International Academy of Astronautics

6, rue Galilee, 75116 Paris
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Commission 4

AGENDA

Location IAA Office Rue Galilee 6, Paris

Monday March 17 2014

13h30 – 16h00

1. Welcome

Welcome notes from Chair Prof. Paolo TEOFILATTO, and Secretary Dr. Tibor BALINT

2. Adoption of the Agenda

The Agenda for this Commission 4 meeting have been adopted.

3. Adoption of the Minutes of Commission 4 Meeting in Beijing, China, on September 21, 2013

The minutes of the Commission 4 meeting in Beijing were approved.

4. IAA Cosmic Studies

- *International Aerospace System for Monitoring of Global Geophysical Phenomena and Forecasting of Natural and Man-Caused Disasters* – (SG. 4.9 BY V. Menshikov / Krs. Murthi) – final report presented
- *The applications of micro satellites and Cubesats to planetary science and exploration missions* (SG 4.16 by Alkalai and Graziani)

  During the past 6 months the following progress has been made:

  The study group is focused on four aspects of the Study as follows:
  1. History and Background, Charles Norton and others
  2. Science and Exploration using Small/Micro Satellites, Julie Castillo-Rogez
  3. Technology perspective,
  4. Missions, Andrew Klesh and others

  A detailed outline of the Science section has been received from Science Section Lead Julie Castillo-Rogez at JPL. This outline, copied here and included as an attachment, is going to be reviewed in the coming months and then the writing will proceed, in parallel to the development of the other 4 theme areas listed above.

  Up to now, there is a suggestion from Michael Ovchinnikov to include the Advanced Astrodynamical Concepts subsection in the Technology section. This subsection will cover the following topics:
  – Gravity-Assist Maneuvers and Resonant Encounters

– Invariant Manifolds and Interplanetary Transport Network
– Solar Sails and Other HAMR Mechanisms of Propulsion

Further details on the status and the proposed Table of Context is provided by Leon Alkalai in the Appendix C.

There was a discussion between Commission 1 and Commission 4 about potentially joining activities on this topic. The position of Commission 4 is that we will forge ahead with our study plan and execution, but would be willing to accommodate members from Commission 1, if they wish to provide complementary contribution to our study. There is no issue with adding some Commission 1 members to our study group. The discussions are still ongoing about the actual roles of Commission 1 members, if they decide to join our study.

- *Coordination and cooperation for global environment impact* (SG.4.11 by Gu Xinfa) Final report submitted and presented; PDF available

Future Studies

- *Space Systems for biomedical research* (SG 4.17) by Cappelletti and Graziani Proposed Table of Contents is attached in Appendix. The study was approved by IAA. Team members received IAA notices and are in the process of responding back individually.
- *Standardization of microsatellites*, will be proposed on September by Mengu Cho David Finkelman: ISO standardization effort is ongoing (e.g., standardization of tests)

5. IAA Conferences

5.1 February 03-09, 2013, 2nd CubeSat Winter Workshop in Europe, Roma, Italy

5.2 April 08-12, 2013, 9th IAA Symposium on Small Satellites for Earth Observation, Berlin, Germany

5.3 April 15-19, 2013, 3rd Planetary Defense Conference, Flagstaff, USA

5.4 April 17-19, 2013, 4th IAA International Conference on Advanced Space Technologies for Humankind Prosperity, Dnepropetrovsk , Ukraine

5.6 April 22-25, 2013, 6th European Conference on Space Debris, Darmstadt, Germany

5.7 May 20-23, 2013, 5th CSA-IAA Conference on Advanced Space Technology, Shanghai, China

5.8 May 21-24, 2013, ISPRS – IAA Hannover Workshop 2013 on High-Resolution Earth Imaging for Geospatial Information, Hannover, Germany

