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COMPARATIVE ANALYSIS OF MULTIPLE FILTERS FOR COMPACT SIZED SPACE DEBRIS
DETECTION

Abstract

For the past few decades there has been a surge in space technology with many organizations launching satellites in orbit for their respective purpose. However, this has resulted in clogging of space debris causing serious threat to existing satellites in their respective orbits. A survey conducted by US Space Surveillance Network stated that the majority of the space debris are situated at an altitude of 500-2000 km which travel with an astounding speed of 17,500 mph. Presently, the detection of Space Debris is achieved through 2 methods, first, by Ground Station and second, by existing satellites in orbit. The problem faced by ground based radar is that it cannot detect objects which are smaller than 10cm precisely, implying that a large part of existing debris remains undetected. Using sensors in satellites can detect debris in a much more accurate way but still there would be uncertainty in sensor readings which may cause minor inaccuracy in detecting the debris. The trajectories of space debris are predicted by applying sensor fusion techniques namely, Kalman filtering and particle filtering. In this paper, a comprehensive comparative analysis between Kalman filter and particle filtering has been performed. Precisely the extended and unscented version of the filters have been used since the data observed at such high altitudes are non-linear. The study was conducted using datasets from Space-Track. The aforementioned techniques were employed on this dataset and their accuracy were investigated through MATLAB and Sat-Coord. After a detailed analysis of the filters, the most efficient algorithm has been considered for detection of debris. Using the above results a study of multi-filter fusion has been done by integrating various combinations of filters (kalman-kalman filtering) and a detailed report regarding this observation has been presented.