# Ultra-Dense Electrode-Based Brain Imaging System With High Spatial And Temporal Resolution

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## INVENTORS

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## OTHER INFORMATION

**KEYWORDS**

Brain imaging, spatially focused, electrode array, compressed sensing brain imaging, total variation, optimized electrical tomography

**CATEGORIZED AS**

- **Biotechnology**
  - Health
  - Medical
- **Medical**
  - Devices
  - Disease: Central Nervous System
- **Sensors & Instrumentation**
  - Biosensors
  - Medical
  - Scientific/Research

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## SUMMARY

UCLA researchers in the Department of Bioengineering have developed a novel integrated brain imaging system that utilizes an ultra-dense electrode-based device. This system provides high resolution of functional brain images spatially and temporally.

## BACKGROUND

Brain imaging using regular MRI and fMRI is part of the $6 billion medical magnetic resonance imaging global market. Although fMRI has been more widely used to provide real time and detailed feedbacks of brain responses, it is not portable and not fast enough to record changes happening on the millisecond scale. In recent years, using high-density electrodes to replace fMRI has provided improved accuracy in brain imaging. These devices only adopt 64-256 electrodes, resulting in poor spatial resolution in brain mapping and imaging. Additionally, these devices do not come with an integrated system that allows streamlined data collection, analysis and interpretation that is suitable for easy daily use.

## INNOVATION

An ultra-dense electrode-based brain imaging system was invented to address the aforementioned issues in brain imaging using fMRI and conventional electrode-based devices. The ultra-dense large area electrode-based device is capable of capturing functional brain information across all major areas of the brain. It has up to a thousand electrodes, which allows for fine spatial resolution (~5 mm) that is comparable to fMRI (~3-5 mm). The high data acquisition frequency cuts down the time resolution of imaging to milliseconds instead of seconds for fMRI. The gigabit wireless transceiver provides high bandwidth for fast data transfer between devices in the imaging system. The innovative spatially focused electrode technology minimizes duplicate signals from nearby electrodes and improves imaging accuracy. The system also incorporates novel compressed sensing brain imaging algorithm that is capable of recovering varying intensity of the brain image and enhancing the spatial resolution of the image. As well, the system is streamlined from hardware manipulation to integrated software support that allows portable and real-time monitoring of patients. This system can be easily used for diagnosis and treatment of brain disorders as well as basic scientific studies of brain functions.

## APPLICATIONS

- Patient monitoring at home
- Brain imaging and mapping for scientific studies
- Diagnosis and treatment of brain disorders
- Stimulation of particular brain areas using electrodes
- Personalized learning/training online

## ADVANTAGES

- Integrated into data collection, analysis and feedback systems
- Streamlined operation from hardware to software
- High spatial and temporal resolution
- High imaging accuracy
- Low cost and light weight

## PATENT STATUS

| Country | Type | Number | Dated | Case |
|---|---|---|---|---|
| United States Of America | Issued Patent | 11,042,982 | 06/22/2021 | 2016-151 |

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Electrical Charge Balancing Scheme For Functional Stimulation Using Pulse Width Compensation
- Flexible Stretchable Electrode And Recording Method For Gastrointestinal Prostheses
- Methods Of Fabricating A Multi-Electrode Array For Spinal Cord Epidural Stimulation
- Selective Chemical Bath Deposition of IrOx on Thin Film Structure
- Wireless Wearable Big Data Brain Machine Interface (W2b2/Wwbb)

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