5.9 June 18-20, 2013, 10th IAA Low-Cost Planetary Missions Conference, Pasadena, USA

5.10 July 03-05, 2013, 8th IAA Symposium on the Future of Space Exploration: Towards the Stars, Turin, Italy

5.11 July 07-12 , 2013, 19th IAA Human in Space Symposium, Cologne, Germany

5.12 August 29-30, 2013, 2nd IAA Conference on Space Systems as Critical Infrastructure , Mamaia, Romania

5.13 September 21-27, 2013, 64th IAC International Astronautical Congress, Beijing, China

5.14 March 24-26, 2014, 2nd IAA Conference on Dynamics and Control of Space Systems (DYCOSS), Roma, Italy

5.15 May 26-30, 2014, the 4S Symposium, Small Satellites Systems and Services, Majorca, Spain

5.16 July 28-31, 2014, IAA Conference on Space Flight Safety, Saint Petersburg, Russia

5.17 September 29 - October 3, 2014, 65th International Astronautical Congress, Toronto, Canada

5.A Permanent Committee Report

B.4 Small Satellites Committee

Conferences linked to Small Satellites:

- R. Sandau – 5th IAA Small Satellite for Earth Observations
  good attendance; addressed educational satellites below ISS orbit, below 350 km and these satellites naturally deorbit

- UAE / Dubai Symposium
  mostly Arabic countries attended

- UNISEC (University Space Engineering Consortium) Global competition
  expanding Japanese university framework to global in support of IAA;
  regional UNISEC branches are operational around the world;
  goal to have 100 countries as members by 2020
  Secretariat (Point of Contact): Rei Kawashima (Secretary-General)
  UNISEC-Global, c/o University Space Engineering Consortium (UNISEC)
  Central Yayoi 2F, 2-3-2 Yayoi, Bunkyo, Tokyo 113-0032, Japan
  Tel: +81-3-5800-6645; Fax: +81-3-3868-2208;
  Email: secretariat@unisec-global.org

6. Publications (Acta Astronautica and IAA Book Series)

The commission members had a discussion on the need to increase the impact factor of Acta Astronautica.

The commission members discussed a potential special issue of Acta Astronautica on Distributed Missions. This would focus on new trends and tendencies. Commission 4 endorses this special issue, as it would provide a continuation for a previous IAA Study (Lead: Marco D'Errico). I would also provide a focus topic for such an issue, instead of having a broad set of diverse topics and papers.

7. New Commission 4 Members

Mengu Cho, Shin Nakasuka, Jordi Puig-Suari, Vladislav Solovey, Brij Agraval, Paolo Gasbarri, Giangrande Barresi

8. Other Business

The committee members have discussed broadening the involvement of other subcommittees. Currently the Small Satellites Permanent Committee is the most active within the Commission, and some of the other subcommittees are less represented. The Commission members agreed to get better representation from other subcommittees at future meetings.

9. Adjourn

Attendance:

Paolo Teofilatto – University of Rome – paolo.teofilatto@uniroma1.it

Michael Ovchinnikov – Keldysh Institute of Applied Mathematics – ovchinni@keldysh.ru

Tibor Balint – Royal College of Art – tibor.balint@network.rca.ac.uk

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Vladislav Solorey – solovey47@mail.ru

Akira Tsuchida – tsuchida.akira@jamss.co.jp or tsuchida.akira@gmail.com

Appendix A: Study Group 4.8 on Space Systems Cross Compatibility:

To: IAA Commission 4
Re: Study Group 4.8 Space Systems Cross-Compatibility: Response to Reviewer Comments and Final Recommendations
From: Jaime Esper, Study Group Chair
Date: 16 March, 2014

Dear Commission 4 Leadership:

Please find below responses to the reviewer comments, and recommendations for follow-on actions. I am pleased to say the report was well received among all reviewers, and if anything is to be highlighted, it is that there is a desire to continue to expand and encourage space systems cross-compatibility within our industry. Only comments that require some form of response or actions are included below, and positive (100% agreeable) information is omitted for the sake of clarity. Please also note that some members of our study group have since moved-on to other companies or responsibilities, or have retired. Hence, composition of any future study group on this same topic (or follow-on) would have to come from a new membership pool.

Is the study taking into account all aspects, cross disciplinary and with sufficient international prospective?

Reviewer 2: “If we can organize whole key members in this global community through IAA channel, maybe we can develop a space industry standard and interface. These are what I expect to see in the following study in this group.”

Reviewer 3: “Yes. Should consider including Cubesat initiative”.

