Debris capture technologies

overview





Milano Bicocca, 9th May 2014





1. Who's Aviospace

Aviospace is an aerospace company created in 2004.

In January 2010, Aviospace has been acquired by EADS Astrium (now AIRBUS Defence & Space), although remaining an Italian registered company with Italian management and personnel.



Main fields of Aviospace activities are design and development of Space Transportation and Exploration systems (ST&E).

Particles between 1 and 10 cm in diameter is around



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67000. • Particles smaller than 1 cm exceeds 170 million.

More than 29000 debris larger than 10 cm are

AIRBUS

estimated orbiting Earth.

exponentially*.

from orbits.

•

THE ORBITAL DEBRIS ISSUE

16.00 otal objects Iridium/Cosmos collision 14.000 hina anti-satellite 12,000 10.000 Fragmentation debris 8.000 6,000 4.000 Spacecra Mission-related 2.000 debris Rocket bodies 1970 1980 1990 2010 2000

*(Donald J. Kessler - "The Kessler Syndrome: Implications to Future Space operations"). Source: Nasa

The only effective way to avoid this trend is to remove dismissed satellites and launchers stages



Different mitigation strategies, related to target's mass and orbit, have been proposed:

Re-orbit to graveyard orbits

- spacecrafts/rocket upper stages on high apogee orbits
- high hazardousness spacecrafts (e.g. nuclear technologies on board)

De-orbit within 25 years (uncontrolled reentry)

• the complete destruction of the system during atmospheric reentry is assured

Direct de-orbit (controlled reentry)

• medium/large debris that may survive to atmospheric reentry



FOCUS ON THE REFERENCE MISSION

Development of a complex system able to remove debris from commercial orbits, in particular is focused on:

- European medium/large debris
 ✓ Satellites at the end of life
 ✓ Rocket upper stages
- Near polar orbit debris



Main reasons for the choice:

- High hazard of this class of targets for space missions and, in case of unexpected reentry, for people and property
- High density of space junk in the aforementioned region



Phase	Impacted areas	Adequate now?
Closing	AOCS, Sensing (proximity)	Ν
Solidarization	Power, Materials	Y

• Following charts will be focused on capture systems screening performed by Aviospace in several research programs



Aviospace was responsible of the selection of the debris capture systems in the following programs :

CADET technological development co-funded by Regione Piemonte
 VAC (Versatile Autonomous Concept), system study for ESA
 SOAPAD (Service Oriented Approach to Active Debr. Rem.)system study for ESA
 HADR (Heavy Active Debris Removal) AIRBUS in-house system study
 e.Deorbit system study for ESA – phase A

The expertise gained in the above programs is now being focused on testing activities oriented to the validation of the concepts exploited.



FAMILIES OF DEBRIS CAPTURE MEANS





"fisherman" net



Robotic Harm



Issues:

- interfaces? (handles)
- Tumbling/roll mitigation?



Pro's:

- Link rigidizable when required
- Easy to study in 1 g



FOAM/Magnetic paints application



Issues:

- Materials depending from substrate (no unified solution)
- Fly-around challenging in case of tumbling
- Detumbling very, very complicated



pro,'s:

• No direct contact chaser-debris during de-tumbling



pro,'s:



Issues:

- Heavy impacts on AOCS (captured debris • not prevented from impacting chaser)
- stiffness of the gate very difficult to get • but fundamental

• _____ de-tumbling required







Inflatable Finger



Issues:

- Strength of the capture
- Heavy impacts on AOCS (captured debris not prevented from impacting chaser)



pro,'s:

 Nearly-no direct contact chaser-debris during de-tumbling



Tentacles

Issues:

• Tumbling/roll mitigation?



Pro's:

- Link rigidizable when required
- Easy to study in 1 g



Fisherman Net



Issues:

- Nearly impossible to simulate on ground
- Dynamics of tethered bodies to be better understood



pro,'s:

- Nearly-no direct contact chaser-debris during de-tumbling
- Light and compact





THE PICTURE AND ANNOTATIONS HERE PRESENTED ARE REFLECTING THE PRESENT STATUS OF PROGRAMS STILL GOING ON IN THE FRAME OF THE AIRBUS DS GROUP.

THERE IS NOT YET A CONSOLIDATED AND FULLY RELIABLE SOLUTION, BUT IT IS SURE THAT THIS WILL HAPPEN.

Thanks for the attention

F.A.Fossati

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