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Neuroscience uses optical imaging to map the brain

By GINO FANELLI

For all of the advancements made in the world of neuroscience, the medical community's knowledge of the brain is still far from complete.

The organ is extremely complex. One hundred billion neurons, each firing signals and receiving information, make up the brain. Suffice to say, we are still far from fully understanding how the network of neurons works.

The common method for mapping neurons in the brain, whether for research or prior to surgery, is to implant electrodes and monitor electrical signals between neurons. Toronto's Neurescence is offering a different approach. Part of the Luminate NY accelerator, the company is proprietor of the Quartet, a small fluorescence microscope which, following the implantation of four electrodes in the brain and spinal cord, allows the user to monitor neurons' natural optical signals.

"These are like small lenses. There's a surgical procedure in which they get planted in regions of the brain and spinal cord and then fiber-optic cords get connected to the lenses," said founder and CEO Yasaman Soudagar. "The device does this thing called fluorescence imaging and the neurons, depending on how active they are, emit a different color of light."

As Soudagar explained, the Quartet allows the user to track how bright or dim neurons are over the course of days. Since the technology can monitor at the scale of individual neurons, this allows for extremely detailed views of how the brain is functioning. Trials for Neurescence have been done on mice and have been able to monitor brain activity on a task-specific level.

"The mouse is going around and doing what you've designed it to do in the experiment, and you can see the activity of neurons all at the same time," Soudagar said. "So, you can tell what types … of neuronal circuitry are used to compute the task the mouse is doing right now."

The result is a greater understanding of how the brain actually controls the mouse and what specific portions of its neuronal circuitry are used to do certain things. For example, what part of the brain controls eating, or climbing, or drinking, or turning, or running and so on. While that's a boon for researchers and our collective knowledge of consciousness, Nuerescence sees more potential, particularly in drug trials.

"If you are say, a drug development company and you're developing drugs for brain diseases, you want to know how your compound is affecting these types of neurons," Soudagar said. "During the disease time, these computations that the brain is doing are obviously wrong—that's how the disease is happening. So you want to see how the drug is actually acting on these different types of neurons."

The Neurescence technology is a seamless combination of complex optical hardware and software. Soudagar holds a PhD from Polytechnique Montreal with a focus on quantum optics. Software developer Jalani Kanem also has a background in quantum optics but now primarily works on the software and coding end of operations. Kanem's software framework serves as the backbone for creating an understandable view of the information the Quartet picks up.

"Right now, it's mostly to make it easy for a researcher to get this information from whatever is coming out of the microscope," Kanem said. "It's striving to be a very easy-to-use thing for people who may not be the most tech-savvy."

The software Neurescence is using allows for a simple way of tracking changes over time. For example, after giving a patient an experimental drug, the software can keep track of which neurons have become more active or less active, when it happened and how long the change lasted.

"By looking at the different neurons, their correlations and their intensity of activity, then they can come to conclusions about their experiment," Kanem said.

Neurescence is solely active in the neuroscience research market right now, with its first product line ready for roll-out. While that market is the focus, Soudagar said the drug trial and surgical spaces could have potential in the future.

Soudagar said Luminate NY has served as an ideal platform to help springboard her business.

"It is the only accelerator that focuses on hardware, and specifically, optics-enabled hardware," Soudagar said. "Everyone involved, they understand hardware, they understand what we are doing and they also understand our market, which is amazing."

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Yasaman Soudagar (left) and Jalani Kanem of Neurescence.

Spotlight on Luminate

Ten companies composed of some of the brightest minds in the field of optics, imaging and photonics are fine-tuning their technologies inside NextCorps' Luminate NY accelerator. The winners of November's second Lightning Awards, these companies each received $100,000 in funding, free residency in the accelerator and access to NextCorps' web of resources and mentoring. On June 27, the most promising of these 10 will receive a total of $2 million in follow-on funding. Originally funded for two years, the Luminate NY accelerator has now been funded for three more years via $15 million in additional state funding.

Leading up to Demo Day, the Rochester Business Journal is featuring profiles of the companies holding the keys to the next chapter in Rochester's history as the world's imaging center.