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A MEMS-BASED XYLOPHONE BAR MAGNETOMETER FOR PICO SATELLITES

Abstract

Initially studied and developed by students in universities, the very small pico satellites (with a mass lower than 1 Kg) are more and more considered for science applications. In particular they will be used in constellations of small spacecraft for remote sensing of various regions of the magnetosphere. They require a payload with specific size, weight and power consumption. In order to respond to this demand, new instruments have to be developed. Those instruments should exhibit at least the same performance as those used in larger satellites while fulfilling the specific requirements imposed by the size of the satellites. For this reason, we currently develop a xylophone bar magnetometer (XBM) based on micro-electromechanical systems (MEMS) with integrated detector electronics. The principle of this magnetometer is based on classical resonating xylophone bar. A sinusoidal current oscillating at the fundamental transverse resonant frequency of the bar is applied to the bar. When an external magnetic field is present, the resulting Lorentz force causes the bar to vibrate at its fundamental frequency with a displacement directly proportional to the amplitude in one direction of the ambient magnetic field. First, this paper presents the measured characteristics and performance of previously manufactured MEMS XBM (without displacement detector). Then, a comparison between two designs using two different manufacturing technologies is shown. After that, the effects of strong thermo-mechanic and thermo-electric coupling on the vibrating bar are discussed using finite element simulations. Finally, an optimized version of the magnetometer, including the displacement detector is presented.