Title: Sensor Data Quality and Angular Rate Down-Selection Algorithms on SLS EM-1.

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The NASA Space Launch System Block 1 launch vehicle is equipped with an Inertial Navigation System (INS) and multiple Rate Gyro Assemblies (RGA) that are used in the Guidance, Navigation, and Control (GN&C) algorithms. The INS provides the inertial position, velocity, and attitude of the vehicle along with both angular rate and specific force measurements. Additionally, multiple sets of co-located rate gyros supply angular rate data. The collection of angular rate data, taken along the launch vehicle, is used to separate out vehicle motion from flexible body dynamics. Since the system architecture uses redundant sensors, the capability was developed to evaluate the health (or validity) of the independent measurements. A suite of Sensor Data Quality (SDQ) algorithms is responsible for assessing the angular rate data from the redundant sensors. When failures are detected, SDQ will take the appropriate action and disqualify or remove faulted sensors from forward processing. Additionally, the SDQ algorithms contain logic for down-selecting the angular rate data used by the GNC software from the set of healthy measurements. This paper explores the trades and analyses that were performed in selecting a set of robust fault-detection algorithms included in the GN&C flight software. These trades included both an assessment of hardware-provided health and status data as well as an evaluation of different algorithms based on time-to-detection, type of failures detected, and probability of detecting false positives. We then provide an overview of the algorithms used for both fault-detection and measurement down selection. We next discuss the role of trajectory design, flexible-body models, and vehicle response to off-nominal conditions in setting the detection thresholds. Lastly, we present lessons learned from software integration and hardware-in-the-loop testing.