WHEN COMPUTING AND BIOLOGY COLLIDE

It's a long-standing proverb that two minds are better than one. So how about three minds? Two pairs of CDM faculty are putting this adage to the test, collaborating with two assistant professors from Rosalind Franklin University of Medicine and Science (RFUMS) on projects that combine their respective disciplines: computing and biology. Support from a grant program sponsored by the Alliance for Health Sciences, a partnership between DePaul and RFUMS, facilitates these interdisciplinary endeavors—modern-day meetings of great minds.

FOLLOW THAT WORM

Professors Daniela Stan Raicu and Jacob Furst brushed up on biology for their collaboration with RFUMS Assistant Professor Hongkyun Kim. "We hated worms for the first two years," jokes Furst, alluding to the difficulties of the project, which focuses on analyzing the movements of a one-millimeter-long worm, *C. elegans*, in the presence or absence of food.

Typically, cell biologists manually measure the head and tail movements of *C. elegans* during neurological studies, but the process is time-consuming and error-prone. Raicu and Furst knew there had to be a better way. With assistance from their students, the two computer scientists designed a tracker outfitted with a camera that follows the worm on its microscopic journey across a plate. They wrote both the software program that tells the components how to interact with each other and the program that analyzes the images. It's a daunting process: at 20 frames per second, each hour-long video generates tens of thousands of images.

"This is one of our hardest projects, because the data is very noisy," Raicu says. That "noise" includes building vibrations, plate movement and residual dirt on the plate; the digital analysis needs to take all these factors into account. After three years of trial and error, however, the team has made significant strides, and their paper on the project was recently accepted by the journal Computational and Mathematical Methods in Medicine. "Our tracker can analyze data over a longer period of time than was previously possible, which makes it easier to see patterns in the worms' behavior," Raicu asserts.

GETTING COMFORTABLE

For those who use prosthetic limbs, comfort can be a major challenge. "Limbs change over the course of a day," says Assistant Professor Jonathan Gemmell. "They might swell or shrink based on an activity, or muscles may fatigue if they've been going for a while." But what is the precise relationship between comfort and pressure? RFUMS Assistant Professor Noah Rosenblatt asked Gemmell and Professor Bamshad Mobasher to find out.

The prosthetic limbs used in Rosenblatt's lab feature adjustable pressure points that help ease friction and enhance comfort. As patients walk on a treadmill, they generate data through pressure measurements, electrocardiogram (EKG) muscle sensors and verbal feedback. These data are then fed into Gemmell and Mobasher's predictive model. "We can't change EKG because that's coming from the user, but we can change the pressure and affect the comfort that way," Gemmell says, though he notes that the pressure adjustment wouldn't be instantaneous. "It might take five minutes."

The project's implications go beyond comfort. "If the limb doesn't fit or if it's uncomfortable, that often means the person won't use it," notes Gemmell. "That might mean they're sitting down more often, not being physically active, and ultimately could have worse health outcomes."

Long term, the researchers believe their efforts could contribute to the creation of intelligent limbs that react to their user's behavior in real time. "Using the kind of model that we are learning to develop from these data, intelligent limbs would be able to automatically adjust pressure," Mobasher explains. "So if the user's behavior changes—for example, due to the way he or she is walking—the limb would automatically adjust. That's the ideal."