Abstract1

Brain-Machine Interfaces – A new research avenue for cybernetics and systems science

Brain-Machine Interfacing (BMI) is about transforming thought into action, or conversely, sensation into perception. This young interdisciplinary field has grown tremendously during the last decade through the advent of multi-electrode recording technology, and has led to impressive demonstrations of neural control of external devices by rats, followed by monkeys and finally humans in a short span of 10 years. Moreover, this technology has the potential to improve the quality of life for millions of people suffering from spinal cord injuries, stroke and other neurological disorders. In this talk we will review the field of cortical BMIs from an application point of view, with examples from experimental results of the impressive adaptive capabilities displayed by the mammalian brain. Specifically, we will show that monkeys can learn to use their brain activity sampled by implanted microelectrode arrays to produce two distinct types of movements in an artificial actuator, reaching and grasping, even in the absence of overt arm movements. Moreover, we will provide evidence from recent results in our laboratory showing how long-term use of a BMI is associated with the formation of a cortical map for prosthetic function that resembles a putative memory engram. Finally, we will discuss examples of interesting problems that the field of BMI brings to the cybernetics and system science communities. We believe that the impact of this technology in the clinical realm will drive neural technology to the next level: augmentation of sensory, motor and cognitive capabilities in healthy subjects. Ultimately, this technology will impact society in many different ways, allowing humans to have direct wireless communication (internet, sensor networks, mobile devices, etc) and interaction (control of artificial devices) with the real world.