



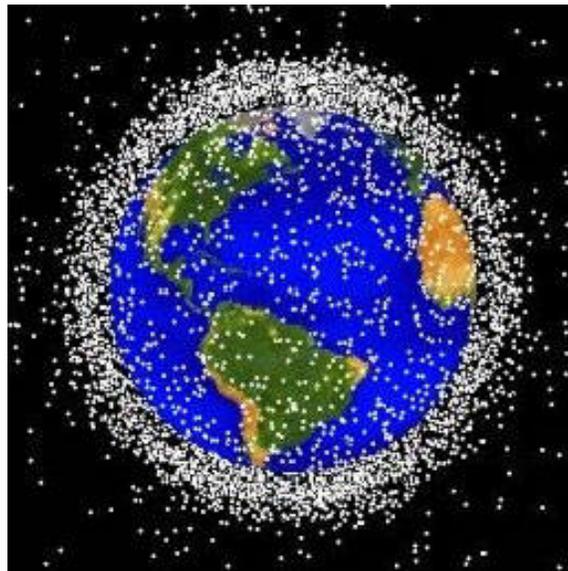
Space Object Query Tool

When planning launches, NASA must first factor in the tens of thousands of objects already in orbit around the Earth. The number of human-made objects, including nonfunctional spacecraft, abandoned launch vehicle stages, mission-related debris and fragmentation debris orbiting Earth has grown steadily since Sputnik 1 was launched in 1957. Currently, the U.S. Department of Defense's Joint Space Operations Center, or JSpOC, tracks over 15,000 distinct objects and provides data for more than 40,000 objects via its Space-Track program, found at space-track.org.

The rising population and high speeds of these objects increases the potential danger to all space vehicles, but especially to the International Space Station and other spacecraft with humans aboard.

Compounding this danger are the limited capabilities for analyzing historical tracking data and the sparseness of data sources compiling data about future satellite launches.

The lack of data affects: a) scientists who develop space debris mitigation methods, b) mission design teams who select orbits for future constellations of spacecraft in Earth orbit, and c) decision makers who have to determine ideal placement of spacecraft and weigh both mission return and impact on the space debris environment.



The Space Object Query Tool, or SO-QT, allows users to analyze historical and projected space congestion data.

The Space Object Query Tool

To fill this gap, researchers at the Mission Design Center (MDC) at NASA's Ames Research Center in California's Silicon Valley have created the Space Object Query Tool, or SO-QT, website.

Still in its proof-of-concept phase, the site allows users to visualize historical space congestion data and to analyze past and current trends. In addition, the SO-QT website provides a collaborative environment for users to gather and access information about future orbital insertions for satellites or spacecraft.

NASAfacts

SO-QT features a collection of tools:

- A database of ephemerides of all tracked space objects over the last decades to allow customized trend analysis.
- A wiki-inspired data collection tool where multiple experts jointly create data on expected future constellations and orbit insertions.
- A data analysis tool to assess future launch trends.
- A copy of the current JSpOC satellite database.

These tools facilitate three primary use cases for the Space Object Query tool: 1) analysis of the historic and current space environment; 2) collection of data about future launches in a collaborative environment; 3) analysis of data on future launches.

Analysis of Historic and Current Space Environment

SO-QT facilitates investigation of the current and historic space environment by providing data on the number, type and orbits of tracked objects over time. The data can be filtered by various criteria, including orbital parameters, object type and country. Although Space-Track provides specific information for each single object, SO-QT aggregates the information to enable trend analyses, such as analysis of specific orbital regimes. For convenience, SO-QT provides the user a copy of JSpOC satellite catalogue and access to specific spacecraft information.

In its current state, users are finding the tool useful to analyze trends, both for very specific orbits and for the overall environment. However, projecting these trends into the future is difficult, as more users enter the “New Space” economy.

Collection of Future Launch Data

Keeping track of launch announcements and updates from old and new players in the space economy, including planned launches for constellations consisting of hundreds of satellites, can be difficult.

SO-QT implements a Wikipedia-inspired collaborative approach enabling invited contributors to jointly create a data source for future launches.

The goal is to pool expert knowledge by first allowing the contributors to start creating new entries in the constellation database and adding launch data. Then the information and launch data are updated by the same expert or others, as needed.

Analysis of Future Launch Data

All constellation-specific data are collected under the heading “Constellation Database” and can be assessed individually. In addition, the data of the latest update for each constellation is aggregated to allow for a global assessment of all launches. The data can also be filtered to allow for the analysis of specific orbits, countries, etc.

The long-term goal is to provide a one-stop-shop tool for NASA, the space community and stakeholders to exploit past, present and future data about congestion of the orbital environment – filtered, and tailored for their needs.

Within the constraints of this proof-of-concept an additional goal is to use open-source software solutions wherever possible. Next steps include developing SO-QT into the prototype phase, where users can build custom scenarios and simulate long-term effects on the orbital environment. The tool will provide additional scenarios for NASA’s standard debris models to generate future projections on the spot.

For more information about SO-QT, please visit:

www.nasa.gov/centers/ames/engineering.

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