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# Diffraction based optical MEMS microphones and accelerometers with active electrostatic force feedback

Baris Bicen[a], Caesar Garcia[a], Neal Hall[a], Murat Okandan[b], Weili Cui[c], Quang Su[c], Ronald Miles[c] and Levent Degertekin[a]
[a]Georgia Institute of Technology, G. W. Woodruff School of Mechanical Engineering, 801 Ferst Dr. NW, Atlanta, GA 30332-0405, USA
[b]Sandia National Laboratories, New Mexico, PO Box 5800, Albuquerque, NM 87185-1080, USA
[c]State University of New York, PO 6000, Vestal Parkway East, Binghamton, NY 13902-6000, USA

Diffraction-based optical displacement detection method and its use in low noise micromachined microphones have been shown earlier. [Hall et al., J. Acoust. Soc. Am. 118, 3000–3009 (2005), Garcia et al., J. Acoust. Soc. Am. 121, 3155 (2007)]. In these devices, the integrated electrostatic port of the sensor is uncoupled from the integrated optical sensing. This structure enables one to use this port for sensitivity tuning, self characterization, and active control to adjust the device dynamics. Given that the displacement noise of integrated optical sensor is below the thermal-mechanical noise of the mechanical structure, one can implement force feedback methods such as active Q-control, or adjust device stiffness without adding substantial noise to the system. We implemented micromachined optical microphones and accelerometers with integrated optoelectronics integrated in a 1.5mm3 volume. We present experimental results on force feedback Q-control of low noise omnidirectional, and biomimetic directional optical microphones, as well as adjusting the stiffness of accelerometers to improve their frequency response. [Work supported by NIH Grant 5R01DC005762-03 and the Catalyst Foundation.]