Wiring neural pathways using a bidirectional neural interface

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Restoring function to a paralysed limb is highly desirable. One way to achieve this goal is to bridge the disrupted pathway between preserved neural structures and muscles using a brain-computer interface. I will demonstrate a bidirectional neural interface, called an artificial neural connection (ANC), which bridges two neural structures and transfers information into and out of the nervous system. A clinical application of ANC is that voluntary walking could be restored by muscle-controlled non-invasive magnetic stimulation of the lumbar spinal cord. Patients with spinal cord injury could control oscillating stimulation patterns of magnetic stimulation to lumbar locomotor circuits below the spinal lesion and regain voluntarily controlled walking that changes step cycles and length through ANC. Another application of ANC is to deliver intracranial reinforcing stimuli dependent on patterns of neural activity, thus implementing prolonged periods of operant conditioning to upregulate positive mood and motor performance. These paradigms have numerous potential applications depending on the input signals, the computed transform and the output targets.

1. Nishimura et al., Spike-timing-dependent plasticity in primate corticospinal connections induced during free behavior. **Neuron**. 80(5):1301-1309. [2013]
2. Kato et al., Bypassing stroke-damaged neural pathways via a neural interface induces targeted cortical adaptation. **Nat Commun.** 10(1):4699. [2019]

主催：神戸大学メディカルトランスフォーメーション研究センター（担当：生理学分野 078-382-5832）