INTRACORTICAL MOTOR NEURAL PROSTHETIC DEVICES

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Our laboratory is developing a neural motor prosthetic (NMP) to restore the ability for paralyzed humans to interact with their environment. We are developing three basic components of an NMP system: an implantable recording array, neural decoding hardware and software, and an interface with real world devices. The recording device, which serves as a brain machine interface (BMI), is a Bionic Technologies silicon 100 electrode array which includes a percutaneous connector for external communication. We have demonstrated that this array can be used to record multiple neurons for years when implanted in the motor cortex (MI) of macaque monkeys, suggesting that it is a reasonable prototype for a human BMI. We are developing decoding algorithms that transform neural activity into useful control signals. Using linear correlation methods we are able to reconstruct intended hand trajectories based upon the activity of small numbers (~6-40) of MI neurons. Such signals can be used to drive robot arms and computer cursors. Finally, we have created a real time system which successfully decodes MI neural activity and translates it into cursor motion on a computer monitor. Using this system monkeys are able to perform visually guided tracking tasks when the cursor is driven by MI neural activity. This decoding nearly as fast, and is about 70% as accurate as the actual hand motion required to perform this task. Further, cursor control does not require that the actual hand tracking motions be performed. These results demonstrate that an NMP should be able to provide rapid, real time control signals for humans. Intended hand motions can be transformed into the motion of other physical or virtual instruments or potentially of paralyzed muscles. Importantly, single neuron based NMPs can provide motions that resemble natural hand trajectories in their speed and accuracy.

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