Bots beat humans probing brain's neural activity

A robotic arm guided by a cell-detecting algorithm could enable scientists to classify thousands of cell types in the brain and learn how diseased ones differ from normal ones.

by Elizabeth Armstrong Moore | May 7, 2012 1:18 PM PDT

Graphic of the robotic arm detecting a cell.

(Credit: Boyden Lab)

In what could be a major boon for the study of brain disorders such as schizophrenia, Parkinson's disease, autism, and epilepsy, researchers at MIT and Georgia Tech say
they've figured out how to **automate finding and recording information from neurons** [http://web.mit.edu/newsoffice/2012/robots-recording-neurons-0507.html] in live brains.

The process, described this week in the journal *Nature Methods*, involves a **robotic arm guided by a cell-detecting algorithm** [http://www.nature.com/nmeth/journal/vaop/ncurrent/full/nmeth.1993.html] that can identify and record data from neurons faster and more accurately than we mortal humans.

"In all [the abovementioned disorders], a molecular description of a cell that is integrated with [its] electrical and circuit properties ... has remained elusive," Ed Boyden, associate professor of biological engineering and brain and cognitive sciences at MIT, said in a school news release. "If we could really describe how diseases change molecules in specific cells within the living brain, it might enable better drug targets to be found."

The team says that the tech it's automating, called **whole-cell patch clamping** [http://en.wikipedia.org/wiki/Patch_clamp#Whole-cell_recording_or_whole-cell_patch], is actually 30 years old and tends to involve months of training. It took Suhasa Kodandaramaiah, a grad student at Georgia Tech, four months to learn to bring a tiny and hollow glass pipette in contact with a neuron's cell membrane and then open a small pore in it to record the cell's electrical activity.

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"When I got reasonably good at it, I could sense that even though it is an art form, it can be reduced to a set of stereotyped tasks and decisions that could be executed by a robot," he said.

The team's robotic arm was able to master this technique on a live mouse with great accuracy. The arm would take 2-micrometer steps and measure impedance 10 times a second (impedance is low when there are no cells and high when the tip hits a cell and electricity cannot flow as well). When it detected a cell, it would stop instantly so as not to break the membrane -- something we humans simply can't do.

After finding a cell, the pipette formed a seal with its membrane through which an electrode can break through to record activity. The team's arm was able to detect cells with 90 percent accuracy and record from them almost half the time.
The team was also able to inject dye into these cells to determine their shapes. Once they can extract a cell's contents, they'll be a step closer to being able to decipher its genetic profile.

"If you really want to know what a neuron is, you can look at the shape, and you can look at how it fires," said Craig Forest, assistant professor of mechanical engineering at Georgia Tech. "Then, if you pull out the genetic information, you can really know what's going on. Now you know everything. That's the whole picture."

The researchers also hope to increase the number of electrodes so that they can record from multiple neurons simultaneously, which would not only be more efficient but might also provide a view of how different regions of the brain are connected and interact.

They're also hoping to classify the thousands of types of neurons in the brain to be identified by shape, genetic profile, and electrical activity. Boyden says this could open the door to a range of other applications, including infusing drugs at highly specific points in the brain and using light to determine the causal role neurons play in a variety of brain functions.

Elizabeth Armstrong Moore is based in Portland, Ore., and has written for Wired, The Christian Science Monitor, and public radio. Her semi-obscure hobbies include climbing, billiards, board games that take up a lot of space, and piano. She is a member of the CNET Blog Network and is not an employee of CNET.