Abstract2

Brain-Machine Interfaces – A new paradigm for studying brain function

Two major technological developments during the last decade triggered a paradigm shift in the quest of understanding the brain: chronic multi-electrode recordings and brain-machine interfaces (BMI). Chronic multi-electrode recordings are a powerful tool to study brain function by analysis of spatiotemporal patterns of neural activity. This technique allows recording from large populations of neurons from multiple areas of the brain simultaneously and for long periods of time. This is paramount for studying the spatio-temporal patterns of neural activity and quantifying the neurophysiological changes occurring in cortical networks while subjects perform sensorimotor tasks in both 'manual' and 'prosthetic' control modes of operation. BMI is a new paradigm which contends that a subject can perceive sensory information and enact voluntary motor actions through a direct interface between the brain and an artificial actuator in virtually the same way that we see, walk or grab an object with our own natural limbs. 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. Moreover, we believe BMI technology will play a key role in the quest for understanding how the brain's architecture and neural circuitry gives rise to its remarkable abilities in perception, cognition, learning, and motor function, which far exceed the abilities of modern digital computers. In this talk, we will discuss the implications of the BMI paradigm for elucidating brain function. We will present recent results from our laboratory showing evidence for long-term consolidation of prosthetic motor memory in non-human primates. This 'cortical map' for prosthetic function resembles a putative memory engram in that it is retained, readily recalled and resistant to interference. The implications of this finding are paramount for the design of neuroprosthetic devices, suggesting that they could be controlled through effortless recall of such a motor memory in a manner that mimics the natural process of skill acquisition and motor control.