DRAGSTER

ORION SPACE SOLUTIONS
an Arcfield company

Next-Gen Atmospheric Drag Simulator

DRAGSTER RENDER

The render above shows an operational view of the Dragster assimilative model. Satellite operators can use Dragster to get more accurate and real time drag data for satellite collision avoidance.

DRAGSTER

With new international participants entering space and the rapid expansion of commercial activities in low Earth orbit (LEO), the number of space objects needing high-fidelity tracking is growing quickly. SpaceX, for example, has indicated that their Starlink constellation will consist of as many as 42,000 satellites when complete, significantly adding to the more than 29,000 objects in LEO that the U.S. Space Force (USSF) currently tracks.

The satellite operator community depends on high-accuracy orbit modeling with well-characterized uncertainties to perform conjunction assessments and prevent collisions between these space objects—any loss in orbit accuracy significantly increases the risk of a catastrophic collision. This is especially critical for the National Reconnaissance Office's management of intelligence, surveillance and reconnaissance satellites.

Current atmospheric drag models are simply not robust enough to provide accurate predictions of orbital dynamics. To truly achieve actionable and timely collision avoidance processes, improved atmospheric density and drag models are necessary.

GREATER ACCURACY

Orion Space Solutions uses Dragster as its nowcasting solution, providing satellite operators accurate and real-time drag data for satellite collision avoidance. Combining the Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIE-GCM) with Mass Spectrometer and

Incoherent Scatter (MSIS) model, Dragster data outputs provide much better drag estimates when compared to other operational models like JB-08—an empirical atmospheric density model used by the USSF for satellite orbit prediction—and the High Accuracy Satellite Drag Model (HASDM). For all their capabilities, the uncertainties in JB-08 and HASDM are too large to satisfy the USSF's operational requirements of neutral density forecasts within 5% over a 72-hour period. Because of these large uncertainty values, operators are forced to factor in large safety bubbles around satellites for collision avoidance. As Dragster maintains an optimal estimate of satellite drag through data assimilation, the size of this safety bubble can be reduced, thus reducing false collision alarms which saves critical time and resources and improves mission success.

FORWARD LOOKING DESIGN

Dragster's software design is modular, enabling satellite operators not only to leverage an ensemble of models most appropriate for the task at hand but also to accommodate inevitable updates to atmospheric models. This means that any future improvements to such models can be seamlessly integrated into Dragster without disrupting its performance.

WHAT'S NEXT

To date, Orion has focused on creating an architecture that combines state-of-the-art physics-based models of the atmosphere with assimilation methods that are compatible with specifying the space environment, demonstrating the ingestion of two-line elements and other readily available data, andw verifying correct operation of the code. We will then leverage tools from both physics and data science to achieve the best forecast density.

While forecasting is notoriously challenging, the accuracy of the nowcast paired with data science and a firm understanding of the underlying physics will allow for unprecedented forecasting ability will greatly improve forecast performance to provide impactful accuracy on the neutral density and drag estimates for spacecraft in LEO.

DRAGSTER CONOPS

Existing atmospheric drag models have large uncertainty values which forces operators to use large safety bubbles around the satellites for collision avoidance, as shown on the right. As Dragster maintains an optimal estimate of satellite drag through ensemble data assimilation, the size of this safety bubble can be reduced, thus reducing false collision alarms which saves critical time and resources and improves mission success.