PATENT
TECHNOLOGY SUMMARY
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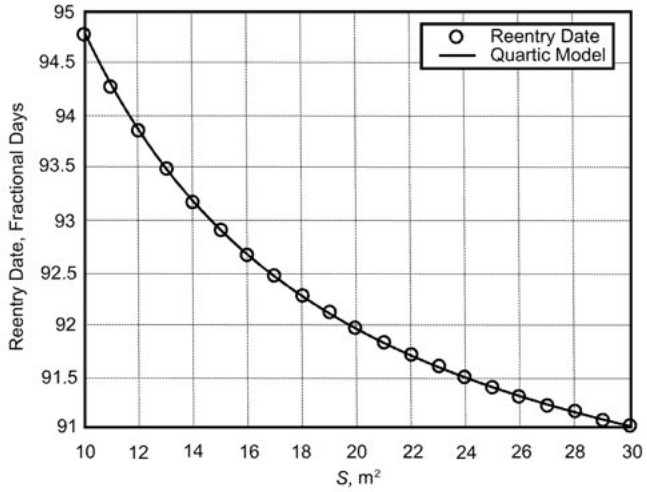
AFIT Engineer Solves Extraterrestrial Dilemma with New Patent

You never know when inspiration will strike. In the case of one Air Force Institute of Technology (AFIT) engineer, inspiration led to innovation from a situation that had captured the world's attention.

In 2017, Lt. Col. Robert Bettinger, Ph. D., a faculty member at AFIT, was formulating a course which involved atmospheric reentry. Among his course objectives was educating his students on charting and monitoring space vehicles reentering the Earth's atmosphere. "I sought to enhance the realism of the course content by assigning a final project for my graduate students pertaining to the reentry prediction of an uncontrolled, naturally decaying object in low Earth orbit," Bettinger said. Orbital decay is the gradual reduction of distance between two orbital bodies, such as a satellite or space station in relation to the Earth. For objects in low-Earth orbits (LEO) – 1,200 miles or less – orbital decay is often caused by atmospheric drag. It just so happened



A sample Tiangong-1 Reference Area Response Curve.

TECHNOLOGY

PATENT NUMBER:
US 11,312,512 B1

TECHNOLOGY NAME:
Early Warning Reentry System Compromising High Efficiency Module for Determining Spacecraft Reentry Time

INVENTOR:
Robert Bettinger

TECHNICAL PROJECT OFFICE:
Air Force Institute of Technology

PATENT DATE:
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at that time that Bettinger had a real-world model for his graduate students to apply what they learned.

“Concurrent with the course was the decaying orbit of the Chinese Tiangong-1 space station, a space vehicle that captured international attention due to the uncertainty of when and where it was to reenter the atmosphere. I used this space vehicle as the test case for the final project and tasked the students with predicting reentry time and location,” he said.

Tiangong-1, launched in 2011, was a 34-foot long, 18,000-pound experimental space station that had been for all intents and purposes de-commissioned by China in 2016. While danger to human life on Earth was considered extremely unlikely, it didn’t stop many from wanting to know when and where it would reenter. Various organizations, including the United Nations Office for Outer Space Affairs (UNOOSA), the Inter-Agency Space Debris Coordination Committee (IADC), and similar agencies from all over the world were involved in attempting to predict when and where the space station would reenter.

Ultimately, Tiangong-1 reentered on April 1, 2018, at 8:16 pm (EST), according to United States military officials, breaking up and plummeting into the South Pacific. This left Bettinger with questions in the aftermath.

“Can reentry predictions improve? If so, then can high-accuracy predictions be made with simplistic models?” he asked. “For the rest of 2018, I developed a simplistic algorithm for reentry time prediction that enables prediction accuracy deviation of less than eight hours approximately five days before reentry.”

Bettinger’s algorithm was found to inexpensively predict spacecraft reentry times faster and with more accuracy using available trajectory information, regardless of design configuration of said spacecraft.

“I envision this technology benefiting the military and civilian sectors by providing a low-complexity means of attaining high-accuracy reentry time predictions. Such predictions are important to help understand areas on the ground that are at-risk for casualty and/or property damage due to the reentry of uncontrolled objects/space vehicles,” Bettinger said.

While his solution is considered a relatively easy module for reentry predictions, Bettinger believes even the “simple” ideas are rich in merit.

“Don’t dismiss the ‘easy’ or ‘simplistic’ solution for answering complex questions. Sometimes the best solutions require the least amount of overhead and fidelity to achieve the desired results.”

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