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Experimental validation for low frequency isolation of six degree of freedom systems using inertial sensors

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After the first detection of gravitational waves in 2015, a new era in understanding the universe took off. To make such detection, gravitational wave detectors are required to operate in an ultra-stable environment that can be obtained only by isolating them from external disturbances. Active isolation control is a major approach in this context, it was successfully implemented in LIGO's positioning platform [1], where it is possible to obtain amplitude spectral densities lower than 10^{-12} m/$\sqrt{\text{Hz}}$ for vertical and longitudinal seismic isolation at frequencies higher than 1 Hz. Nevertheless, it is still extremely challenging to obtain such good performances at lower frequencies. This talk addresses theoretical approaches and corresponding experimental validations for low-frequency active damping and isolation of a six degree of freedom platform using super high-resolution inertial sensors. The active platform is actively isolated by up to two orders of magnitude for frequencies between 0.1 Hz and 10 Hz.
[1] F. Matichard, B. Abbott, S. Abbott, and D. Coyne, "Advanced ligo two-stage twelve-axis vibration isolation and positioning platform. part 2: Experimental investigation and tests results,"Precision Engineering,vol. 40, 04 2015.

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