



Resolution improvement of Low-Cost MEMS accelerometer by aligning Simulations sensors

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Abstract

Nowadays, accelerometers are being used in various civil engineering applications. Their versatility made them desirable in many Structural Health Monitoring (SHM) application. A significant issue with their use is the fact that traditional commercial accelerometers are very expensive. Moreover, the low-cost solutions are not very accurate.

To tackle this drawback and to enable low-cost accelerometers applicable to more SHM applications, a novel methodology for improving the resolution of low-cost MEMS accelerometers is presented in this paper. To this end the noise density level of more than one accelerometer was controlled by aligning on the same location for reading the same input wave.

The results of the performed laboratory tests showed that the higher the number of aligned accelerometers the lower the reported noise. Aligning a higher number of accelerometers also improve.

the system's final resolution in frequency domain diagrams.

Keywords: Low-Cost Sensors, CHEAP, Accelerometers, Data acquisition, Structural Health Monitoring.

1 Introduction

Structural Health Monitoring (SHM) systems are composed of sensors that measure the structural response (such as accelerations, rotations, strains or deflections) over time. This information can be used to estimate changes in the structural performance of infrastructures [1][2]. The time variation of some environmental factors (such as temperature or humidity) that could produce crack opening, rotations, settlements, corrosion and other pathologies is so slow that they can be considered as quasi-static or static [3][4]. Some events (such as the wave response due to

earthquake ground motion, traffic-induced vibrations or ambient activities) need to be accounted for the dynamic nature of the structural response they induce. To observe and control them, dynamic SHM Systems are required [5]. The modal parameters needed for SHM application are mostly acquired by accelerometers [6].

MEMS (Micro Electro Mechanical System) accelerometers are silicon-based micromachined devices that traditionally incorporate an accelerometer sensor and a signal conditioning circuitry [7][8]. The low-cost MEMS accelerometers have found their way to various industrial applications due to their significant on-going