Army scientists earn patent for advanced neural chip

U.S. Army

ADELPHI, Md. (Nov. 5, 2012) -- Two Army scientists and a university professor earned a patent for the forerunner of a powerful quantum neural dynamics computer chip. The device uses nonstandard mathematics to accomplish analog problem solving at high speed.

"The patent covers different ways to make computer chips," said Army scientist and principal investigator Ronald E. Meyers. "These computer chips can represent biological and physical processes."

Meyers and his colleague, Army mathematician Keith Deacon, joined forces with Gert Cauwenberghs, a professor of bioengineering and biology and co-director of the Institute for Neural Computation at the University of California at San Diego.

"This is as a first step toward large-scale non-Lipschitz intelligent information processing systems," Cauwenberghs said.

Cauwenberghs worked with Meyers and Deacon to map the mathematics onto an analog "continuous-time neural architecture." He also designed and tested the integrated circuit implementing the architecture.

"Experimental data from our silicon integrated circuit demonstrated the elements of terminal repulsion and attraction in neural dynamics and synaptic coupling," he said.

In other words, by using different mathematics, the scientists potentially removed a limit on how fast functions can change -- clearing the way for ultra high-speed computing.

"The chip has a lot of application to both the military and civilian use," Meyers said.

A unique aspect of the research is the use of synaptic connections for interfacing neurons and learning through feedback, which is modeled after biological systems, Meyers said.

It's all part of the futuristic vision of quantum computing. Researchers believe one day they will effectively harness individual atoms to build complex super-computers.

Meyers delves into quantum physics research projects at the U.S. Army Research Laboratory. Currently his project is to invent a secure communications system immune to the awesome power of future quantum computers.

"Quantum computing will give unparalleled computational ability," he said. "We're talking about an ability to compute that exceeds exponentially millions of times greater than any of the computers that exist or are on the drawing boards using conventional approaches."

Meyers said neural chips can be made with classical computers or in the future with quantum computers.

"This is a different type of chip that we've developed and it's somewhat in between," Meyers said. "It's not a classical approach, and it's not quantum yet. But, we're wanting to evolve the concepts into quantum computing."

The research took several years. The U.S. Patent and Trademark Office issued a patent Sept. 11.

"It looks like a breakthrough to others but it's just a lot of hard work, continuous work," Meyers said. "When you put something out it's a milestone. It means you're able to explain it in a way that the Patent Office understands, or that other scientists understand. So what happened here is we're looking into one of the most important problems that the Army faces and it turns out -- from my perspective, the ones that are not solved and are most important."

Meyers is listed as the inventor on 14 patents. He co-authored a book, "From Instability to Intelligence: Complexity and Predictability in Nonlinear Dynamics," -- covering nonlinear equations in math, physics and biology, and authored a plethora of scientific papers.

"Problems are unsolved because they're difficult to tackle," he said. "I tend to seek out a different path to go toward solving problems that before have not been solved. I think I have a background that can do that. I've gained some insight. It's putting together your experience and you're trying to project it into the future. And so in my mind I see how things can be applied in the future and I look at how to solve these. Quite often if you go for the hardest unsolved problem, that's the one that gives you the most benefit."

Inspired by difficult problems, Meyers said he and his small team of scientists and mathematicians is focused on the end-user of this technology.

"We work for the Soldier," Meyers said. "We work for the warfighter and that's what our thinking is. That's why we're trying to solve these difficult problems. As Army scientists we are responsible to really help these Soldiers operate in a way that can defend the country and protect them and anticipate any threats and deal with them in an effective manner."

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