ponder

Communicating Desirements

- What would scientists like to see in the near term and long term?
- What would engineers like to know from scientists to make their work more relevant and applicable?
- What would industrial partners like to know from scientists and engineers at NASA?

Capability Advances:

- ***Current:*** What would *current activities in autonomy* enable for near-term missions?
- ***Incremental:*** What science/capabilities could be achieved with *incremental advances* in autonomy that are not being pursued today or not being considered by scientists?
- ***Revolutionary:*** What science/capabilities could be achieved with *revolutionary advances* in autonomy?

Implementation Roadmap

- How would autonomy help with different types of requirements for target bodies?
- What are the steps in developing autonomy technologies to enable such missions?
- What would *enable* or *prevent* the infusion of such technologies?
- What are the key elements of a small-body DRM?
- Are there *technical* reasons why the DRM we define would not be possible today?

Outcome and Deliverables

Targeted Outcome

- Leverage collective knowledge and expertise to draft a DRM
- Follow up after workshop to complete the DRM

Perhaps a more modest outcome from the face-to-face could be identifying the three to four elements of autonomy that would be most useful to enable one or more of the small-body drivers.

Science Mission Directorate Expectations

- A Small-body DRM enabled by autonomy: new or better science, reduced risk, or new opportunities in planetary defense or resource extraction
- Specific strategic recommendations to NASA on autonomy/AI investments (both programmatic and technical)

Deliverables to SMD

- PowerPoint presentation to workshop attendees on Day 2 (15 minutes)
- Completed DRM framework
- White paper for the next AGU or AAS
- Briefing to SMD upper management at NASA Headquarters by DRM leads (in 6 months)