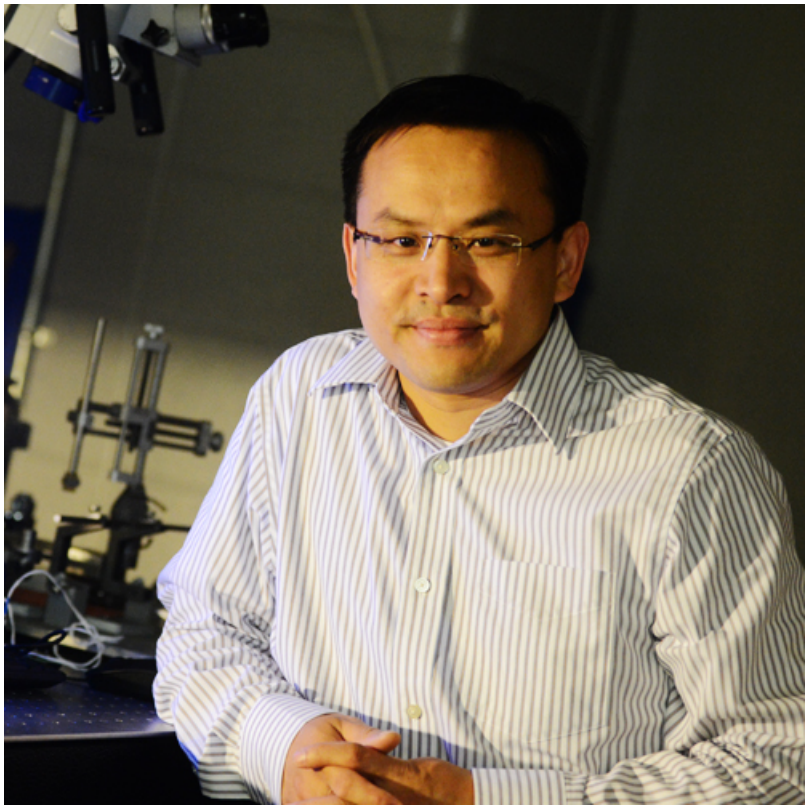
Qi Wang | Writing the Information into the Brain

Numerous factors, including injury, disease, or aging, can contribute to a person's diminished sensory capacity. When individuals lose—or never even had—the ability to touch, see, taste, smell, or hear, it is likely their brains do not receive the required electrical impulses from peripheral sensors such as mechanoreceptors in the finger pad skin or photoreceptors in the retina. To help those with blindness, amputations, Alzheimer's, Parkinson's disease, or other afflictions, scientists must first understand the complex language the neurons are speaking and learn to restore the lost brain functions by writing in this so-called language.

"Our research focuses on how to write the information into the brain," says Qi Wang (http://bme.columbia.edu/qi-wang), assistant professor of biomedical engineering and director of the Neural Engineering and Control Lab at Columbia Engineering. "To substitute the information input channel broken due to injury or disease, we have to recognize how information is processed in the brain. Then we should be able to drive the neural circuitry in the brain or in the whole nervous system to create a correct activity pattern to let people feel what they are supposed to feel if they were not disabled."

Wang explains that for blind people, for example, if a camera is placed in front of the eyes, images captured by the camera can be transduced to electrical pulses in the optic nerve. If this signal reaches the brain in the right language, there is some hope that blind people can see what the camera sees as if the camera's image sensor is the retina.



Qi Wang
Assistant Professor of Biomedical Engineering

—Photo by Eileen Barroso

Wang takes a sci-fi approach when discussing the overall goal of restoring a person's sensory function.

"In the future, we might be able to implant a chip in the brain to help people control activity in order to feel, smell, taste, etc.," he says. "It would be like having a pacemaker in the brain … when the chip understands something is wrong, it could intervene automatically."

Wang's research isn't without challenges, though. Writing the information into the brain is tricky due to the miniscule size of the neurons and potential interference between the electrodes used to drive the neural circuitry. That said, the field of neural engineering is a hot one. Neural engineering combines neuroscience with biomedical engineering allowing scientists to study, understand, and enhance certain functions of the neural systems. In order to tackle sensory issues, engineers like Wang confront other challenges by learning to crack the complicated neural code as well as write it.

"It's like any technology--initially, you have to prove your concept and then there is much room for improvement."

Wang has always been interested in human health. In fact, his first PhD in robotics from the Harbin Institute of Technology focused on helping the elderly. A native of China, Wang is fascinated by perception and artificial sensation, and got his second PhD in electrical engineering from McGill University. His post-doctorate work in neuroscience at Harvard University led to a research scientist position at Georgia Institute of Technology/Emory University, a position he held prior to joining the faculty at Columbia Engineering in January 2013.

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-by Janet Haney

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