Subdural Device for Monitoring Seizures and Mapping Brain Function

Technology Summary

This technology describes a subdurally implanted imaging device for monitoring neural activity and blood oxygenation levels, with clinical applications in patients suffering from epilepsy, traumatic brain injury, and stroke.

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Patents:
Granted

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D-4029

Technology Overview

Epilepsy is a neurological disorder characterized by abnormal brain activity that results in seizures and periods of altered behavior or loss of awareness. Treatment of epilepsy commonly requires surgery and noninvasive brain imaging techniques (e.g., MRI, PET, or SPECT) are generally used prior to surgery to localize the source of the seizures within the patient's brain. However, for some patients noninvasive imaging techniques provide insufficient spatiotemporal resolution for identifying epileptic foci and subsequently they cannot be treated or can only have surgery performed at great personal risk.

Cornell inventors have responded to the pitfalls of noninvasive brain imaging techniques by designing a subdurally implantable device consisting of electro-optical grids and sensors. This device consists of electrodes to monitor neuronal activity in addition to photoemitters and photodiodes to monitor blood flow and oxygenation. The device is implanted within the layers of membranes that protect the brain, providing higher spatiotemporal resolution than noninvasive techniques and can be left in place for 2 – 3 weeks in freely moving patients to allow for longitudinal monitoring of neural activity and blood flow. The comprehensive brain activity data would allow assessment of seizure localization in epileptic patients and may indicate clinically concerning changes in blood flow and oxygenation in patients suffering from other conditions such as traumatic brain injury or hemorrhagic stroke. Implanted monitors in these patients may enable earlier therapeutic intervention and therefore reduce morbidity and mortality.

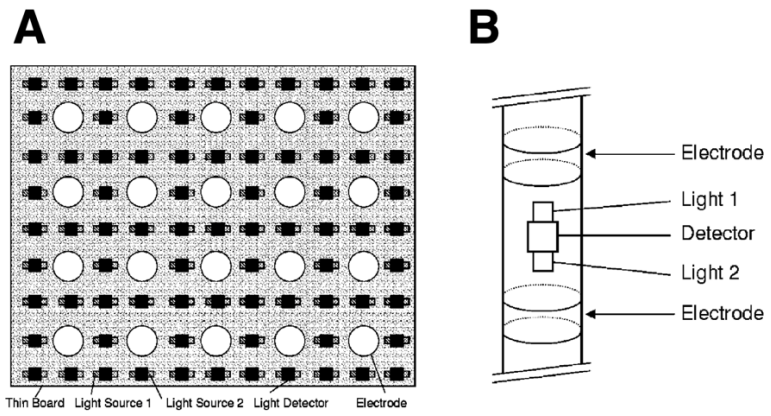

Figure 1. Schematics depicting an example planar intracranial electro-optical sensor (**A**) and an example elongate intracranial electro-optical (**B**).

Executive Summary

Potential Applications

- Accurate localization of epileptic foci that produce seizures
- Brain monitoring to detect and treat complications following hemorrhagic stroke or traumatic brain injury
- Monitoring blood flow and neuronal activity for other uses (e.g., assessing level of consciousness)

Advantages

- Simultaneously measures brain electrical activity, blood volume, and blood oxygenation
- Can be used to monitor neural activity in freely moving patients, which is impossible in competing imaging technologies like fMRI and PET scans
- Chronic subdural implant allows for extremely long recording sessions
- Direct contact between the implant and the cortex allows for extremely high spatiotemporal resolution relative to imaging techniques without direct cortical contact like EEG

Publications

- US Patent: 9,521,955. “Subdural Electro-Optical Sensor”. Granted Dec 20, 2016.