BCI WIMAGINE® TECHNOLOGY

A Brain-Spine Interface to help paraplegic patients regain mobility

PATENTS 25 PATENTS

What is BSI?

The Brain-Spine Interface (BSI) project aims to prove that it is possible for a person with serious motor disabilities (e.g., paraplegic patients) to regain mobility after training thanks to BSI. BSI uses a brain-computer interface coupled to a spinal cord stimulation technology to enable patients to remobilize their body by decoding brain electrical activity and stimulating spinal cord activity.

This technology relies on the fact that moving or imagining a movement generates similar electrical activity in the motor cortex. ElectroCorticoGram (EcoG) signals are recorded and decoded in real-time to provide command signals to the spinal cord electrical stimulation system, which will in turn mobilize muscle functions. With training, this can enable patients to regain the ability to walk.

Applications

BSI is controlled by a user who will simply imagine movements, to which the body will then respond. EcoGs produced by a subject's movement intent are recorded by the WIMAGINE® implant that is surgically implemented inside the skull in front of the motor cortex.

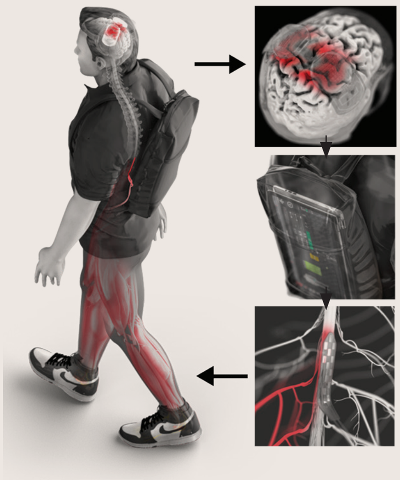
EcoGs are decoded in real time in order to control a spinal cord stimulator. This application offers the potential for paraplegic persons to regain the ability to walk and thus greatly enhance their quality of life.

What's new?

The STIMO BSI clinical trial (**NCT04632290**) yielded significant results that were published in the prestigious Nature journal. CEA researchers and their collaborators effectively demonstrated the ability to consistently activate a spinal cord stimulator using a complete BSI system. This system relies upon continuous, online epidural ECoG recording used to decode brain activity in a paraplegic patient. This unique integrated system efficiently triggers lower-limb muscle activation in order to help regain walking abilities.

Training environments have been developed both in the laboratory and in natural settings, paving the way to more widespread, at-home BSI technology evaluation.

Concept of the Brain Spine Interface technology ▼



What's next?

The BSI platform uses the WIMAGINE® implant, online decoding algorithms and softwares developed by CEA, and a spinal cord stimulator system developed by EPFL and CHUV. The full system complies with European directives for a Class III AIMDs for clinical trial application.

Our team is currently finalizing the 'STIMO BSI' proof-of-concept clinical trial. Future steps include a first-in-human evaluation of the BSI system for tetraplegia in order to enable patients to mobilize and control their upper limbs.

From the technology side, future efforts will focus on developing effective, low-power embedded signal processing approaches based on edge AI, as well as designing and testing high-density implantable systems.

Key facts

- Lorach, H. et al. Walking naturally after spinal cord injury using a brain–spine interface. Nature 618, 126–133 (2023).
- Mestais, C. et al. "WIMAGINE: wireless 64-channel ECoG recording implant for long term clinical applications." IEEE transactions on neural systems and rehabilitation engineering 23.1 (2014): 10-21.
- Benabid, A.L., et al. "An exoskeleton controlled by an epidural wireless brain–machine interface in a tetraplegic patient: a proof-of-concept demonstration." The Lancet Neurology 18.12 (2019): 1112-1122.
- 25 proprietary patents

Work carried out at Clinatec, Edmond J. Safra biomedical research center, quadripartite structure composed of CEA, Fonds de dotation Clinatec, Grenoble-Alpes University Hospital and Grenoble-Alpes University.

Interested in this technology?

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