Response: Agree that we should consider a follow-on study group that continues to encourage space systems cross-compatibility. As Reviewer 3 points out, the Cubesat initiative is a modest example of cross-compatible systems based on a set of standard specifications. These standards are mainly based on specification of form factors and flight qualification requirements, and would prove to be an ideal launching pad for generalization to larger space systems. It is understood this is not the only example of course (ISS is one for very large systems), but can provide a great template for generalization.

Is the introduction clear enough?

Reviewer 2: “It’s clear in the introduction part. However, it would be better if more introduction and analysis on the commercial and industry parts are given.”

Response: This may be expanded via a follow-on Study Group. However, as the other two reviewers stated, it is sufficient for this study.

Are the conclusions and recommendation clear and synthetic?

Reviewer 2: “Both conclusions and recommendation are clear and synthetic. However, it would become more complete if more details on representative architectures and interfaces as well as including the policy roadmap for different systems are further addressed.”

Reviewer 3: The conclusion is too pessimistic, and there is no recommendation. I think it should include some recommendations to IAA.”

Response: The conclusion is realistic based on current geopolitical conditions. The authors did not intend to include “pessimism”, or for that matter “optimism” in the conclusion. The fact remains as it is, that unless the elements discussed throughout the paper, and summarized in the conclusions are considered and overcome, there will be no further progress in this area. There is no, nor should there be any additional recommendation to the IAA, except perhaps to continue to explore and encourage space systems cross-compatibility as stated.

Conclusions and recommendations: From the reviewer comments, it appears that there continues to be much interest in the topic of space systems cross-compatibility. The current study group suffered from continuous membership fluctuations, and time and availability constraints from its participating members. For these and other reasons, its scope had to be limited by necessity. To follow-up on the general comments, but particularly to address the general reviewer comments, it is recommended that the IAA implement a new Study Group that continues to explore this topic, and perhaps focus on one very successful example that has achieved global acceptance in our industry: Cubesats. As mentioned before, these systems are based on a set of standards, and system cross-compatibility is by definition built into its architecture. The challenge is to turn the experience of these simple spacecraft with limited capability into a base for application to larger, more complex systems. This Study Group Chair may volunteer for a follow-on study, provided resources can be secured by his sponsoring organization. Nonetheless, it is recommended that the current Study Group be closed without further action.

Dr. - Eng. Jaime Esper
Chair, Study Group 4.8 Space Systems Cross-Compatibility

Appendix B: Study Group 4.17 on Space Systems for Biological Research

Proposed Table of Contents
Introduction

- Motivations
    - Space: a laboratory for biomedical research
- Microgravity Conditions
    - Simulated Microgravity

        - Clinostat
        - Random Positioning Machine
        - Rotating Vessel
        - Rotary Cell Culture System
        - Artificial Gravity Generators Based on Spinning Superconductors
    - Real Microgravity on Space
- Hypergravity
- Biomedical Experiment in Different Gravity Conditions
    - Simulated Microgravity vs Real Microgravity
    - Hypergravity Results
- Ionizing Radiation and Non-Ionizing Radiations
- Space Radiations
    - Galactic Cosmic Radiation
    - Trapped Radiation
    - Solar Particle Events
- Space Radiations Source and Spaceflights
- Radiation Detectors
- Ionizing Radiation Measurement in Space
- Radiation Effects
    - Radiation Damage to Biological Systems
        - Non-Stochastic Effects
        - Stochastic Effects
    - Radiation and Cancer Risk
- Space Radiation and Biological Effects
    - Space Ionizing Radiation Effects on Cancer Cells
- Biological Samples
    - Adherent Cell Culture vs. Suspension Cell Culture
    - Other Biomedical Samples
    - Biomedical Samples Container
- Space Systems for Biomedical Research Past, Present and Future
    - Past
        - Russian research in space biomedicine
- MIR
- Other Russian research systems
        - SpaceLab
        - Others
    - Present
        - International Space Stations
- Nanoracks
        - Dragon Capsule
        - Chinese Systems
        - Others
    - Future: design a system for biomedical research in space
        - Structure and Mechanical System
        - Observation System
        - Thermal Environment Control
        - Ionizing Radiation Environment Monitoring
        - Microgravity Environment Monitoring
        - Power Systems
        - Telemetry, Tracking and Communications System
        - On Board Computer
        - Tests

Appendix C: Study Group SG 4.16: The Application of Microsatellites and Cube-Sats to Planetary Science and Exploration Missions

