MICROELECTROMECHANICAL SYSTEMS (MEMS) SENSORS AND ACTUATORS (Ramot)

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Technology

My research activity in the area of design and modeling of micro- and nanoelectromechanical systems (MEMS/NEMS) combines both theoretical and applied aspects and falls in several directions. The overall scope of the research is in the development of new approaches to actuation and sensing and their implementation in micro devices. In the realm of micro systems, the increasing device performance requirements of a highly competitive industry have resulted in the emergence of more sophisticated designs that exploit more complex physical effects. We in the Microsystems Design and Characterization Laboratory (MDCL) established at the School of Mechanical Engineering, Faculty of Engineering, Tel Aviv University, develop new actuation and sensing approaches based on in-depth theoretical and experimental investigation of complex electromechanical phenomena encountered in microstructures. Among the examples of the devices developed in our group, one can mention electrostatically actuated parametrically excited micro resonators, inertial (accelerometers and gyros) and displacement sensors, tilting micro mirrors as well as bistable and multistable devices for switching and micro mechanical memories applications.

Bistable and multistable micro devices for non-volatile mechanical memory and logical elements

One of the distinguishing features of electrostatically or magnetically actuated microstructures is that they are inherently nonlinear. The research provides new theoretical and experimental results shedding light on the dynamic behavior and stability of micro and nano structures in general and bistable and multistable structures as well as parametrically excited devices in particular. These devices can be implemented in very robust and reliable mechanical non-volatile memories, switching devices as well as micro and nano mechanical logical elements.

Inertial sensors – micro accelerometers and angular rate sensors (micro gyros)

The research is focused on the development of new operational principles of inertial micro sensors – accelerometers and gyros. Specifically, a novel acceleration/force sensor was recently developed. The operational principle is based on the monitoring of the stability boundaries of a bistable device. This approach allows significant improvement of the sensitivity of the device. The feasibility of the approach was demonstrated experimentally. In parallel, a new micro gyro with a static sensing mode was suggested. In-depth theoretical analysis shows that the device may have significantly improved performance. Angular rate sensors with very efficient parametric excitation in the drive mode was recently introduced and is currently at the characterization stage.
In addition, several other research projects are being conducted including development of micro devices built of electroactive polymers (in collaboration with Prof. Shacham, Tel Aviv University) and nano resonators for biosensing and gas sensing (in collaboration with Prof. Craighead and Dr. Ilic, Cornell University, USA).

Patents

US granted patent 7,613,367

PCT applications IL2007/001554, IL2009/000243, IL2012/050165, IL2012/050114 on the non-zero momentum gyro and on the bistable accelerometer and a provisional on a parametric gyro.

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