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UAE SPACE AGENCY

United Arab Emirates

Towards mitigation of space debris

“Space as a driver for socio-economic sustainable development”
United Nations/United Arab Emirates High Level Forum
6-9 November 2017

Special Session: Space Debris
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Facts

- Over **4000 launches** have been carried out successfully by different spacefaring countries in the past years.
- More than **26,000 objects**, such as **satellites** and **debris** resulting from the launches carried out
- The vast majority of insured satellites, worth a total value of about **$18.3 bil**lion, are operating in GEO/GSO.
- There are currently close to **1000 active satellites** on orbit.
- **23,000 objects** within the catalogue maintained by the United States Space Surveillance Network. Of these 23,000 objects includes active satellites and debris, information concerning **17,000 is publicly available**
- The remaining **6000 objects** their the origin is **unknown** or the data remains **confidential**.
- It is estimated that there is around **740,000 pieces of debris** in orbit **between 1 and 10 cm** in size
- It is estimated that the existing space debris population is around **7000 tonnes of man-made objects** orbiting the Earth, the vast majority of which is made up of objects **larger than 10 cm**.

Technical Challenges

- Currently object bigger than **10 cm** in low Earth orbit (LEO) and bigger than **1m** in GEO can be tracked and catalogued.
- It is much more difficult to remove small objects in GEO because they are extremely difficult to track from the ground
- There are currently a number of technologies and techniques being proposed and considered for **Active Debris Removal (ADR)** - Most of these exist only as theoretical concepts and have not been operationally tested or proven
- The single biggest source of space debris are **explosions/collisions** of non-functional spacecraft and/or non-functional upper stages of launch vehicles
- Debris from small objects, created as a result of explosions can generate large quantities of smaller debris, which greatly increases the probability of collisions by a cascade effect.
- Through “collisional cascading” process large pieces of space debris would get hit by smaller pieces of debris, creating hundreds or thousands of new pieces of small debris which could then collide with other large pieces.
- In the future space debris would hit a critical point where it grew at a rate faster than the rate at which debris is removed from orbit through natural decay into the Earth’s atmosphere “Kessler syndrome”
- These factors will significantly increase the risks and costs of operating in space
- Space objects re-entering the atmosphere are subject to large disturbances from the atmosphere - estimates of the exact place of re-entry fall into grey areas at the present level of understanding.

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Non-Technical Challenges (Legal Issues)

- The major UN treaties on outer space were developed during a period when space debris was not considered a problem of importance.
- There was also no clear technical understanding at that time of debris generation and debris mitigation mechanisms.
- Legal distinction between functional satellites and non-functional space debris
  - A large satellite could be nonfunctional for years or decades
- Which debris are critically important to be removed? Is it by size or consequences?
  - larger than about 10 cm in size can cause total destruction, generate thousands more pieces of debris.
  - between 1 and 10 cm can be lethal to a spacecraft, but are less likely to generate debris.
  - smaller than 1 cm can be shielded against and are unlikely to generate significant debris.
- Who is responsible or allowed to remove an object from space?
  - Launching State is not always known
  - Attempt by a third party to remove that object could be seen as a breach of sovereignty
- What is the official reference catalog of space debris objects?
  - Registry of space objects does not contain all space debris objects, or even those currently being tracked via SSA,
  - and similarly UN Registry lack the positional information necessary
- It is impossible to trace the origin or the source of space object due to limitation in tracking capability.
- Interference with other country space assets or capabilities is considered as serious national threats and raises significant concerns with regard to intellectual property rights

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UAE's Space Debris Related Activities

Policy and Regulations…

- In 2016, the UAE launched the National Space Policy, it will be followed by:
  - National registry of space objects
  - Accident investigation regulations
  - Regulations on reduction impact of space debris

Research and Development…

- In 2016, the UAE Space Agency established the Science, Technology and Innovation Roadmap:
  - It prioritized Research and Development (R&D) activities on space related ST&I topics
  - Space debris and meteorite was a topic of interest
  - Funded an initial meteorite project and placed cambers in three locations in UAE
  - Expanded the existing scope:
    - Currently funding a meteorite project with local university
    - Inclusive of space debris R&D
    - An outreach program to encouraging student to get into space activities topics.

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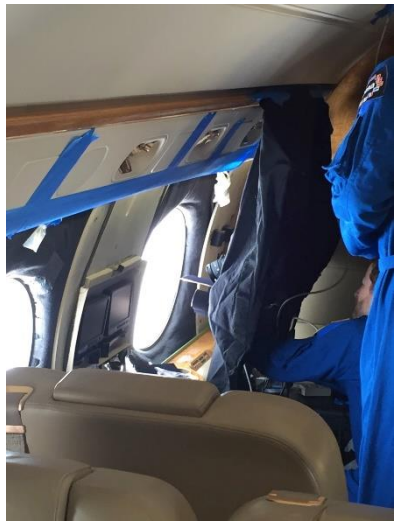
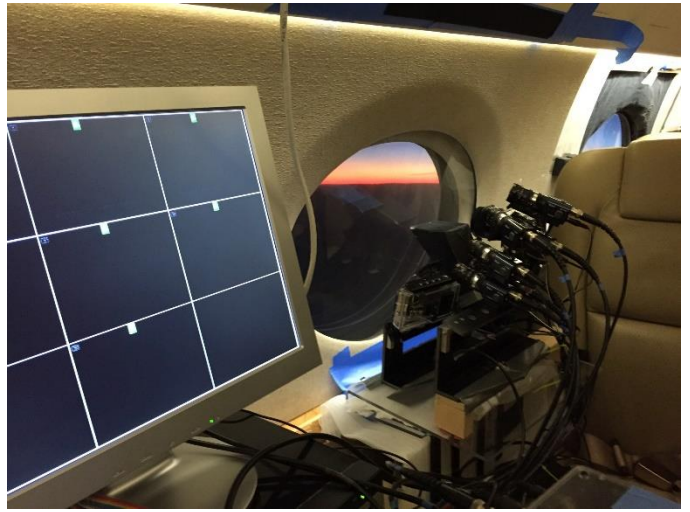
Space Debris Object WT1190F

An airborne observing campaign organized to practice the rapid response to announced small asteroid impacts organized by the UAE Space Agency and in collaboration with International Astronomical Center, NASA and ESA

- An instrumented G450 aircraft was deployed from Abu Dhabi, United Arab Emirates.
- The daytime re-entry of ~1-m sized space debris object WT1190F on November 13, 2015, occurred at a known place and time, under circumstances that enabled gathering data for high-fidelity modeling



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Space Debris Object WT1190F

Wide-field view of the WT1190F re-entry. *The object moved from top left to bottom right towards the observer. The field of view is about 17ºx30º (Sony a7s).*

Red Epic camera observations. These single frames are just at and after the main fragmentation event.

WT1190F shortly after breakup. In UAE camera.

https://www.youtube.com/watch?v=2gFUXR3ilWs

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Meteorite project

Recommendations

- Clear definition of space debris
- Space debris is an urgent problem requiring both short–term and long–term solutions.
- International collaborations between countries and with engineers and scientist
- Access to space debris databases for all countries
- Space debris mitigation efforts can provide solution up to certain level
- Development and implementation of remediation technologies is necessary to prevent the onset of cascading debris generation
- Clearer legal guidance regarding liabilities and responsibilities,
- Further technical research and development on ADR techniques and technologies is required,
- Metrics to determine priority of debris objects to be removed


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