INSIGHT

TAPPING INNOVATIVE SOLUTIONS & TECHNOLOGY AT JOHNS HOPKINS MEDICINE

JULY/AUGUST 2016 PUBLISHED BY JOHNS HOPKINS MEDICINE MARKETING AND COMMUNICATIONS

Modeling the Human Brain to Study How We Hear

A simulation of an area in the brain—the first project to emerge from Johns Hopkins' new Computational Medicine Core—could help researchers better understand how humans process sound.

Once perfected, it could be used to understand why some people, such as those with schizophrenia or tinnitus, hear things that don't exist, or why others, like people with autism, are overly sensitive to background noise.

"I think this small prototype can improve our understanding of what goes on in the brain of normal listeners and in those who do not process sound normally," says auditory neuroscientist Dana Boatman.

This model of auditory cortex—representing a patch of primary auditory cortex that processes sound frequencies—is detailed down to the cellular level. Computational neuroscientist Pawel Kudela took roughly two months of the Army Research Office-funded project to build the model with GENESIS simulation software.

The team is now refining the simulation and examining how it "reacts" to sound compared to human versions.

To do this, data representing sound are fed into the model. The results are then compared to Boatman's studies of electrical activity in the brains of real people hearing sounds.

It's one of several projects being taken on by the recently formed Computational Medicine Core. Created by Kudela, neurosurgeon William Anderson and Institute for Computational Medicine Director Raimond Winslow, the core provides Johns Hopkins clinical researchers with mathematical models of complex biological systems.

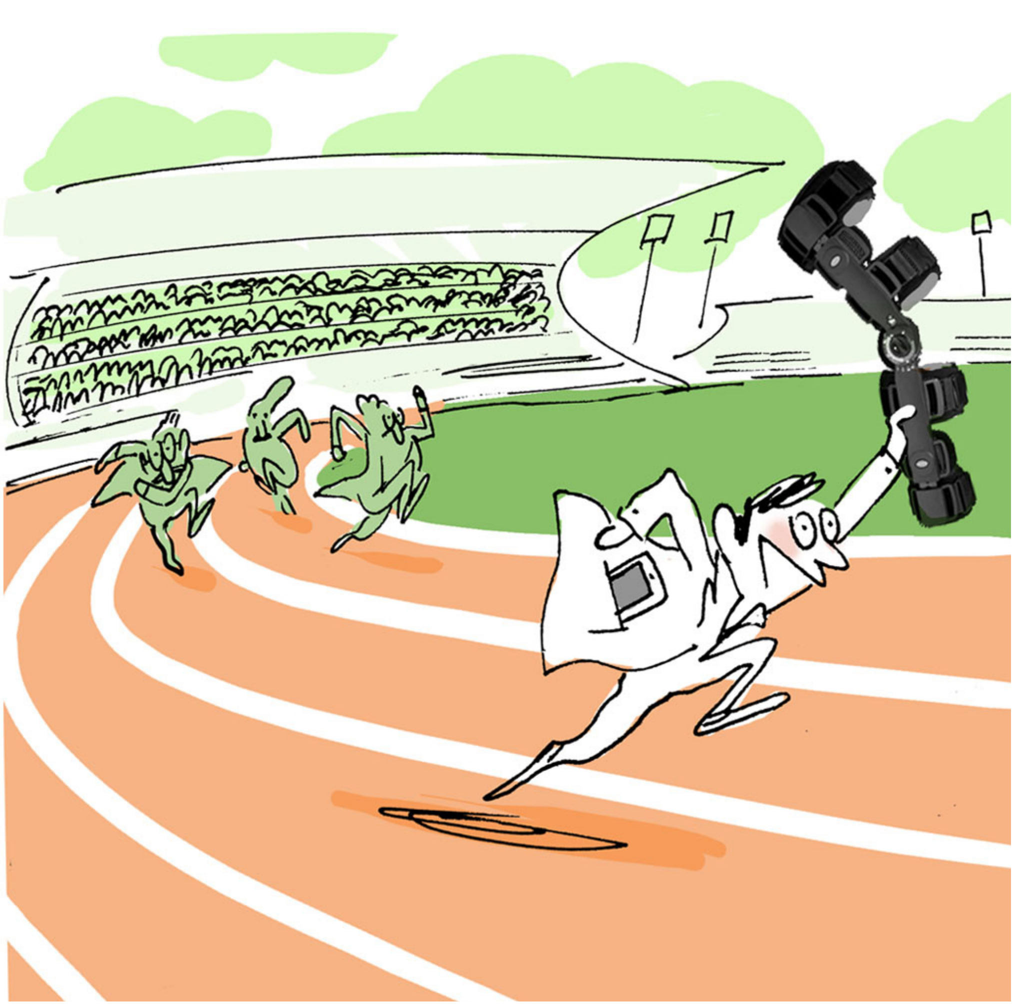
"Computational modeling techniques have proven themselves to be so important in other fields, like the natural sciences and engineering, and they're beginning to penetrate medicine as well," says Anderson. "Mathematical models provide quick hypothesis and theory testing platforms that you can then use to look at the real data in a more enlightened fashion."

