A Piezoresistive MEMS Memory Device Using a Buckled Beam

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Abstract

Microelectronics and microelectromechanical systems (MEMS) have given rise to a large class of new devices, from ultra-miniature sensors for cell phones and automobiles to complex memory devices for computers. Recent research in memory devices has largely focused on designing new non-volatile forms of electronic memory; however, a MEMS-based memory device has not been proposed in the literature. This work presents a novel MEMS memory device using an asymmetrical, bistable buckled beam. Relying on well-known MEMS structures and the piezoresistive effect, the MEMS memory model was first conceptually designed, then optimized for signal strength using CoventorWare finite-element modeling. In the optimization process, various aspects of the device's geometry were ranked in order of magnitude of influence on the device's output signal strength, then optimized based on their importance. Simulation results indicate that the optimized device can generate signals up to 5.5uV with a supply voltage of 2.5V, a 27.5x improvement over the initial design. The length and width of the beam were found to be the most influential factors in controlling the signal output: increases in beam width lead to significant increases in signal when paired with the corresponding beam lengths. However, large beam widths caused the beam to buckle into higher-order modes when the beam was short, leading to sharp decreases in signal. Other geometric factors had only minor impacts on signal strength. The MEMS memory device paves the way for future low-power, radiation-hard MEMS memory models.

Biography of Presenter

Jerry A. Yang is a third-year electrical engineering honors student at the University of Texas at Austin. His current technical cores are integrated circuit design and nanotechnology. He is a student member of the Institute of Electrical and Electronics Engineers as well as the American Society of Engineering Education. At UT Austin, he has served as a teaching assistant in courses on digital logic, embedded systems and computer architecture. His engineering interests include micro/nanofabrication, MEMS systems, digital logic design, embedded systems and microcontrollers. His non-engineering interests include STEM/engineering education and LGBTQ+ studies.