James Kegley

Five teams made it to the final DIADEM tournament at Janelia Farm. They were from: Rensselaer Polytechnic Institute (pictured right), École Polytechnique Fédérale de Lausanne, Janelia Farm Research Campus, and two from Northeastern University.

**DIADEM Contest Moves Neuromapping in the Right Direction**

CREATING A DETAILED MAP OF EVERY NEURAL CONNECTION IN the brain takes patience—and lots of time. Scientists have typically worked at the goal of a complete brain diagram by painstakingly tracing the structure of nerve cells by hand. But this is tedious, and it would take many lifetimes of this work to finish a full map.

To spur computer-driven algorithms for mapping the complex, branching shapes of neurons, HHMI, the Allen Institute for Brain Science, and the Krasnow Institute for Advanced Study at George Mason University launched, in April 2009, an international scientific contest. To win the grand prize, a team had to develop a method to trace neuronal morphology that is at least 20 times faster than mapping by hand.

In September, DIADEM—short for Digital Reconstruction of Axonal and Dendritic Morphology—came to a close, with a tournament-style conclusion between five final teams taking place at HHMI’s Janelia Farm Research Campus. While no team hit the 20-fold goal, their computational tools could trace neurons 10 times faster than a human hand. The judges commended the teams for developing original and creative ideas that would help solve the difficult problem of automated image reconstruction, and $75,000 in prize money was distributed among four teams.

Georgio Ascoli, a neuroscientist at George Mason University who proposed the idea for the competition, acknowledges that the 20-fold increase was a demanding challenge. At the same time, he says, it is important to recognize that “this is only the first step towards the actual goal. If we’re serious about automation at the brain level, we need a 20,000-fold speed up.” Thus, he says, the DIADEM challenge was intended to set the necessary developmental efforts in motion. “Once the first brick comes down, the whole building might follow soon.”

More than 100 teams, from both the private sector and academic laboratories, registered to participate in the DIADEM challenge. Competitors had one year to develop an algorithm and test it against manual reconstruction. An international panel of experts then selected five finalists. During the final tournament, these developers teamed with neuroscientists, whose real data were used to test the algorithms. In six editing sessions, each competitor worked with the data owners to solve six imaging problems.

Even with the advent of computer technology that enables mapping in three dimensions, full reconstruction of a single neuron may still take months. The vast majority of branching nerve projections must be traced manually, using fluorescent labeling to highlight the neurons and microscopes to view them. Many scientists who attended the DIADEM challenge, either as participants or as judges, openly commiserated about the inefficiency of manual reconstruction techniques.

The strategies presented by each of the finalist teams will help bring neuroscientists closer to eliminating this tedious task—allowing them to conduct larger studies and collect more data or to focus on less technical aspects of their research.

“We hope that we are seeing the light at the end of the tunnel in terms of the beginning of the end of manual reconstruction of neurons,” says Ascoli.

WEB EXTRA: For a sense of what the competition was like, watch the audio slideshow found at www.hhmi.org/bulletin/2010. To learn more about the competing teams and their prizes, visit www.hhmi.org/news/20100902.html.

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