Simultaneous multi-axis inertial sensing with point source atom interferometry

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In point source atom interferometry (PSI), a cloud of laser-cooled atom expands within a pair of counter-propagating Raman laser beams and, after a beamsplitter-mirror-beamsplitter Raman pulse sequence, a single snapshot of the expanded cloud allows simultaneous measurements of one axis of acceleration and two axes of rotation. In PSI, the thermal expansion of the cold-atom cloud, which is undesirable in other atom interferometry methods, is used to establish a position-velocity correlation in the expanded atom cloud. This correlation is employed to map the velocity dependence of the interferometric phase shift onto a two-dimensional spatial image plane. As a result, the thermal velocity spread of the cloud of laser-cooled atoms facilitates the parallel operation of many atom interferometers, which yields the simultaneous multi-axis sensitivity. PSI provides a new approach to applications of atom interferometers in navigation and space science. For example, the 2D rotation measurement with PSI can be used to find geographic north or to measure the precession of a rotation vector. We have developed a scheme using PSI that is amenable to portable applications and we have demonstrated the measurement of a rotation vector in a plane [1]. We will present our recent results on evaluating the performance and systematic errors in a compact setup and discuss our proposals to address the challenges toward implementing a high-precision and portable PSI system.

[1] https://arxiv.org/abs/1812.00106