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Redesigned Neuromodulation Device for Improved Psychiatric Treatment

Researchers at Stanford have developed a device capable of delivering ultrasonic neuromodulation to defined areas of the brain while simultaneously recording neuronal activity with cell-type specificity. The use of ultrasound to non-invasively modulate brain behavior is a growing area of research, with great potential for treating an array of neurological disorders including epilepsy, essential tremor, depression and sleep disorders. However, the precise waveform features required to enhance or suppress neurological activity have not yet been well-established. Furthermore, how different cell-types respond to these features is almost entirely unknown. These shortcomings remain a major barrier to ultrasound neuromodulation replacing or supplementing pharmacological psychiatric treatments. The new device, which uses an implantable optical fiber with an integrated ultrasonic transducer, could improve waveform selection and therefore transform the use of ultrasonic neuromodulation for psychiatric disorders.

Stage of research
The ability of the device to produce an ultrasonic excitation at the fiber tip has been demonstrated. It has been tested on an awake mouse with a genetically encoded fluorescent calcium indicator in the cells immediately below the fiber tip. The mouse moved freely with the device attached, the photometry measurement was not impeded, and the mouse showed no ill effects when an excitation voltage was applied across the piezo. A neuronal response to ultrasonic delivery was measured.

Applications

- Ultrasonic neuromodulation
- Clinical research tool for identifying the precise ultrasonic waveforms that excite or inhibit particular cell types

- Development of precisely targeted treatments for neurological disorders (e.g., to improve sleep quality)

Advantages

- Enables measurement of cell-type specific response in spatially controlled regions of the brain
- Improves waveform selection
- Extremely lightweight so it can be used on awake, freely moving subjects
- Avoids the confounding effect of anesthesia or physical constraint

Patents

- Published Application: WO2021097095
- Published Application: 20220378360

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