

Proposal for Forming an IAA Study Group SG4.23

Title of Study: Post-Mission Disposal for Micro and Smaller Satellites: Concepts and Trade Studies

Proposer(s):

(Must be member(s) of the Academy M or CM)

Darren McKnight, Toshiya Hanada, Alex da Silva Curiel, Peter Martinez and Rei Kawashima

Primary IAA Commission Preference:

(From Commission 1 to Commission 6)

Commission 4 – Space Systems Operations & Utilization

Secondary IAA Commission Interests:

(From Commission 1 to Commission 6) Commission 5 – Space Policy, Law & Economics

Members of Study Team

Chair(s): Darren McKnight, Toshiya Hanada, Alex da Silva Curie, and Peter Martinez

Secretary: Rei Kawashima

Other Members:

(Open to members and non-members of the Academy)

Juan-Carlos Dolado Perez, CNES
Heiner Klinkrad, TU Braunschweig
Satomi Kawamoto, JAXA
Sergey Trofimov, KIAM RAS
Yukihito Kitazawa
Bonnal Christophe, CNES
Thomas Schildknecht, University of Bern
Vladimir Agapov, Roscosmos
Benjamin Bastida Virgili, ESOC
Rainer Sandau, IAA
Sir Martin Sweeting, SSTL
Rene Laufer, Baylor University
Yasuyuki Miyazaki, Nihon Universtiy
Herman Steyn, Stellenbosh University
Craig Underwood, University of Surrey
Rustem Aslan, Istanbul Technical University
Fabio Santoni, University of Rome
Toshinori Kuwahara, Tohoku University
Hironori Sahara, Tokyo Metropolitan Universtiy
David Spencer, Penn State University
Emma Kerr, University of Strathclyde
Malcolm Macdonald, University of Strathclyde
Norman Fitz-coy, University of Florida

Klaus Schilling, Wuerzburg Universtiy
Carsten Wiedemann, TU Branschweig
Jordi Puig-Suari, CalPoly
Mengu Cho, Kyushu Institute of Technology
Mohamed Khalil Ibrahim, Cairo Universtiy
Shinichi Nakasuka, University of Tokyo
Hanspeter Schaub, Universtiy of Colorado
Christopher Johnson, SecureWorld Foundation
Matteo Emanuelli, GomSpace
Jose Sergio de Almada, INPE
Camille Colombo, Politecnico di Milano
Lourens Visagie, Stellenbosch University
Tetsuo Yasaka, iQPS Inc.
Marlon Sorge, Aerospace Corporation

(in random order)

Short Description of Scope of Study

Overall Goal: Provide framework for a practical implementation to assure compliance with Space Debris Mitigation guidelines for micro and smaller satellites.

Motivation is to provide easy to use design tradeoff information to small satellite community including university satellite community. The final report will be disseminated through the UNISEC-Global network and other small satellite communities and networks.

(Expected scientific or practical benefit of the study group's efforts)

Scope of study:

Study Scope and Objectives

-Create framework (from trade study organization and results of trade study) for debris mitigation compliance for university space users leveraging post-mission disposal (PMD) devices.

- >Define all relevant terms.
- >Do not recommend specific products.

-This report should also useful for emerging space powers and possibly regulators.
-Make it clear that a PMD simply exerts a force on the microsat (or smaller) to help it adhere to debris mitigation guidelines. Current minimum guidelines call for 25 years explicitly (even though report should show how to comply to any timeline) but also to do so without inadvertently posing more risk while executing the reorbit/deorbit process.

Debris Mitigation Guidelines

-Clearly state existing debris mitigation guidelines to which they must adhere.
-Identify applicable standards (e.g., ISO framework and documents).

Trade Study for Post Mission Disposal Devices for Microsats and Smaller

- Parameters to vary in trade study for microsats and smaller:
 - >Altitude and inclination
 - >Satellite mass, power, pointing accuracy, communications, propulsion, computing power, etc.
 - >Budget (financial)
 - >Collision hazard posed to the environment (number of objects and size of objects)
 - >Reliability of satellite
 - >Number of satellites

- Parameters to vary for potential PMD solutions:
 - >TRL (i.e., availability, previous use, etc.)
 - >Reliability
 - >Complexity (in installation and operations)
 - >Size, weight, and power requirements
 - >Type of force to leverage
 - Drag, propulsive, solar radiation, electromagnetic, etc.
 - >Typical summary figures shall include, but not be limited to, the following:
 - Mass-applicability (i.e., how massive of an object can this work for)
 - Orbit-applicability (i.e., altitude and inclination)
 - Capabilities-applicability (i.e., power, pointing accuracy, etc.)

Summary

-Explain that mitigation guidelines, the technologies, and space system operations will all evolve over time to apply this document as a framework to continue to assess how your satellite may act responsibly and efficiently to minimize risks to other satellites from your operations.

Intermediate Goals:

Determine how to evaluate the positive/negative impact of various debris mitigation devices, processes, and operational concepts.

Methodology:

(Email works, workshops, stand alone conferences, interim publications, etc.)

Reviewing the effectiveness and the risks of debris mitigation devices, processes, and operational concepts in the light of existing debris mitigation guidelines.

Time Line:

(Cannot exceed three years)

2017

September (during IAC) Kick-off

International Academy of Astronautics (IAA)

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Instructions and application form: see: "Scientific Activity" section at <http://iaaweb.org/content/view/256/393/>

2018

March 26-29 Planning meeting at IAA spring meeting

October 1-5 (during IAC) Complete the first draft

2019

March 25-30 Planning meeting at IAA spring meeting

October (during IAC): Complete the second draft.

2020

March Complete final report

Final Product (Report, Publication, etc.):

Final Report

Target Communities:

Universities, micro/nano/pico-satellite manufacturers, and new spacefaring entities

Support Needed:

- >Access to the latest information on debris models
- >Collaboration with IAA Permanent Committee on Space Debris and Permanent Committee on Small Satellites

Potential Sponsors:

TBD

To be returned to the IAA Secretary General Paris

by fax: 33 1 47 23 82 16 or

by email: sgeneral@iaamail.org

Date: Sep 7, 2017 (Modified on Jan 10, 2018)

Name: Rei Kawashima (on behalf of Darren McKnight, Toshiya Hanada, Alex da Silva Curiel and Peter Martinez)

(No Signature required if document authenticated).