IAA Study Group Status Report

10. RESPONSIBLE COMMISSION: IV

Study Number and Title: The Applications of Micro-Satellites and Cube-Sats to Planetary Science and Exploration Missions

Short Study Description (repeat from Study Group Proposal):

Whereas CubeSats and various forms of Micro-Sats have been in existance for the past 20-30 years, they have been primarily focused on Earth-bound applications and primarily developed by universities and small businesses. In light of recent advances in spacecraft and science instrument technologies, Cube-Sats and small satellites can now be considered for very low cost planetary missions. COTS components utilization and accessibility of miniaturized technologies and devices make small satellites a more powerful and cheaper tools than in the past to carry out low cost exploration.
This study will focus on developingn a clear vision and a concensus on the future use of such small (~ 1-10kg) satellites for science and technology demonstration missions beyond Earth orbit, including but not limited to the exploraiton of the Earth's Moon, Mars, Outer Planets, Small Bodies (asteroids and comets) and other destinations.

11. PROGRESS IN PAST SIX MONTHS:

During the past 6 months the following progress has been made:

The study group is focused on four aspects of the Study as follows:

1. History and Background, Charles Norton and others
2. Science and Exploration using Small/Micro Satellites, Julie Castillo-Rogez
3. Technology perspective,
4. Missions, Andrew Klesh and others

A detailed outline of the Science section has been received from Science Section Lead Julie Castillo-Rogez at JPL. This outline, copied here and included as an attachment is going to be reviewed in the coming months and then the writing will proceed, in parallel to the development of the other 4 theme areas listed above.

Website Study Information up to date? Yes.

Issues requiring resolution? (recommend approach): NONE.

Product Deliveries on Schedule? (If modified explain rationale):

Study Team Member Changes? Yes, new members added: Michael Ovchinnikov (KIAM); Sergey Trofimov (KIAM)

Name of person providing Study Group Status: Leon Alkalai, Chair

Status Report Date: 3-17-2014
Section XX. SCIENCE APPLICATIONS

1. Introduction

2. Smallsat application to Space Exploration – Novel Take on Long-Standing Questions

Vision statement (or part of Introduction)

3. Astronomy and Astrophysics Applications

3.1 Key Science Objectives and Measurements
3.1.1 Cosmic Origins and physics of the Cosmos
3.1.2 Exoplanet detection and characterization
To be completed by expert

3.2 State of the Art in Space-Based Astrophysics

3.3 Gaps and Needs for Novel Observational Strategies

3.4 Smallsats as Enabling Platforms for Discovery in Astrophysics
Examples of Emerging Concepts

3.5 The Way Forward

4. Heliophysics Applications

4.1 Key Science Objectives and Measurements
4.1.1 Solar and Heliospheric Physics
4.1.2 Solar Wind/Magnetosphere Interactions
4.1.3 Atmosphere/Ionosphere/Magnetosphere Interactions

4.2 State of the Art in Space-Based Heliophysics

4.3 Gaps and Needs for Novel Observational Strategies

4.4 Smallsats as Enabling Platforms for Discovery in Heliophysics
Examples of Emerging Concepts

4.5 The Way Forward

5. Planetary Science Applications

5.1 Key Science Objectives and Measurements
5.1.1 Origins Science
5.1.2 Searching for Planetary Habitats
5.1.3 Understanding the Workings of Solar Systems

5.2 State of the Art in Planetary Exploration

5.3 Gaps and Needs for Novel Observational Strategies

5.4 Smallsats as Enabling Platforms for Discovery in Planetary Science
Examples of Emerging Concepts

5.5 The Way Forward
Mention the development of miniaturized instrumentation

6. Applications to Human Exploration

6.1 Strategic Knowledge Gaps and Exploration Science

6.1.1 Finding and Characterizing New Targets
6.1.2 Retiring risk (journey and at target)
6.1.3 Preparing for Operations

6.2 State of the Art

6.3 Gaps and Needs for Novel Observational Strategies

6.4 Smallsats as Robotic Precursors to Exploration
Examples of Emerging Concepts

6.5 The Way Forward

7. Conclusion
Enabling Discovery in Space Exploration
Science return vs. cost and risk posture – A change in paradigm

8. References

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