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Lecture #1

Title: Vibrating beam MEMS accelerometers for gravity and seismic measurements

Abstract: Advances in microelectromechanical systems (MEMS) have enabled the widespread development of sensors for a variety of consumer, automotive, and wearable healthcare electronics applications. However, there is increasing interest in the development of highly accurate MEMS inertial sensors for a variety of emerging applications, for e.g., navigation systems for pedestrians and autonomous vehicles, and seismic and gravity imaging, where the traditional attributes of MEMS (miniaturization and system integration) are combined with scalable transduction principles to enable highly accurate physical measurements. Resonant transducers and oscillatory systems have historically been employed to conduct some of the most precise physical measurements, and resonant approaches to measurement of forces and displacements in MEMS devices have enabled significant advances in accuracy of MEMS inertial sensors in recent years. This progress has been assisted by parallel advances in wafer-level encapsulation techniques, interface circuits, and approaches to mitigate temperature sensitivity, also applied to products in MEMS timing and frequency control. This talk will describe the evolution of vibrating beam MEMS accelerometers demonstrating exceptional long-term stability for applications in gravimetry and seismology. Device sensitivity and stability is demonstrated through the tracking of Earth tides and recording of ground motion corresponding to a number of seismic events. These results demonstrate the potential of vibrating beam MEMS accelerometers for high-resolution and stable measurements with wider implications for precision measurement employing other resonant-output MEMS devices such as gyroscopes and magnetometers.