

Inter–Agency Space Debris Coordination Committee



The Inter-Agency Space Debris Coordination Committee (IADC)

– An overview of IADC's annual activities

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IADC Chair

www.iadc-online.org

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United Nations Committee on the Peaceful Uses of Outer Space

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Overview of IADC

- IADC is an international forum of national and international space agencies for the worldwide technical/scientific coordination of activities related to space debris in Earth orbit issues and provides technical recommendations.
- The 13 IADC member agencies are:
 - ASI (Agenzia Spaziale Italiana)
 - CNES (Centre National d'Etudes Spatiales)
 - CNSA (China National Space Administration)
 - CSA (Canadian Space Agency)
 - DLR (German Aerospace Center)
 - ESA (European Space Agency)
 - ISRO (Indian Space Research Organisation)
 - JAXA (Japan Aerospace Exploration Agency)
 - KARI (Korea Aerospace Research Institute)
 - NASA (National Aeronautics and Space Administration)
 - ROSCOSMOS (State Space Corporation “ROSCOSMOS”)
 - SSAU (State Space Agency of Ukraine)
 - UKSA (United Kingdom Space Agency)

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Membership

- IADC members are national or international space and state organizations that carry out space activities through planning, designing, launching, or operating space objects.
- IADC members should actively undertake space debris research activities and contribute to an increased understanding of space debris issues for the preservation of the orbital environment

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Structure and Purposes of IADC

- IADC consists of a Steering Group and four specified Working Groups (WGs) covering measurements (WG1), environment and database (WG2), protection (WG3), and mitigation (WG4).
- The primary purpose of the IADC is to
 - exchange information on space debris research activities between member space agencies.
 - facilitate opportunities for cooperation in space debris research.
 - review the progress of ongoing cooperative activities.
 - identify debris mitigation options.

(IADC Terms of Reference, see <http://www.iadc-online.org>)
- IADC provides technical recommendations to the world space communities. It is not a regulatory organization

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Annual Meetings

- More than 100 technical experts from member agencies participate in the annual meetings to share information, address issues, and define and conduct studies on all aspects of space debris: measurements, modeling, protection, and mitigation.
 - UKSA hosted the meeting in Harwell Oxford, UK in 2016
 - ESA hosted the meeting in Darmstadt, Germany in 2017
 - JAXA will host the next meeting in Tsukuba, Japan in June 2018

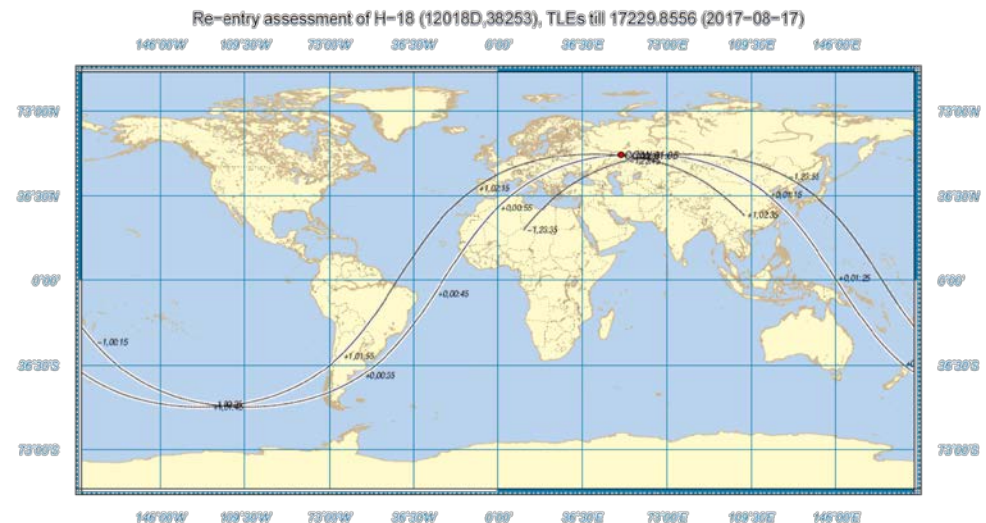
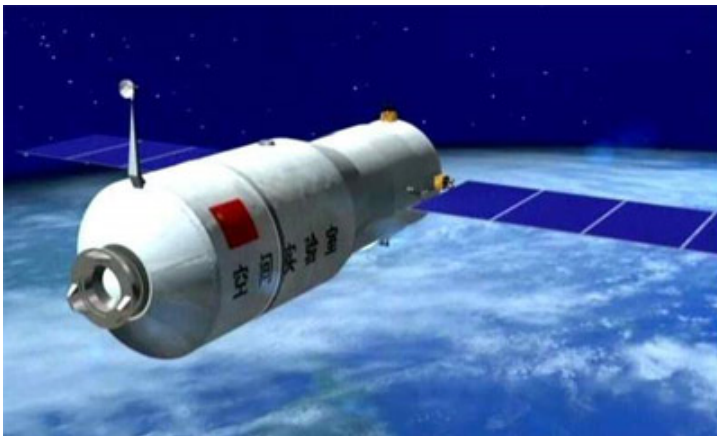


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Re-entry Prediction Campaigns

- To prepare for and respond to high risk re-entry events, the IADC members conduct annual object re-entry prediction campaigns for data sharing exercises and improvement of the prediction techniques.
 - 21 campaigns have been conducted since 1998, including a Long March 3B upper-stage in 2017.
 - The campaign for Tiangong-1 will be conducted on this March or April.



