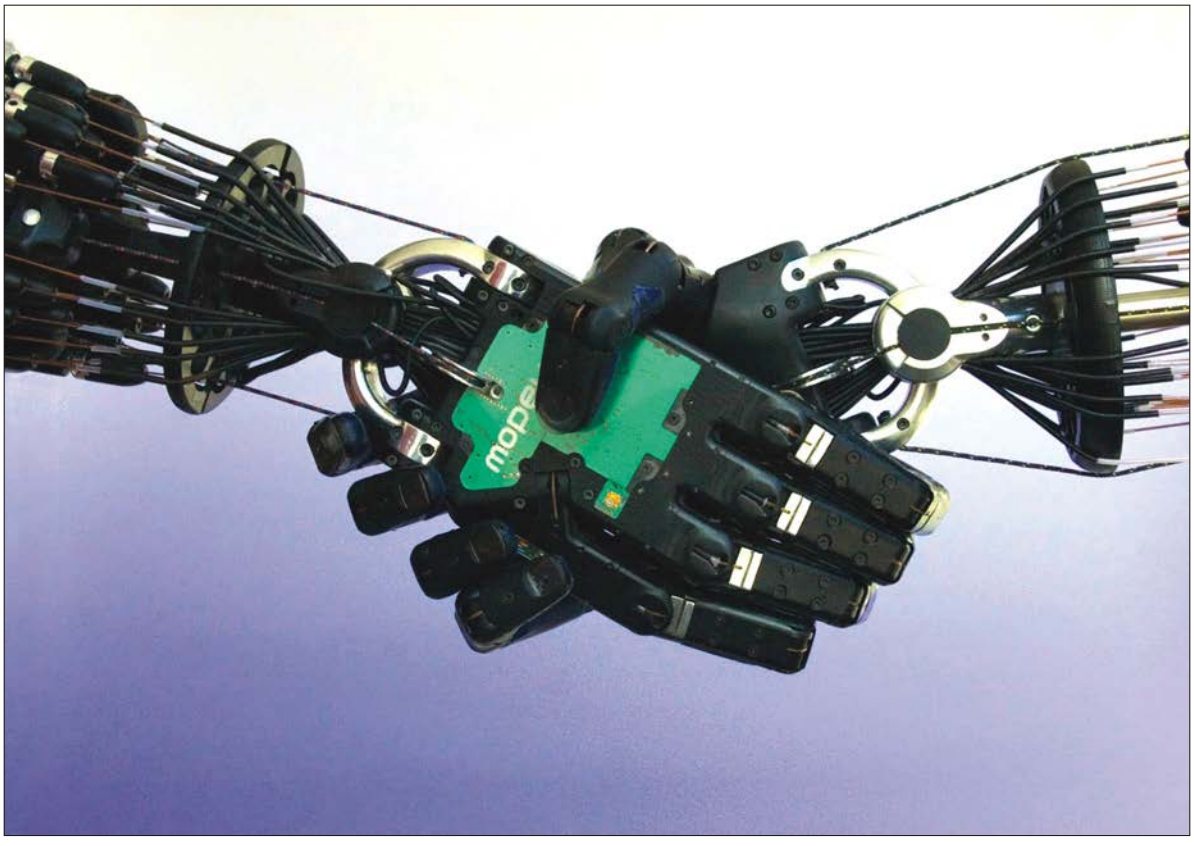

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New Cognitive Robotics Lab Tests Theories of Human Thought

In a new Cognitive Robotics Lab, students at Rensselaer are exploring how human thought outwits brute force computing in the real world? The lab's 20 programmable robots allow students to test the real-world performance of computer models that mimic human thought.

"The real world has a lot of inconsistency that humans handle almost without noticing -- for example, we walk on uneven terrain, we see in shifting light," said Professor Vladislav Daniel Veksler, who is currently teaching Cognitive Robotics. "With robots, we can see the problems humans face when navigating their environment."

Cognitive Robotics marries the study of cognitive science -- how the brain represents and transforms information -- with the challenges of a physical environment. Advances in cognitive robotics transfer to artificial intelligence, which seeks to develop more efficient computer systems patterned on the versatility of human thought.

Professor Bram Van Heuveln, who organized the lab, said cognitive scientists have developed a suite of elements -- perception/action, planning, reasoning, memory, decision-making -- that are believed to constitute human thought. When properly modeled and connected, those elements are capable of solving complex problems without the raw power required by precise mathematical computations.

"Suppose we wanted to build a robot to catch fly balls in an outfield. There are two approaches: one uses a lot of calculations -- Newton's law, mechanics, trigonometry, calculus -- to get the robot to be in the right spot at the right time," said Van Heuveln. "But that's not the way humans do it. We just keep moving toward the ball. It's a very simple solution that doesn't involve a lot of computation but it gets the job done."

Robotics are an ideal testing ground for that principle because robots act in the real world, and a correct cognitive solution will withstand the unexpected variables presented by the real world.

"The physical world can help us to drive science because it's different from any simulated world we could come up with -- the camera shakes, the motors slip, there's friction, the light changes," Veksler said. "This platform -- robotics -- allows us to see that you can't rely on calculations. You have to be adaptive."

The lab is open to all students at Rensselaer. In its first semester, the lab has largely attracted computer science and cognitive science students enrolled in a Cognitive Robotics course taught by Veksler, but Veksler and Van Heuveln hope it will attract more engineering and art students as word of the facility spreads.

"We want different students together in one space -- a place, where we can bring the different disciplines and perspectives together," said Van Heuveln. "I would like students to use this space for independent research: they come up with the research project, they say 'let's look at this.'"

The lab is equipped with five "Create" robots -- essentially a Roomba robotic vacuum cleaner paired with a laptop; three hand-eye systems; one Chiara (which looks like a large metal crab); and 10 LEGO robots paired with the Sony Handy Board robotic controller.

On a recent day, Jacqui Brunelli and Benno Lee were working on their robot "cat" and "mouse" pair, which try to chase and evade each other respectively; Shane Reilly was improving the computer "vision" of his robotic arm; and Ben Ball was programming his robot to maintain a fixed distance from a pink object waved in front of its "eye."

"The thing that I've learned is that the sensor data isn't exact -- what it 'sees' constantly changes by a few pixels -- and to try to go by that isn't going to work," said Ball, a junior and student of computer science and physics.

Ball said, "he is trying to pattern his robot on a more human approach".

"We don't just look at an object and walk toward it. We check our position, adjusting our course," Ball said. "I need to devise an iterative approach where the robot looks at something, then moves, then looks again to check its results."

The work of the students, who program their robots with the Tekkotsu open-source software, could be applied in future projects, said Van Heuveln.

"As a cognitive scientist, I want this to be built on elements that are cognitively plausible and that are recyclable -- parts of cognition that I can apply to other solutions as well," said Van Heuveln. "To me, that's a heck of a lot more interesting than the computational solution."

In a generic domain, their early investigations clearly show how a more cognitive approach employing limited resources can easily outpace more powerful computers using a brute force approach, said Veksler.

"We look to humans not just because we want to simulate what we do, which is an interesting problem in itself, but also because we're smart," said Veksler. "Some of the things we have, like limited working memory -- which may seem like a bad thing -- are actually optimal for solving problems in our environment. If you remembered everything, how would you know what's important?"

The above story is reprinted from materials provided by Rensselaer Polytechnic Institute (RPI).