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Real-Time Control System: Improving Low Frequency Performance

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Drawing upon insights from the VIRGO project, this study focuses on the development of an advanced Real-Time Control System (RCS) tailored for the precise feedback control of suspended optical devices and seismic isolation systems. We provide an overview of the project's status, highlighting the use of standard communication protocols, Field-Programmable Gate Arrays (FPGAs), and Digital Signal Processors (DSPs). In this work, we propose enhancements aimed at boosting performance in the low frequency range.

Specifically, we address the challenge of Digital-to-Analog Converters (DACs) exhibiting suboptimal low frequency performance due to voltage reference noise. Our investigation explores cutting-edge DACs sourced from the high-end audio domain, renowned for their remarkable total harmonic distortion (THD) and signal-to-noise ratio (SNR) characteristics, which hold promise for elevating system performance.

Moreover, we discuss the selection of Analog-to-Digital Converters (ADCs) optimized for compatibility with modulated sensors, a crucial consideration often overlooked in gravitational wave detectors. Enhanced low frequency ADCs are indispensable for applications such as the DC readout of optical levers used for position measurement of suspended optics in respect with the local reference frame, or for monitoring low frequency currents in magnet-coil actuators.

By integrating these advancements, we aim to improve the low frequency capabilities of the real-time control system.

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