Hybrid Architectures with Quantum Gravity Gradiometry and Satellite-to-Satellite Tracking for Spaceborne Mass Change Measurements - A Sensitivity and Performance Analysis

Mitchell Rosen¹, Srinivas Bettadpur¹, Sheng-vey Chiow², and Nan Yu²

¹Center for Space Research, The University of Texas at Austin, Austin, United States of America (mitch.rosen@utexas.edu)
²The Jet Propulsion Laboratory, California Institute of Technology, Pasadena, United States of America (sheng-vey.chiow@jpl.nasa.gov)

Advances in atom interferometry have led to quantum gravity gradiometer instruments, which have further led to spaceborne mission concepts utilizing this technology to measure Earth's gravity field and its time variations. The mass changes inferred from gravity change measurements lead to greater understanding of the dynamical Earth system, as demonstrated by GRACE and GRACE Follow-On missions.

We report the results from a sensitivity and performance assessment study with quantum gradiometers used in two configurations – first as a single-axis gradiometer with a GNSS receiver; and second in a novel hybrid configuration combining cross-track quantum gravity gradiometer and an inter-satellite tracking system. The relative advantages of the two configurations are assessed in terms of their susceptibility to system errors (such as tracking, pointing, or measurement errors), and to modeling errors due to aliasing from rapid time-variations of gravity (so-called “de-aliasing errors”). We evaluate and discuss the impact of de-aliasing errors on gravity fields resulting from the study. We conclude with a specification of the key measurement error thresholds for a notional hybrid gravity field mapping mission.

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