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WG1: Measurements

Objective: identify, evaluate and recommend opportunities for cooperation

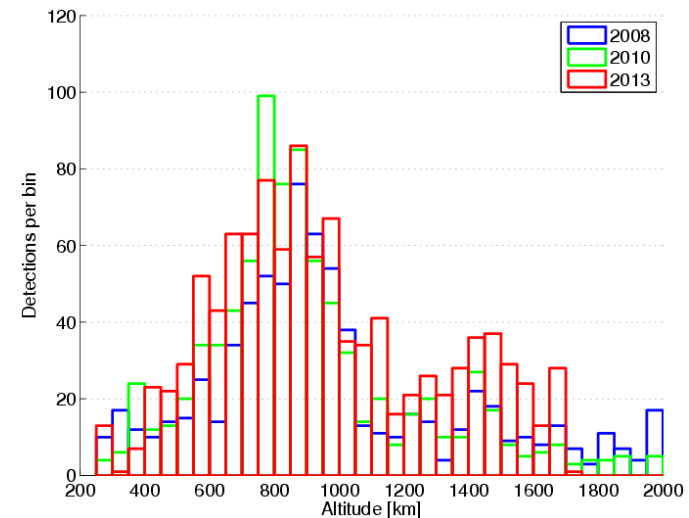
Haystack radar



- 24 hour LEO radar beampark campaign
 - regular 24-hour radar survey of LEO population
 - snapshot of population $> \sim 1$ cm
 - monitor evolution of population



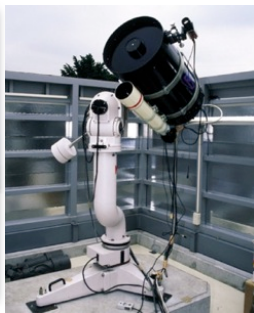
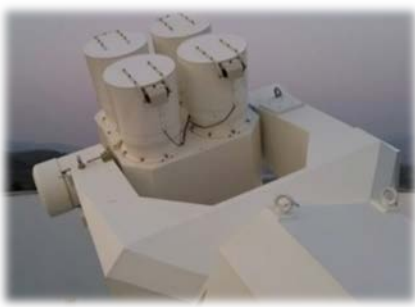
TIRA radar



Altitude distributions of detected objects

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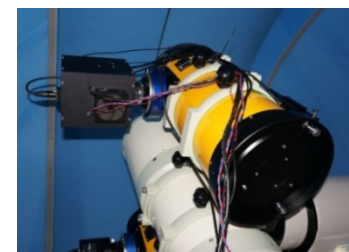
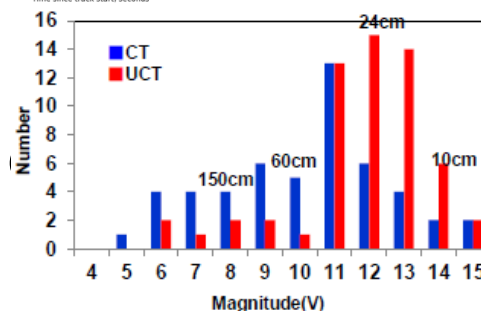
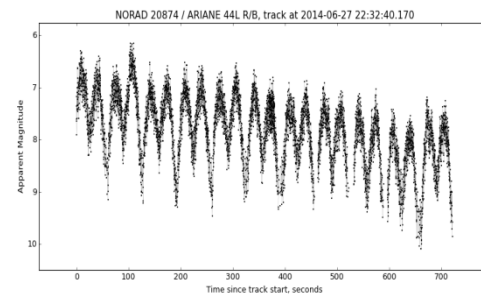
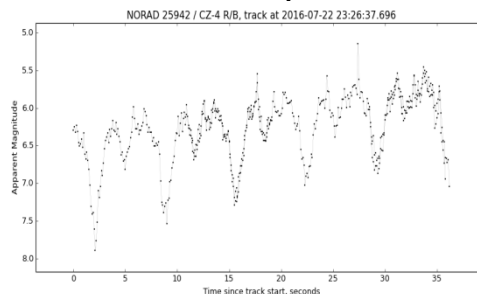




