An Automated, Minimally-invasive Neural Interface System Providing the Means for Scalable Electrode Implantation

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INVENTION NOVELTY

This invention provides an automated, high-throughput, minimally-invasive system to insert electrodes within the brain and other parts of the central nervous system (CNS). The system provides a means for inserting these electrodes within the brain with minimal to no disruption of the blood brain barrier (BBB). This feature is critical, as neural electrode failure is closely associated with inflammation resulting from the disruption of the BBB. Furthermore, this system will allow the implantation of electrodes within the CNS at a much higher density than current standards.

VALUE PROPOSITION

The ability to insert highly-compliant, minimally-sized electrodes into precise locations within the brain is urgently needed for neuroscience research, and is necessary for the clinical application of neural interfaces (e.g. neuroprosthetic devices, neurostimulation). Current electrode implantation techniques often result in damage to the BBB due to the large size of the electrode and implantation apparatus. In addition, current neural electrodes are silicon-based and substantially rigid in relation to the surrounding tissue, which can result in significant local tissue displacement. Both of these factors can lead to a local inflammatory response, which is the primary cause of electrode failure in the current generation of devices. Highly compliant, minimally-sized electrodes would mitigate these problems and minimize chronic damage to brain tissue. This invention would allow a large number of highly-compliant, minimally sized electrodes to be automatically inserted into the brain at precise anatomical locations. In addition, different brain regions can be individually targeted at varying depths, a feature strongly needed for future neuroscience research, and also necessary for advanced neuroprosthetics. This invention can also be coupled with current magnetic resonance imaging technologies to map out a patient's neural vascular system and avoid disrupting it during electrode implantation.

This novel invention provides the following advantages:

- Small, compliant electrodes that **minimize brain tissue damage**.
- An **automated, minimally-invasive** method to insert a large number of electrodes within the CNS.

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OTHER INFORMATION

KEYWORDS

Minimally-invasive system, Electrodes, Central nervous system (CNS), Neurostimulation, Brain, Neuroprosthetic devices

CATEGORIZED AS

- **Medical**
  - Devices
  - Disease: Central Nervous System
  - Therapeutics

RELATED CASES

2013-173-0

No blood brain barrier disruption, resulting in **increased electrode viability**.

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Deeper implantation within the brain, and at a **higher electrode density** compared to current neurostimulation devices.

TECHNOLOGY DESCRIPTION

Physiologists at the University of California, San Francisco have designed a new system that automates the implantations of a large number of flexible electrodes at precise locations within the CNS in a minimally invasive manner.

The device incorporates the following novel elements that are critical to its function; micron scale-diameter needle controlled by a motorized system, novel mechanism to deliver electrodes, robotic mechanisms, and an integrated system.

Additionally, the system is envisioned to be integrated with commercial magnetic resonance imaging or optical coherence tomography techniques to map out a patient's vasculature, thereby allowing the aforementioned robotic targeting system to prevent BBB disruption.

APPLICATION

- Bi-directional (stimulation and recording) clinical neuroprosthetics, not exclusively motor, somatosensory, vestibular, auditory, proprioceptive, nociceptive, baroreceptive, and visual prosthetics.

- Research tools for cutting-edge neuroscience research, especially research that requires recording/stimulation in many neurons in many different brain regions.

- New clinical treatments of prevalent diseases via patterned and/or neural-state dependent neurostimulation, notably Parkinson's disease (e.g. more precise electrical triggering on synchrony or tremor events), or Alzheimer's disease.

LOOKING FOR PARTNERS

To develop and commercialize this technology as a new, more effective tool for clinical neurostimulation and neuroscience research.

STAGE OF DEVELOPMENT

Preclinical

RELATED MATERIALS

DATA AVAILABILITY

Under NDA/CDA

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,963,697	04/23/2024	2013-173
Canada	Issued Patent	2,972,032.	01/16/2024	2013-173
United States Of America	Issued Patent	11,660,115	05/30/2023	2013-173

Hong Kong	Issued Patent	HK1246225	10/21/2022	2013-173
Germany	Issued Patent	3237058	02/16/2022	2013-173
France	Issued Patent	3237058	02/16/2022	2013-173
United Kingdom	Issued Patent	3237058	02/16/2022	2013-173

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