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ASTROGYRO – IRU QUALIFICATION AND TEST RESULTS

Abstract

Present state of the art attitude and orbit control systems (AOCS) in telecom satellites make use of autonomous star trackers (STR) and gyroscopes as separate sensors, with individual data processing located in the spacecraft central AOCS computer. In such a configuration, the star tracker has no direct access to the high bandwidth gyroscopic data. On the other hand, the gyroscope provides its pre-processed angle rate or rate-integrated information with low data rate solely to the central processing unit. There exists a well-known complementarity between the two types of sensors, but it is obvious that any hybridizing of sensor data is confined to execution in the S/C board computer.

The ASTROgyro (AGY) is a modular inertial reference sensor system, comprising two star trackers (AGS) and two gyroscope units (each 3 axis, AGI) in a combined product. Both, star tracker and gyroscope take substantial benefit in their respective performance. Consequently, ASTROgyro improves the operational availability, robustness, and performance of rate and attitude measurements for the navigation tasks performed by the satellite AOCS system.

The ASTROgyro star tracker (AGS) is an evolution of the heritage ASTRO APS star tracker with more than 190 flight models under contract, 116 flight models delivered to customers and 65 units in orbit.

For the ASTROgyro IRU (AGI) Coriolis Vibratory Gyroscopes were chosen because of their low complexity and high reliability. The gyroscope works up to a rate of $20\frac{deg}{sec}$ with an Angle Random Walk $<0.01\frac{deg}{\sqrt{hr}}$ (per axis) and a Noise Equivalent Angle $<0.4\ arcsec$ (1σ, per axis). The bias instability (Allan deviation) of $<0.12\frac{deg}{hr}$ (1σ, per axis) will be calibrated out on unit level by the support of the star tracker attitude data. Therefore, the gyroscope delivers its rate information with an update rate of $150\,Hz$ to the star tracker for calibration and data fusion.

This presentation gives a brief overview of the overall ASTROgyro system design and the results of the ASTROgyro IRU qualification campaign performed in the frame of an ESA project. In addition, the qualification results will be compared to the results of the first FM acceptance tests.