NEUROSCIENCE

A wave of the WAND for neuromodulation

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A novel, implantable device that can perform therapeutic electrical stimulation while simultaneously recording neuronal activity has recently been developed by researchers at the University of California Berkeley. Designed for use in animal models, the wireless artefact-free neuromodulation device (WAND) allows 'closed loop' experiments and therapeutic approaches, in which the device itself senses a neuronal state and delivers or monitors a therapeutic stimulation.

WAND is a significant advance over previous devices, largely because the act of delivering an electrical stimulation can produce large and persistent artefacts that may interfere with recording. "That's been a major limitation in the state of the art," said lead researcher Rikky Muller.

The researchers looked for the fundamental cause of the interference problem in other devices and found that the root lay in incompatibility of some of their circuits. "If we were very smart about how we designed the circuits, we could overcome a lot of the instrumentation limitations that were causing these artefacts. Those integrated circuits also allow us to create a device that is very small and very low power, and we built a platform around it that is reprogrammable, so that we can use that interface in a broad variety of contexts," said Muller. The team has created miniature versions about an inch in diameter, which allows its use in a variety of animal models.

In one experiment, the team used WAND to disrupt preparatory activity during a delayed-reach task in a male rhesus macaque. Previous researchers had demonstrated that microstimulation to the dorsal premotor and primary motor cortical sites disrupts preparatory activity and increases reaction time, but it had been necessary to externally synchronize the stimulation to coincide with the task (*J. Neurophysiol.* **97**, 348–359; 2007).

Muller and her colleagues repeated the experiment, allowing WAND to do the work. It could detect when the subject was holding the object prior to moving it, and automatically deliver stimulation to electrodes embedded in the dorsal premotor site. "The entire experiment was done autonomously and in a closed loop for the first time. This opens up a whole realm of experiments with closed loop devices that are triggered based on the neural state as opposed to primed on some kind of external queue," said Muller.

It also expands the potential clinical applications of implantable neuromodulating devices. A closed-loop device could monitor for adverse events associated with a condition like epilepsy, and then automatically deliver stimulation to counter it, or even ramp up stimulation until the event dissipates while continuously monitoring the neural response. "You can start imagining clinical uses for conditions where symptoms are not present all the time," said Dr. Muller.

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