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Accurate Estimation of Upper Atmospheric Density

Technology No. 20180161

IP Status: Pending US Patent; **Application #:** 16/266,515

Estimates state of upper atmosphere with more accurate results

A new methodology predicts atmospheric density using satellite measurements. It provides a critical step in decreasing the error in orbital drag and increasing space situational awareness in the lower orbit. Satellite operators may use the forecasted properties in a variety of satellite control applications (e.g., computing orbital drag, collision conjunctions, and collision avoidance for satellite devices). In addition, private companies and government agencies can track space debris in real time to develop avoidance maneuvers and preventative flight plans.

Real-time thermospheric mass density measurements

The lower earth orbit is becoming more densely populated with satellites, debris and other dangerous objects, increasing the likelihood for devastating collisions rendering significant damage. Predicting the orbit of space objects relies on accurate atmospheric drag measurements, yet thermospheric mass density, which feeds directly into this calculation, is the leading cause of error in system dynamics. Current models, which are either too computationally expensive (physics-based) or too inaccurate (empirical models), offer no solutions for accurate, real-time thermospheric mass density measurements. This new approach decreases the complexity of computations in physics-based models and achieves the speed of empirically based models by using a Reduced Order Model (ROM) formulation that simplifies data assimilation through the Kalman filter technique.

Phase of Development

- Proof of Concept

Benefits

- Decreases the error in orbital drag
- Increases space situational awareness in the lower orbit
- Achieves the speed of empirically based models

Features

- Predicts atmospheric density using satellite measurements
- Reduced Order Model (ROM) applied to collected orbital elements
- Computes an estimate of the state of the atmosphere
- Decreases complexity of computations in physics-based models

Applications

- Satellite control applications, such as computing orbital drag, collision conjunctions, and collision avoidance for satellite devices
- Develop avoidance maneuvers and preventative flight plans
- Providing accurate conjunction assessments and collision warnings
- Space situational awareness
- Tracking space debris in real time
- Harvesting space debris
- Industry and government satellite operators

Researchers

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Publications

A Quasi-Physical Dynamic Reduced Order Model for Thermospheric Mass Density via Hermitian Space-Dynamic Mode Decomposition
Space Weather, arXiv:1802.08901 23 April 2018

Interested in Licensing?

The University relies on industry partners to further develop and ultimately commercialize this technology. The license is for the sale, manufacture or use of products claimed by the patents. Please contact us to share your business needs and licensing and technical interests in this technology.