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REFERENCE MIRROR MISALIGNMENT OF COLD ATOM INTERFEROMETERS ON SATELLITE-BASED GRAVIMETRY MISSIONS

Abstract

The success of GRACE-FO and its predecessors have demonstrated the benefits of satellite gravimetry for monitoring mass variations on the Earth's surface and its interior. However, the demand for increasingly higher spatial and temporal resolution of gravity field solutions has brought into focus the need for next-generation gravimetry missions (NGGMs). Therefore, we investigate the hybridization of electrostatic accelerometers (E-ACC) with cold atom interferometers (CAI), which can reduce the instrumental error contribution of the E-ACC, e.g. by enabling in-flight estimation of E-ACC bias parameters, and reduce systematic effects in gravity field solutions by proving drift free measurements.

However, these sensors introduce more stringent requirements on the computation of environmental disturbances in lower earth orbits, as the alignment of the CAI's reference mirror has to be controlled precisely. Therefore, the movement of the CAI's reference mirror inside the satellite is analyzed using the Hybrid Simulation Platform for Space Systems (HPS) developed by DLR and ZARM (University of Bremen). Misalignments and vibrations of the reference mirror cause an additional CAI phase shift, which introduces measurement inaccuracies. Our work examines the translational displacement, rotational misalignment and angular velocity of the reference mirror, due to forces transferred by the coupling link between mirror and satellite. This helps to compare different hybridization concepts and to improve noise and signal models for CAI accelerometers.