

Title:

Biologically inspired artificial haircell sensors

Abstract:

Today's engineering systems, such as machines, vehicles, robots, medical devices, home appliances and entertainment devices, are often sensor deficient. They may often have high power and/or high speed, but do not exhibit autonomous behavior, agility, and maneuverability.

Biological systems, on the other hand, exhibit great sensory intelligence. Evolved over millions of years, biological systems offer many exquisite examples of sensing and intelligence. To start, many biological sensors are highly sensitive. Many biological sensors match or surpass the best engineering devices with ease and elegance. They often offer vastly superior dynamic range, frequency response, adaptability, and low power. Further, animal sensory intelligence functions well in complex and noisy environments, allowing them to survive in unstructured conditions.

The biological sensory intelligence has been the subject of study by biologists since the dawn of civilization. However, most biologists have been isolated, focused discovery processes. With the advancement in micro fabrication, it is now possible to mimic the structures and functions of many biological sensors at their native scales. We argue that disruptive system technology can emerge by (1) having better performance sensors; (2) by reducing the cost of sensors; (3) by allowing easier integration of sensors in systems; and (4) by developing technologies to utilize sensor data for decision and control.

The work at my group is aimed at bridging the gap between biology and system engineering. I will illustrate a few examples of sensors inspired by nature, including biomimetic artificial haircells, artificial lateral line, and multimodal tactile sensing skin. These devices can be used to sense vibration, touch, flow, pressure, heat, and contact. I will also discuss our work in the area of polymer MEMS to enable simple sensor packaging and sensor-electronics integration.

Short Bio:

Chang Liu is a professor of engineering at Northwestern University, Evanston, IL. Chang Liu received his M.S. and Ph.D. degrees from the California Institute of Technology in 1991 and 1995, respectively. In January 1996, he joined the Microelectronics Laboratory of the University of Illinois and earned tenure in 2003. He joined Northwestern University in 2007, and established the Medx Laboratory to conduct interdisciplinary research focusing on medical applications of micro engineering. He authored a textbook "Foundations of MEMS" and was elected IEEE Fellow in 2010.