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Author: Mr. Henning Heibrok
German Aerospace Center (DLR), Germany

PETER MISSION FOR THE IN-ORBIT DEMONSTRATION OF A NEW AND PROMISING GYROSCOPE TECHNOLOGY

Abstract

The QYRO (Quantum-Optical Gyroscope) mission is a technology demonstration mission introducing a new, highly promising gyroscope technology for space applications. It is a collaboration of several well-known companies in the German technology landscape. The advantages of the NMR (Nuclear Magnetic Resonance) technology for gyroscope applications lay in the potential for very low size, weight and power (SWaP) properties. The possible SWaP properties of the NMR gyroscope technology are comparable to those of a state-of-the-art micro-electromechanical system (MEMS) gyroscope. The potential angular random walk and bias instability performance potential lies in the range of fiber-optical gyroscopes. This makes the technology very attractive for space applications, as it provides high performance paired with a low SWaP impact on a spacecraft. The goal of the PETER (Performance Evaluation Test Environment) mission is to demonstrate the potential use of this technology under space conditions. This encompasses the evaluation of the performance while being subject to microgravity, high vacuum, temperature variations and ionizing radiation. A prototype of the QYRO gyroscope is being developed and will be launched in 2027, among other payloads, on a commercial-off-the-shelf microsatellite platform weighing approximately 30 kg. The requirements on the platform pose a special challenge, as the gyroscope performance testing requires the satellite to spin stable around one axis for an extended period of time. The spin motion must be as undisturbed as possible, which requires all platform actuators to be disabled during the rotation maneuver. This alone is challenging for many commercial-off-the-shelf microsatellite Attitude Determination and Control System (ADCS) platforms. Furthermore, the ADCS must be robust in the provision of high accuracy attitude data during the spin maneuver. Lastly, sufficient power must be generated in order to sustain the operation of QYRO and the attitude references at the same time. The payloads include several of these attitude references in order to allow the determination of a reference rotation rate at all times during the rotation maneuver. Firstly, there is the reference gyroscope (RGYRO), which is a state-of-the-art fiber optical gyroscope. Secondly, the payload includes GALANT, an experimental phased-array GNSS antenna capable of determine the attitude from GNSS signals. Most importantly, the platform star tracker data and the platform Kalman-filtered attitude data are utilized. The data provided by the references is then used to compare with and potentially correct rotation disturbances.