VEN. 2 OCT.

Les conférences scientifiques du centre de recherche CERVO et de NeuroQuébec

F-1455 11 h

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Invité par Christian Éthier

Brain-controlled functional electrical stimulation to restore hand use after spinal cord injury: Opportunities and challenges

INTÉRÊTS DE RECHERCHE

The greatest desire for most people with high-level spinal cord injury is for restored hand movement. My lab developed an intracortical brain-computer interface (iBCI) in monkeys that used recordings of single neurons in the motor cortex to make predictions of muscle activity. These, in turn, we used to control intramuscular Functional Electrical Stimulation (FES) of the muscles of the monkey's hand, which were temporarily paralyzed by a peripheral nerve block. This "biomimetic" iBCI allowed more nearly natural control not only of the motion of the monkeys' wrist and fingers, but also well-controlled grasp force, which kinematic iBCIs struggle to accomplish. Beyond the ability to immediately restore voluntary limb movement, there is evidence that the tight synchrony between a user's attempted movement and the peripheral stimulation, may invoke mechanisms of neural plasticity that could accelerate recovery from SCI. In this talk, I will describe the basic proof-of-concept work in monkeys and our later work to expand that to a wide range of motor activities, for which simple linear decoders of EMG fail. Finally, I will describe our current work to extend this approach to humans, first in a virtual setting, and ultimately through FES.

PUBLICATIONS

- Ethier, C., E. R. Oby, M. J. Bauman and L. E. Miller (2012). "Restoration of grasp following paralysis through brain-controlled stimulation of muscles." Nature 485(7398): 368-371.
- Ma, X., F. Rizzoglio, K. L. Bodkin and L. E. Miller (2025). "Unsupervised, piecewise linear decoding enables an accurate prediction of muscle activity in a multi-task brain computer interface." Journal of Neural Engineering 22(1): 016019.
- Ciucci, C., X. Ma, F. Rizzoglio, E. Gasper, A. R. Sobinov and L. E. Miller (2026). "Consistent EMG encoding during reach and grasp by neurons in motor cortex." bioRxiv: 2026.2003.2002.709159.

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