Post-Release Capacitance Enhancement in Micromachined Devices

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BACKGROUND

Capacitive detection and actuation are commonly used in micromachined devices due to simplicity of implementation and effectiveness. However, the performance of capacitive sensors and actuators highly depends on the nominal capacitance of the microsystem. For example, in capacitive micromachined inertial sensors (i.e. accelerometers, gyroscopes, etc.) the performance is generally defined by the nominal capacitance of the sensing electrodes. Furthermore, in electrostatically actuated devices, the nominal actuation capacitance determines the required drive voltages. For a small actuation capacitance, large voltages are needed to achieve sufficient forces, which in turn results in a large drive signal feed-through. Thus, it is desired to maximize the sensing capacitance, and minimize the actuation voltages by increasing the actuation capacitance. However, the sensing and actuation capacitances of micromachined devices are limited by the minimum-gap requirement of the fabrication process.

TECHNOLOGY DESCRIPTION

University researchers have developed a post-release assembly technique aimed to increase the sensing and actuation capacitances in micromachined devices, in order to enhance the performance and noise characteristics beyond the fabrication process limitations. The approach is based on attaching the stationary electrodes of the device to a moving stage that locks into the desired position to minimize the electrode gap before operation. The locking mechanisms include, but are not limited to, ratchet structures and bistable mechanisms. Thermal actuators are employed for displacing the moving stage, but other actuation means are possible. The concept has been implemented in bulk-micromachined prototype gyroscopes, and the experimental results have successfully demonstrated the feasibility of the design concept.

APPLICATIONS

Immediate potential applications of the design concept include capacitive micromachined inertial sensors, especially accelerometers and gyroscopes, where the performance of the sensor is generally defined by the nominal capacitance of the sensing electrodes. Micromachined inertial sensors have a wide application range, including high performance navigation and guidance systems, automotive safety systems like yaw and tilt control, roll-over protection and next generation airbag and antilock brake systems, and also consumer electronics applications like image stabilization in video cameras, virtual reality products, and pointing devices. The idea can also be implemented in various electrostatically actuated devices, where the nominal actuation capacitance has to be enhanced to minimize the required drive voltages.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,279,761	10/09/2007	2004-542

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OTHER INFORMATION

CATEGORIZED AS

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