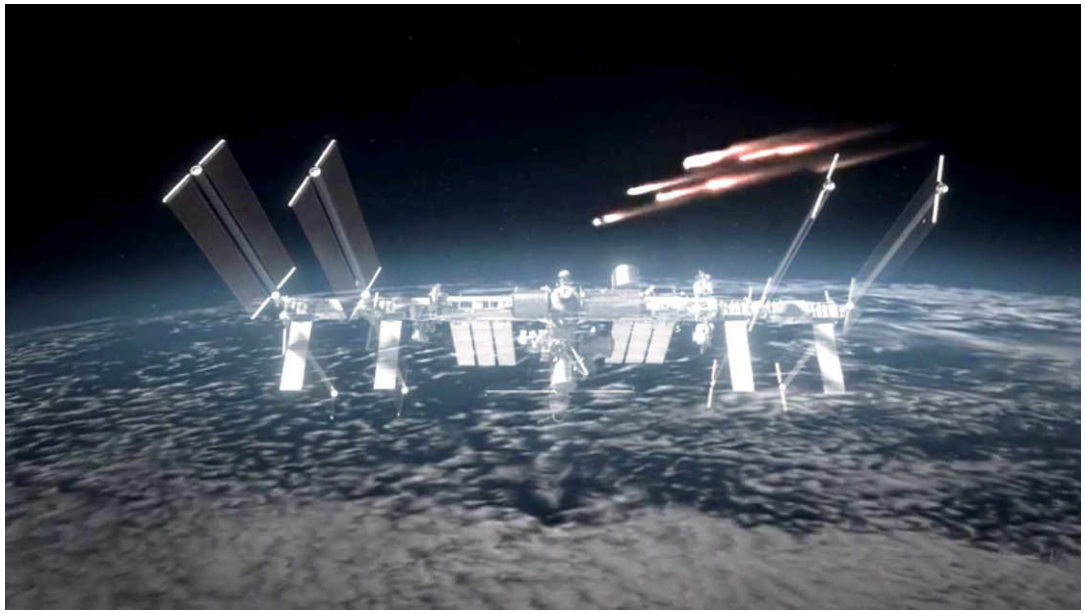
The power of innovation

OREKIT FOR ESA' SPACE DEBRIS MOVIE 2017



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Orekit Day 2017

European Space Agency

SPACE DEBRIS MOVIE – A JOURNEY TO EARTH

- 12 minutes stereoscopic 3D Space debris movies 3D developed in 2017 for ESA'sSpace Debris Office by ONiRIXEL with support from CS OREKIT team for Flight Dynamics and Attitude simulation.
- In order to display realistic positions and attitude requested by ESA, physically sound simulation was required for Earth Orbiting objects. This simulation was based on OREKIT, that was directly interfaced with Blender Open-Source 3D animation Software to provide accurately realistic simulations for more than 15 000 objects.

ASSUMPTIONS FOR SIMULATION

- Propagation duration is a few hours only
  - Limitation of the perturbation models to Earth gravity field, truncated to 12x12
- Attitude is handled using a few predefined modes, depending on the debris category.
  - Active spacecraft use controlled attitude depending on their orbit
  - Other objects use tumbling mode with random initial attitude and angular velocity.
  - Solar arrays attitude is also computed with respect to the body attitude to ensure a proper orientation with respect to lighting in the movie scenes.
- Orbit and attitude are propagated using a variable step numerical propagator
  - Creation of Blender particle files containing position, body attitude and solar arrays attitude.
- Files can be read directly by Blender for display, with 3D shapes depending on the debris type, active satellites being associated with two shapes, one for the spacecraft body and one for the solar arrays, as they have different (but related) orientations

SIMULATION RESULTS

- Simulation performed for **16 748 debris** (1688 rocket bodies, 1055 mission-related, 981 active, 7 unknown, 2717 defunct, 10300 fragments) over 3 hours
- Took 265 seconds to run on a three year old common laptop running Linux and creates **2.3 Gbytes of data** in **16 640 files**
- Simulation very realistic, movie available on the net (ESAWEB, YouTube, Google+, French and European Public media) in both 2D & 3D.
- **Orekit_To_Blender** Interface that has been developed for this movie could be easily re-used for other 3D movies with trajectory & attitude simulation.