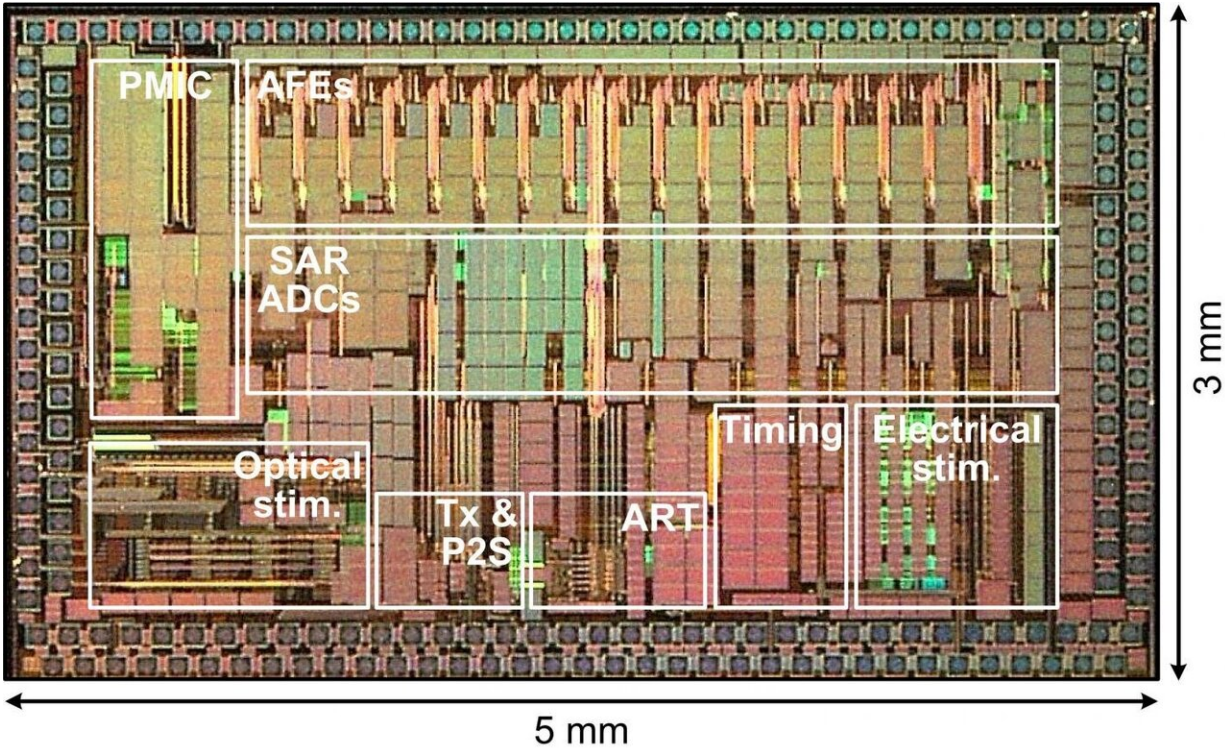


For neural research, wireless chip shines light on the brain

November 18 2020, by Matt Shipman



The new chip is fully wireless. Researchers can power the 5×3 mm² chip, which has an integrated power receiver coil, by applying an electromagnetic field. The chip is also capable of sending and receiving information wirelessly. The chip is also trimodal, meaning that it can perform three tasks. Current state-of-the-art neural interface chips of this kind can read neural signals in targeted regions of the brain, and they can stimulate the brain by introducing a small electrical current into the brain tissue. The new chip can do both of those things, but it can also shine light onto the brain tissue - a function called optical stimulation. By helping researchers (literally) shine a light on neural tissue, the new chip will

help them (figuratively) shine a light on how the brain works. Credit: Yaoyao Jia, NC State University

Researchers have developed a chip that is powered wirelessly and can be surgically implanted to read neural signals and stimulate the brain with both light and electrical current. The technology has been demonstrated successfully in rats and is designed for use as a research tool.

"Our goal was to create a [research tool](#) that can be used to help us better understand the behavior of different regions of the brain, particularly in response to various forms of neural stimulation," says Yaoyao Jia, corresponding author of a paper on the work and an assistant professor of electrical and computer engineering at North Carolina State University. "This tool will help us answer fundamental questions that could then pave the way for advances in addressing neurological disorders such as Alzheimer's or Parkinson's disease."

The new technology has two features that set it apart from the previous state of the art.

First, it is fully wireless. Researchers can power the $5 \times 3 \text{ mm}^2$ [chip](#), which has an integrated power receiver coil, by applying an electromagnetic field. For example, in testing the researchers did with lab rats, the [electromagnetic field](#) surrounded each rat's cage—so the device was fully powered regardless of what the rat was doing. The chip is also capable of sending and receiving information wirelessly.

The second feature is that the chip is trimodal, meaning that it can perform three tasks.

Current state-of-the-art neural interface chips of this kind can do two

things: they can read [neural signals](#) in targeted regions of the brain by detecting electrical changes in those regions; and they can stimulate the brain by introducing a small [electrical current](#) into the [brain tissue](#).

The new chip can do both of those things, but it can also shine light onto the brain tissue—a function called optical stimulation. But for optical stimulation to work, you have to first genetically modify targeted neurons to make them respond to specific wavelengths of light.

"When you use electrical stimulation, you have little control over where the electrical current goes," Jia says. "But with optical stimulation, you can be far more precise, because you have only modified those neurons that you want to target in order to make them sensitive to light. This is an active field of research in neuroscience, but the field has lacked the electronic tools it needs to move forward. That's where this work comes in."

In other words, by helping researchers (literally) shine a light on [neural tissue](#), the new chip will help them (figuratively) shine a light on how the brain works.

More information: Yaoyao Jia et al, A Trimodal Wireless Implantable Neural Interface System-on-Chip, *IEEE Transactions on Biomedical Circuits and Systems* (2020). [DOI: 10.1109/TBCAS.2020.3037452](https://doi.org/10.1109/TBCAS.2020.3037452)

Provided by North Carolina State University

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