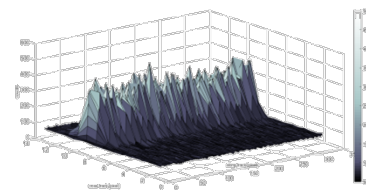
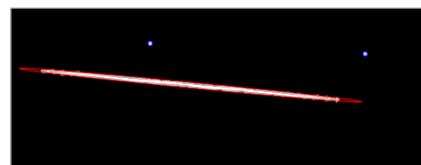
Sensors used for the lightcurve observations.
CNSA(upper left), JAXA(upper right),
ESA(bottom left) and Roscosmos(bottom right)

• Optical lightcurves of massive LEO objects

- Objective: understand the motion of ADR targets for long duration
- Campaign observations were carried out (ESA, CNSA, NASA, JAXA, Roscosmos)
- Some insights were revealed
- Further analysis is needed



LEO survey observation using the large CMOS



New software for lightcurve of ASI

• Information exchange of current status each delegation

- Roscosmos started regular operation of Automated Warning System on Hazardous Situations in Outer Space(ASPOS OKP)
- JAXA carried out LEO survey test observation using the large CMOS sensor.
- ASI developed the software to extract lightcurve

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WG2: Environment and Database

- Study to quantify the benefits of active debris removal initiated as a result of 2013 LEO stability report
- Companion studies in progress to extend and clarify main study results
 - Characterise the uncertainties in future environment projections from propagation, solar activity, fragmentation
 - Quantify the effect of differences/unknowns in the future launch traffic such as small satellite proliferation and increases in launch rates
- Consideration of space sustainability effects from deploying large constellations of satellites

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WG3: Protection

- **Document status**

- Spacecraft Component Vulnerability for Space Debris Impact
 - Unique collection of hypervelocity impact test data and numerical simulation results of space vehicle components such as batteries, cables, etc.
 - Updated to version 0.7 September 2017
 - Will be ready for IADC Steering Group review by IADC36 in 2018
- Protection Manual (IADC-04-03) version 7.0
 - Compendium of meteoroid and orbital debris risk assessment methodology
 - Edits for version 7.1 to be completed by IADC36 in 2018

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WG3: Protection

- **Upcoming Action Items**

- New Shielding Methods and Materials
 - CSA, CNSA, JAXA and NASA agreed to describe approach/methodology for development of advanced meteoroid and orbital debris shielding and provide examples
- Projectile Shape Effects
 - Orbital debris environment definitions continue to improve
 - Implications to spacecraft shield performance from non-spherical projectiles needs additional investigation
 - Discussion will continue at IADC36 in 2018

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WG4 : Mitigation

- WG4 discussed the proposed the revisions in the IADC Space Debris Mitigation Guidelines based on AI 33.2 “Update of the IADC space debris mitigation guidelines and of the support document”
- Modified the Guidelines to provide numerical figures and rationale for several key points such as and referred to SG for approval:
 - On-ground casualty expectation for re-entry events
 - Maximum long-term presence tolerated in GEO region
 - Probability of success for post mission disposal
 - Probability of break-up during operational phase
- Large Constellation:
 - Potential Additional Mitigation Measures to Address the Proliferation of Small Satellites and Large Constellations
 - Reached consensus on study scenarios with WG2. Expected study results from WG2 by next annual meeting
- WG4 reviewed and revised IADC Statement and First Recommendations on Large Constellations of Satellites in Low Earth Orbit
- Studies progressing on the action item Guidelines to aid orbit and attitude determination.
- Other topics:
 - Commercial launches, attitude / orbit determination help, MEO objects...

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Current Adherence to Mitigation Guidelines

- Members of the IADC use surveillance data to analyse global trends in the adherence to mitigation guidelines:
- GEO:
 - IADC guidelines request a disposal of the space object into a graveyard orbit after completion of the mission
 - a trend towards satisfactory levels of successful re-orbiting activities has been observed over the past years
- LEO:
 - IADC guidelines request to dispose the space object such that it limits the orbital lifetime to 25 years in the LEO region
 - the current implementation level is considered insufficient and no apparent trend towards a better implementation is observed

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New Activities for WG4

- One new Action Item proposed on
Geosynchronous Satellite Disposal
- Proposed two internal tasks
 1. Various uncertainties in natural re-entry analysis
 - JAXA lead
 2. Casualty risk procedure assessment
 - ESA lead

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Large constellation statement

- IADC issued the first statement in 2015
- IADC updated the statement in late 2017 with additional recommendations for considerations by large constellation operators to mitigate the risk to other operational spacecraft and to the environment

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Conclusions

- IADC is the internationally recognized technical/scientific authority on space debris.
- IADC participates in and contributes to the UN space debris activities via the Scientific and Technical Subcommittee (STSC) of the Committee on the Peaceful Uses of Outer Space (COPUOS).
- IADC will continue to advance the knowledge of space debris and to develop environment management strategies to preserve the near-Earth space for future generations
 - http://www.iadc-online.org/index.cgi?item=docs_pub

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