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OPEN SOURCE COLLISION AVOIDANCE MANEUVER PLANNING TOOL

Abstract

Open Source Collision Avoidance Maneuver Planning Tool (OpenCAMPT), is a new tool designed to compute fuel-optimal maneuvers for avoiding short-term and long-term encounters in space. Moreover, the tool will include a module for propellantless propulsion using space environmental effects, such as atmospheric drag and solar radiation pressure force to avoid collisions utilizing the attitude state of the spacecraft. This effort is significant because there is no open source tool to help operators to assess the collision risk, and propose a maneuver that reduces both the probability of collision and the fuel requirement. OpenCAMPT can be used as a low level library in Python although it is coded in Cython, C, and C++. Therefore, the tool can be used along with other space flight dynamics software. It will include user-friendly graphical interface and intuitive design that even non-experts will use it effortlessly. OpenCAMPT is capable of reading different file formats. Some of these formats are two-line element (TLE), collision summary message (CSM), and ephemeris and state vector in any reference frame. For frame of reference, The International Astronomical Union's Standarts of Fundamental Astronomy Library (SOFA) is used. Collision dynamics part of the tool is based on Simplified General Perturbations 4 (SGP4) and TLE, and it guarantees that the calculations are fast and robust. In addition, a faster method to calculate optimal impulsive maneuver based on the proposed collision dynamics using SGP4 and TLE will be developed using machine learning techniques. Such instant method is being developed because analytical optimal impulsive maneuver calculations have similar outcomes depending on collision geometry and orbital elements of the primary spacecraft. Both methods will provide initial estimations for precise method that yields highly accurate informing optimal impulsive maneuver based on numerical High Precision Orbit Propagation Method. Because both time and good estimation for optimal impulsive maneuver are known before the encounter, the problem can be developed as a two-point boundary problem. The solution to the problem will yield the precise optimal maneuver that can be used for real missions. OpenCAMPT will include visual aids that help users to evaluate the threat intuitively.