To add computational modeling to your biomedical research projects, email Pawel Kudela at pkudela@jhmi.edu.

MARTIN LEON BARRETO / MARLENA AGENCY

On a Mission to Deliver Leg Braces More Quickly

When Harry Goldberg heard how two Johns Hopkins engineering students wanted to improve the manufacturing process for orthopaedic braces, he knew they were on to something. Their goal was to make leg braces so rapidly that patients could walk out of their initial fitting appointment wearing one.



CATHERINE MEURISSE / MARLENA AGENCY

WEB EXTRA: Learn about other mission-driven ventures supported by the Social Innovation Lab by visiting this article at hopkinsmedicine.org/insight.

Goldberg, a biomedical engineer, encouraged Param Shah and Alex Mathews to put their ideas on paper. He then recommended a meeting with the Abell Foundation.

After a few months, the foundation provided $25,000 for the students to build the prototypes. Shah and Mathews soon formed a company, Fusiform, and received additional support from the Social Innovation Lab at Johns Hopkins Technology Ventures.

Using off-the-shelf 3-D scanners that connect to a tablet, the students took 3-D scans of a person's leg in 10 minutes, eliminating the hourlong manual fitting process in use since the 1970s. They also developed software that can quickly design a brace from a 3-D leg scan.

With a novel approach to the design that consists of several replaceable parts, Shah says: "This potentially doubles the life span of the device. Instead of throwing it away when the patient outgrows the brace, we can replace one of the pieces to accommodate any change in shape."

While Fusiform's goal is to produce braces in the clinic using a 3-D printer, Shah says the current technology is not viable for this model. In the meantime, the software will enable quicker web-based communication and collaboration with a manufacturing company to produce a brace.

The students are now working with clinicians to incorporate the software into manufacturing processes for leg braces. In the future, Shah and Mathews aim to use the software for other types of orthopaedic braces.

A look at innovative developments outside the halls of Johns Hopkins Medicine

Big Plans for Big Data

From the White House to Silicon Valley, everyone's focused on harnessing patient data to create tailor-made care. Here are some of the collaborations taking place to turn big data into big promise.

A database aims to gather genetic, molecular, behavioral and environmental data to develop targeted treatments that take a person's medical history and lifestyle into consideration. The database is part of President Obama's Precision Medicine Initiative. It is being developed by researchers from Vanderbilt University, Google's Verily, the University of Michigan, and the Broad Institute of MIT and Harvard.

An open-source framework brings research study apps designed for iPhones to Android users and opens the door to new study apps designed for Android devices. Called ResearchStack, the software gives developers access to scientifically validated consent forms, surveys, sensor inputs, secure communication channels and large amounts of storage. A team from Cornell Tech, Open mHealth and touchlab created ResearchStack. More than 50 percent of smartphones in the U.S. ran on the Android operating system in 2015.

