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CENTER FOR ORBITAL DEBRIS EDUCATION AND RESEARCH

Space Traffic Management Conference
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An Integrated Approach to Orbital Debris Research and Management

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Space Traffic Management and Debris Issues

- Little control over what is placed into orbit
- Flight paths of low-orbiting satellites are not coordinated
- Low orbiting satellites and objects all travel at speeds > 7.3 km/sec, in all directions
- Satellite and object separations are not controlled
- Increased space traffic leads to required space traffic management
- We lack required technology and political will to create a space traffic management architecture
- Satellites overfly all longitudes as they circle Earth
- Most popular orbits are shared by civil, commercial and military satellites
- We lack the ability to accurately track/predict precise movement of debris
- Locations and movements of most debris are unknown
- Orbiting junk is not controllable
- Few active satellites can maneuver to avoid collisions

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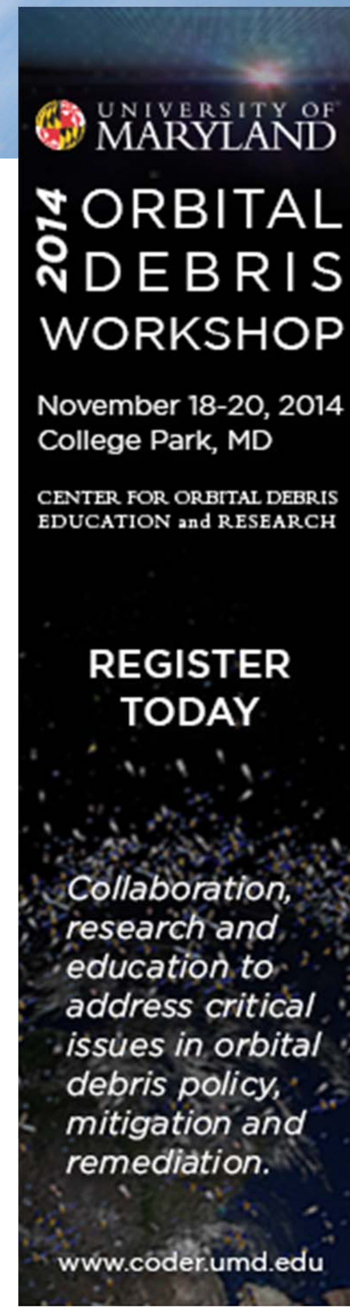
Dealing with Orbital Debris

- No systems or programs to remove or clean debris
- So far, debris has only been a nuisance, but future threats may require a solution
- Previously, no organization has ventured toward an integrated, multidisciplinary and international approach to addressing all technical and non-technical issues. The University of Maryland has. As a result, the Center for Orbital Debris Education and Research (CODER) was conceived and is currently ramping-up to address the many issues.
- CODER may quickly develop into an international collaborative center of education and research that addresses the space trash problem in an integrated and all-inclusive manner. A university-based center allows maximum transparency and inclusiveness.
- CODER will quickly become a focal point for idea interchange through conferences, meetings and outreach programs.



General Issues of Space Traffic Management

- Collision risks are still probabilistically low, but risks are real and growing
- A minimum requirement for effective space traffic management is timely, accurate position data on all space objects in a controlled traffic region.
- Future satellites may need quick-response maneuvering capabilities.
- Space traffic management must be internationally accepted in order to e effective.
- Closing speeds in space can be 30 times higher than possible for aircraft. Thus, close-approach warnings must be issued much earlier than for aircraft. Typically, two approaching aircraft can respond to a warning in a few seconds. Two approaching satellites may require at least 30 minutes, or more, to execute a maneuver after a warning is received.
- A first-step in developing a space traffic management system may be to address the issue of managing the large number of passive derelict objects that may eventually jam the traffic lanes.

Fundamental Physical Limitations of Space Traffic Management

- Physical differences between air traffic management and space traffic management

  Air Traffic

  - Airliners typically travel at speeds near 0.25 km/sec (550 mph) and are easily separated because they travel in two-dimensional planes that are defined by altitude.
  - In-plane separation is accomplished by defined airways and air traffic controller instructions.
  - Navigation is easily accomplished with GPS and other devices.
  - Aircraft can easily maneuver to change course.

  Space Traffic

  - Satellites travel roughly 30 times faster than airliners and are in circular or elliptical orbits.
  - Most satellites cannot easily maneuver and closing speeds can be as high as 14.6 km/sec.
  - Satellite tracking accuracies are not sufficient enough to predict collisions ahead of events.
- Propellant expenditures for satellite maneuvers are prohibitively high.

Conclusions

- Space traffic management will require significant new and innovative approaches to operating in the space environment.
- Even with traffic management there is the persistent issue of debris interference.
- There is no way to manage or control debris objects that clutter desired "space-ways."
- Three ways to deal with debris:

  (1) Ignore the debris threat and proceed without controlling it.

  (2) Address the debris problem and try to clean up space.

  (3) Avoid the high-density debris regions and reinvent how space is used.
- Option 1 may prove initially workable, but the threat level may become unacceptable as debris increases.
- Option 2 seems attractive, but the cost of cleanup may prove too excessive.