Microscopy And VR Illuminate New Ways To PREVENT AND TREAT DISEASE

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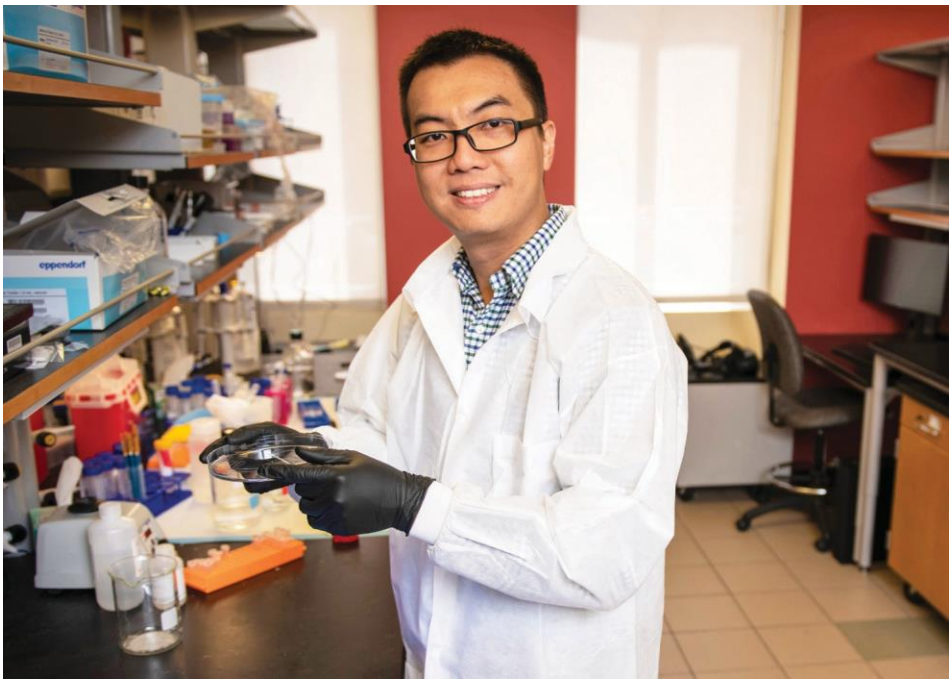
A combined research team from Carnegie Mellon University and Benaroya Research Institute (BRI) at Virginia Mason is pairing a nanoscale imaging technique with virtual reality (VR) technology to create a method that allows researchers to "step inside" their biological data.

By combining the technique, called expansion microscopy, with VR, scientists will be able to enlarge, explore and analyze cell structures far beyond the capabilities of traditional light microscopy.

The development of these technologies, a two-step process funded with $200,000 from Bill & Melinda Gates Foundation's Grand Challenges, will accelerate researchers' understanding of infectious and autoimmune diseases and enhance their ability to develop disease diagnostics and prevention and treatment methods.



Assistant Professor of Biological Sciences in CMU's Mellon College of Science Yongxin (Leon) Zhao is developing a microscopy technique that allows researchers to analyze cell structures in greater detail.

Yongxin (Leon) Zhao, an assistant professor of biological sciences at Carnegie Mellon's Mellon College of Science, has been developing the expansion microscopy technique to physically magnify a biopsy, allowing researchers to see fine details in biological samples using standard microscopes.

> *"This is the future of how scientists can handle complex data. It's an immersive experience, just like you are sitting inside your data. "*
>
> *– Yongxin (Leon) Zhao,*
> *Assistant Professor of Biological Sciences*

Zhao makes biopsy samples grow in size by chemically transforming them into water-soluble hydrogels. This treatment loosens the tissues and allows them to expand more than 100 times in volume. The tissues and molecules within the sample can then be labeled, imaged and

compiled into a complex set of data to study interactions among cells and their structures.

However, a limitation of the technology is that it extracts two to three orders of magnitude more data than current techniques can interpret.

To remedy that problem, the grant pairs expansion microscopy with a VR technique developed at BRI at Virginia Mason, a healthcare system in Seattle, Washington.

Through VR technology developed specifically for the purpose, researchers will be able to see and manipulate the originally 2-D expansion microscopy images in 3-D — creating a 360-degree view of tissue and protein organizations and interactions.

The system to convert expansion microscopy data into VR 3-D images will be affordable and easily accessible to researchers and physicians in developing countries. It will also allow for up to six people to collaborate and view the same sample remotely at the same time.

"At BRI, we'll prepare the live infectious and autoimmune disease samples," said Caroline Stefani, senior postdoctoral research associate.

Biological Sciences graduate student Brendan Gallagher (S 2019) views expansion microscopy data using virtual reality.

"We'll send those to Carnegie Mellon, where they will enlarge the samples and send images back to BRI to be viewed in VR."

The VR technology was developed by Tom Skillman, BRI's former director of informatics and research technology, who has since founded a VR company, Immersive Science.

"Bringing all that data into VR not only allows the scientist to see their 2-D microscope images in full 3-D, but to interact with the data, selecting channels, adjusting the views, colors and contrast, and grabbing and rotating the images to quickly identify key aspects of the image that are coupled back to the disease under study," Skillman said.

The eventual goal is for the VR tool, called ExMicroVR™, to be shared on open platforms with other researchers along with expansion microscopy, so that they also can view new details of disease processes and understand larger, more complex sets of data.

"You have the freedom to explore your data from every angle and every spot."

– Yongxin (Leon) Zhao,
Assistant Professor of Biological Sciences