Towards a sensorimotor forelimb prosthesis for the mouse model

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Abstract

Research towards the restoration of upper limb function through bidirectional, BMI-controlled prostheses calls for tractable experimental models. A mouse forelimb neuroprosthesis would make this animal model a highly relevant neuroprosthetics research platform with its unique genetic and molecular toolboxes.
Here we take advantage of a mouse bidirectional BMI that we previously built in the team (Abbasi et al. 2018, Goueytes et al. 2022), and combine it with a miniature, mouse-scale 3D-printed forelimb prosthesis with four degrees of freedom and a tracking system to ensure its accuracy. Electrophysiological activity of neurons is recorded in the primary motor cortex and converted into a command. This command can be either the joints angles, a cartesian coordinates of the tip of the limb or even a combination of predefined trajectories. In preliminary experiments, we trained a mouse to control the forelimb prosthesis in a physiological 2-degrees of freedom space in order to obtain water by bringing the prosthesis to the mouth, and back to a water reservoir to refill the drop carried by the prosthesis paw.

In our next experiments, we will probe the ability of mice to control this prosthesis in a 3 dimensions polar space, and we will finalize the implementation of touch/proprioceptive feedback based on camera tracking and embedded force sensors. We now aim to test the impact of this feedback on the accuracy and overall speed of the prosthesis motor control.

Abbasi et al 2018: https://iopscience.iop.org/article/10.1088/1741-2552/aabb80/meta

Goueytes et al. 2022: https://iopscience.iop.org/article/10.1088/1741-2552/acab87

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