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Advancing differential atom interferometry for space applications

SHENG-WEY CHIOW, JASON WILLIAMS, NAN YU, Jet Propulsion Lab — Atom interferometer (AI) based sensors exhibit precision and accuracy unattainable with classical sensors, thanks to the inherent stability of atomic properties. Dual atomic sensors operating in a differential mode further extend AI applicability beyond environmental disturbances. Extraction of the phase difference between dual AIs, however, typically introduces uncertainty and systematic in excess of that warranted by each AIs intrinsic noise characteristics, especially in practical applications and real time measurements. In this presentation, we report our efforts in developing practical schemes for reducing noises and enhancing sensitivities in the differential AI measurement implementations. We will describe an active phase extraction method that eliminates the noise overhead and demonstrates a performance boost of a gravity gradiometer by a factor of 3. We will also describe a new long-baseline approach for differential AI measurements in a laser ranging assisted AI configuration. The approach uses well-developed AIs for local measurements but leverage the mature schemes of space laser interferometry for LISA and GRACE. This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA.

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