FPGA-Based X-Ray Detection and Measurement for an X-Ray Polarimeter

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This technology enables detection and measurement of x-rays in an x-ray polarimeter using a field-programmable gate array (FPGA). The technology was developed for the Gravitational and Extreme Magnetism Small Explorer (GEMS) mission. It performs precision energy and timing measurements, as well as rejection of non-x-ray events. It enables the GEMS polarimeter to detect precisely when an event has taken place so that additional measurements can be made. The technology also enables this function to be performed in an FPGA using limited resources so that mass and power can be minimized while reliability for a space application is maximized and precise real-time operation is achieved.

Sequential Probability Ratio Test for Spacecraft Collision Avoidance Maneuver Decisions

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A document discusses sequential probability ratio tests that explicitly allow decision-makers to incorporate false alarm and missed detection risks, and are potentially less sensitive to modeling errors than a procedure that relies solely on a probability of collision threshold. Recent work on constrained Kalman filtering has suggested an approach to formulating such a test for collision avoidance maneuver decisions: a filter bank with two norm-inequality-constrained epoch-state extended Kalman filters. One filter models the null hypotheses that the miss distance is inside the combined hard body radius at the predicted time of closest approach, and one filter models the alternative hypothesis. The epoch-state filter developed for this method explicitly accounts for any process noise present in the system. The method appears to work well using a realistic example based on an upcoming, highly elliptical orbit formation flying mission.

This work was done by Kyle Gregory, Joanne Hill, and Kevin Black of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16611-1

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This innovation enables the function to be performed in space where it can operate autonomously with a rapid response time. This implementation combines advantages of computing system-based approaches with those of pure analog approaches. The result is an implementation that is highly reliable, performs in real-time, rejects background events, and consumes minimal power.

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