Study on an Advanced Attitude Determination Algorithm for the ERG Spacecraft

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The Exploration of Energization and Radiation in Geospace (ERG) spacecraft of JAXA will explore how relativistic electrons in the radiation belts are generated during space storms. The spacecraft will be sun-oriented and spin-stabilized with ~7.5 rpm spin rate. Two attitude determination algorithms are considered for the mission: A conventional simple algorithm that inherits from old missions and an advanced algorithm that is newly designed. This paper discusses the design of the advanced attitude determination algorithm. The algorithm is composed of three main parts: The coarse attitude estimator, star identification and tracking algorithm, and the fine attitude estimator (Fig.1). The coarse attitude estimation algorithm is based on the magnetometer and spin-type solar aspect sensor (SSAS) measurements and uses different algorithms including the TRIAD and Tanygin-Shuster algorithm to estimate a coarse attitude. The magnetometer measurements are calibrated using a simple pseudo-linear Kalman filter [1]. The star identification algorithm first pairs the star pulses detected by the star scanner (SSC) and then uses the coarse attitude estimate to match the detected pulses with the catalogue stars. The identification process mainly uses distance-orientation algorithm for star matching [2]. The fine attitude estimator consists of two algorithms: The Unscented Kalman Filter for spinning spacecraft (SpinUKF) for fine attitude estimation [3] and the spin-axis tilt estimation algorithm for correcting the spacecraft inertia knowledge [4]. In this paper we give an overview of the sub-algorithms, describe how they are integrated to form the overall attitude determination algorithm and present the preliminary results.

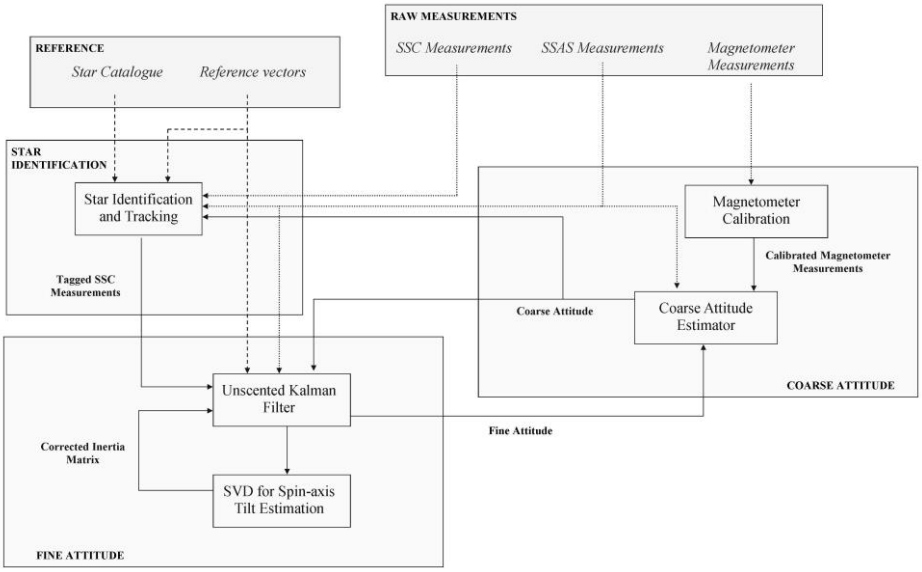

Fig. 1. The Attitude Determination Algorithm for the ERG Spacecraft.

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