People can track their symptoms and medications and share the information with their physicians through Apple's CareKit. The open-source software sends information from the CareKit app to Epic and Cerner, a health IT company, to create a more complete picture of an individual's overall health. The goal is to provide information that will assist clinicians in making better diagnoses and treatment plans.

Wearable Sweat Sensor to Monitor Cystic Fibrosis

Consider the sad story of sweat: Unless it involves relaxing in a sauna, most of us loathe its feeling—and its smell. Yet sweat provides critical information: People with cystic fibrosis, for instance, have abnormally high chloride levels in their perspiration.

TOMASZ WALENTA / MARLENA AGENCY

A new wearable sweat sensor developed by Johns Hopkins researchers plays off this fact and aims to monitor and eventually diagnose cystic fibrosis.

To diagnose and monitor cystic fibrosis today, patients must visit clinical labs for a sweat test, a method also invented at Johns Hopkins. The test involves collecting and analyzing perspiration by applying a sweat-stimulating chemical, pilocarpine.

"There have been various upgrades to the technique, but it's basically remained the same for 57 years," says pediatrician and medical geneticist Garry Cutting, an adviser to the student design team developing the device.

The tiny prototype relies on a sensor capable of assessing the concentration of chloride ions in a person's sweat by measuring the potential difference between two small electrodes.

The team is perfecting the sensor to ensure it provides accurate chloride readings done by patients themselves, either through replaceable elements in the device or an entirely replaceable device.

The project emerged after Cutting, biostatistician Scott Zeger and Institute for NanoBioTechnology Director Peter Searson teamed up on a Johns Hopkins Individualized Health Initiative (Hopkins *in*Health) program for cystic fibrosis patients.

The sensor could assess other conditions too: Sewn into a garment, the monitor could provide soldiers and athletes with information on their electrolyte balance, indicating what they need to drink to operate at peak performance.

A patent is pending, while an app and electronics to communicate with smartphones are in development. The team plans to verify the accuracy of the sensor's measures against that of a sweat test this summer.

Facebook as a Medium for Medical Education

Radiologist Elliot Fishman published a case study in the March 2016 *Journal of the American College of Radiology* about using Facebook to share medical education materials. "We wanted to provide a road map for educators and show them what's successful," he says.

Since 2013, Fishman has made an average of 15 posts per day on a Facebook page for CTisus.com, a website he developed with colleagues in 2000 for radiology education. His posts feature medical images and videos, illustrations, and general content.

In the study, Fishman cites data from Facebook Insights, a tool that provides information about the activity of posts on a page. In July 2015, for example, Facebook Insights reported CTisus.com posts reached an average of 29,307 people per day. These people interacted with the posts—by clicking, sharing, liking or commenting—approximately 2,354 times per day.

"Compared to a class or lecture, where I share information with a room full of people, Facebook gives me an astounding reach to educate," says Fishman.

An additional data point from Facebook Insights is where people most frequently access a Facebook page. For CTisus.com's page, the top cities include Cairo; Mexico City; Riyadh, Saudi Arabia; Baghdad; and New Delhi.

"As an educator at Johns Hopkins, where our mission is to educate the world, that's incredibly powerful," says Fishman. "Some places don't have access to education, but the web connects us."

With over 90,000 likes for the CTisus.com Facebook page, Fishman's approach is drawing attention. For educators who want to try the medium, he recommends just doing it. "It's not like a textbook that has to be perfect before it's shared," he says.

Fishman recommends frequent posting between 10 a.m. and 3 p.m., including on weekends, and says illustrations and videos see the most interaction.

Check out the CTisus.com Facebook page at facebook.com/ctisus.

VIGG / THREE IN A BOX

WEB EXTRA: Learn more about Fishman's study by clicking on this article at hopkinsmedicine.org/insight.