

# **Grand Challenges in Bio-Inspired Medical Devices**

I. Y. (Steve) Shen

Mechanical Engineering, University of Washington

Seattle, WA 98195-2600, USA

Email: [ishen@u.washington.edu](mailto:ishen@u.washington.edu)

For the last 50 years, there have been significant developments in medical devices, such as implants and prostheses, to restore functionality of human bodies. Many of them are truly engineering wonders. One such example is cochlear implants. The basic concept is to use an electrode array to stimulate neurons bypassing hair cells that are severely damaged.

As the development of many medical devices matures, it is natural to look for a new philosophy that will advance the state of the art in a revolutionary way. One such paradigm shift is to infuse bio-mimicry with medical devices. Why? First, bio-mimetic medical devices adopt the mechanisms and functionalities of human bodies that have evolved for millions of years. Therefore, they are more efficient and sensitive as a result of the natural selection process. Second, bio-mimetic medical devices are multi-functional, capable of performing multiple tasks simultaneously as in many biological systems.

To develop the new breed of medical devices, there are many challenges to overcome. First, physiology needs to be studied from the engineering point of view to gain understanding, so that it can be used to design bio-mimetic medical devices. Second, new materials and new fabrication processes must be developed to perform specific functions of a bio-mimetic device. Third, new algorithms are needed to process vast amount of information transmitted to or received from these medical devices. Fourth, the ability for the medical device to feed back and adapt requires significant study in control theories. Finally, system integration becomes extremely critical.