The Visual Motion and Inertial Motion Sensing Project

Personnel

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Sponsorship

DARPA

This project maps the distributed feedback loops of biological photoreceptors to silicon to create low-power high-performance silicon photoreceptors. Such photoreceptors are useful as front ends in VLSI motion sensors, important in robotic and active-vision applications. An ultra-low-noise MEMS vibration sensor, which provides inertial information to a vibrating visual sensor being built by collaborators at Caltech, has also been built.

Figure 38 shows the VLSI layout of a visual motion sensor that yields the speed and direction of a globally moving visual image along the “Y” direction. The array contains both photodiodes and analog VLSI processing circuitry that is inspired by similar circuitry in the housefly. Figure 39 shows the experimental setup for testing a capacitive MEMS vibration sensor with associated ultra low noise offset-compensating electronics on an electronics die, which is wirebonded to the MEMS die. The sensor achieved an electronic noise floor equivalent to 30ug/rt(Hz) over a 1Hz-100Hz bandwidth, a specification that appears to be 3 times better than any equivalent commercial or research system, in spite of its separate-die solution for mechanical and electrical systems. The system was able to detect a change of 1 part per 5 million in capacitance. The offset-compensating electronics has been briefly described in "A Low-Noise Nonlinear Feedback Technique for Compensating Offset in Analog Multipliers”, Maziar Tavakoli-Dastjerdi and Rahul Sarpeshkar, accepted paper, IEEE International Symposium on Circuits and Systems, Arizona, May 2002.

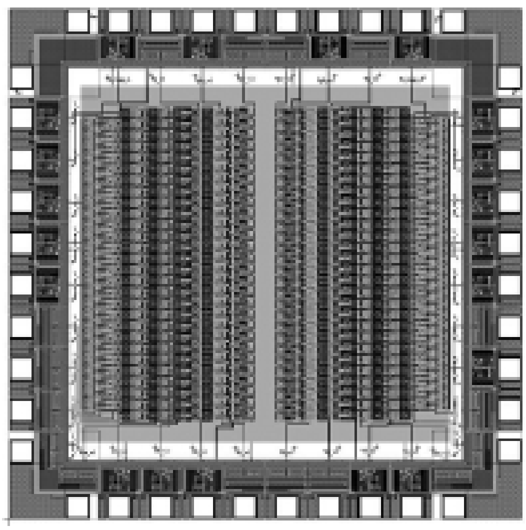

Fig. 38: Layout of a (modified Reichardt-like facilitate-and-sample) visual motion sensor.

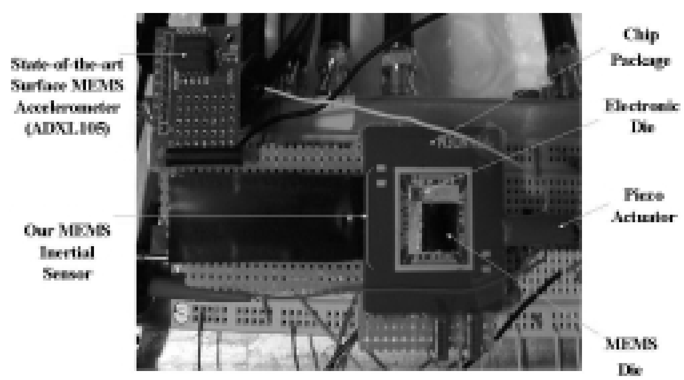

Fig. 39: The test setup utilized to evaluate the performance of our combined MEMS-and-electronic vibration sensor