Engineering Neuroscience

Edward Song is developing a biosensor to detect chemical conversations in the brain

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EDWARD SONG, RECIPIENT OF A PRESTIGIOUS NSF CAREER GRANT, IS DEVELOPING A BIOSENSOR THAT WILL HELP RESEARCHERS UNDERSTAND MOLECULAR MECHANISMS OF

NEURODEGENERATIVE DISORDERS LIKE ALZHEIMER'S.

To better understand how neurodegenerative disorders like Alzheimer's and Parkinson's diseases develop, researchers need to study how neurons and immune cells in the brain communicate with each other. With a major new National Science Foundation (NSF) grant, assistant professor of electrical and computer engineering Edward Song hopes to be a part of that conversation, even though his background isn't in medicine or neuroscience.

"I'm using my knowledge in engineering and technology to bring a solution to the neuroscience community," says Song, who recently received a prestigious CAREER Award from the NSF. "What I hope to achieve is to provide a new platform for measuring chemicals and proteins in the brain that allows medical researchers or neuroscientists to study the mechanisms by which these diseases develop and progress."

Song is working to develop a biosensing platform that will measure the bi-directional communication between key neurotransmitters and protein biomarkers called cytokines, which are involved in inflammation and immune responses. "If successful, this technology will help elucidate the complex interplay between neurotransmission and neuroinflammation. It's becoming increasingly important to study both signals at the same time," he says. That knowledge, he adds, is a critical component in understanding the mechanisms by which cognitive disorders like Alzheimer's progress at the molecular level.

An important step on the path toward a biosensor implementation will be developing a "lab-on-a-chip" system, which miniaturizes and automates the entire laboratory work done by human technicians onto a small chip that is the size of a few square centimeters. This innovation would not only enhance the performance in biosensing but would also reduce cost and processing time by eliminating human involvement and lowering the volume of chemical reagents needed. But "we are not quite there yet," Song says. "It's a lot more complicated than we initially thought."

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The lab-on-a-chip system that he is currently developing would measure neurotransmitters and cytokines directly from the neurons and immune cells from a single miniaturized device. The goal is to demonstrate the feasibility of the novel biosensing technology on a laboratory platform before moving the sensors to animal models and ultimately to clinical trials in humans.

The award, for $500,000, has educational implications as well as research ones: It will support one doctoral student working in Song's lab, as well as outreach to budding scientists. Song already brings his research to K-12 students who participate in UNH's Project SMART and KEEPERS science and engineering camps.

Song, who is also on the UNH Center of Integrated Biomedical and Bioengineering Research team, believes the prestigious CAREER award will fulfill its purpose of boosting his career development. “I can see myself investing a major portion of my early career towards working at the interface between engineering technology and biomedical research,” he says. “I’m very excited to be working on this, and I’m very fortunate to receive this grant.”

- WRITTEN BY:
  Beth Potier | Communications and Public Affairs | beth.potier@unh.edu | 2-1566

PHOTOGRAPHER:
Brooks Payette | College of Engineering and Physical Sciences

RESEARCH

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