Neural networks make intelligent sensors, smarter grids

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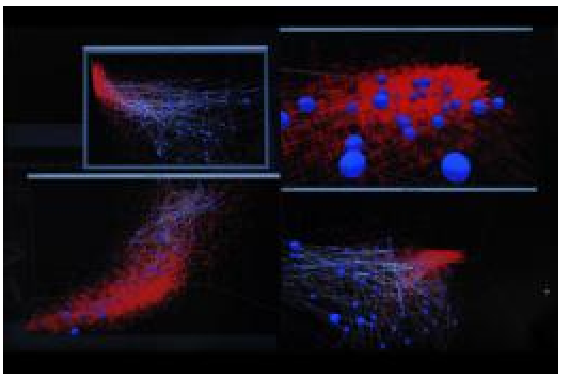


Neural networks, combined with “fuzzy math” result in self-organizing maps of data grouped in clusters which can then be evaluated by researchers.

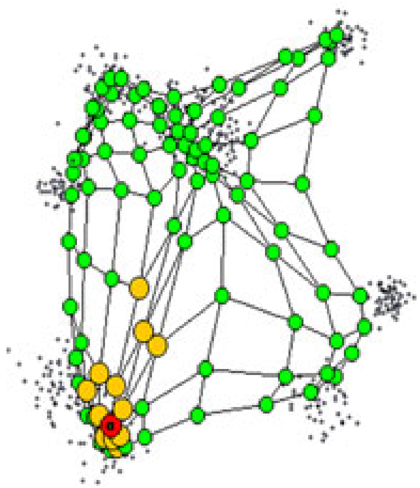
In Hollywood movies such as Terminator or I, Robot, highly intelligent computers that can learn, reason and make decisions try to take over the world.

That idea may seem farfetched to most people, but not to Milos Manic, a University of Idaho professor and researcher at Idaho National Laboratory's Center for Advanced Energy Studies (CAES). Manic specializes in neural networks — algorithms that actually help computers learn by mimicking human intelligence and reasoning.

The only part he views as outlandish is the bit about taking over the world.

"Neural networks are based on the human mind and are able to reason and learn," Manic said.

Such networks could help provide intelligence for smart grid or industrial control systems.



Self-organizing maps can examine multiple sets of data for similarities and interdependencies and then group them in clusters that are easier for researchers to evaluate.

Manic's research focuses primarily on creating neural networks and combining them with something called "fuzzy math" to build data-driven models such as self-organizing maps of data. The maps examine data for similarities and interdependencies then group them in clusters, which researchers can evaluate.

The maps are loaded into a computer-assisted virtual environment — or CAVE—so researchers can view the data in 3-D. Manic and his students have also used self-organizing maps to sort wind turbine data that is collected at CAES.

"It is difficult for humans to view and analyze 12- to 15-dimensional data and comprehend them," Manic said. "We're just not set up for it. With self-organizing maps, a computer is able to organize and visualize it for us. It can help researchers find correlations they might not have been able to otherwise see."

Manic started delving into neural networks in the early 2000s during his doctoral studies at the University of Idaho. He studied math principles while attending schools in his native Serbia and wanted to continue in Idaho. However, his professor suggested he focus instead on neural networks.

"I did not like neural networks at first," Manic said. "They can be chaotic and creating them is as much art as it is science. You have to figure out how to combine the right algorithms. Sometimes they don't work as you expected they would, and you have to play around until you get it right. It can be frustrating because there's not one definite way to do it."

Milos Manic and his students use a 3-D imaging system called a CAVE to explore and analyze self-organizing maps.

Manic was intrigued by the complexity and power of these algorithms and now has built his career around using them to help researchers evaluate complex sets of data.

For example, one research project involves smart cyber sensors that provide situational awareness in industrial control or smart grid systems. By using neural networks and fuzzy math, Manic and others are able to help sensors collect and fuse different types of data, analyze different factors and predict future behavior of the system. This could improve on most traditional sensors, which simply detect signals, but do not perform intelligent analysis on their own.

Manic acknowledges his field can seem scary and straight out of a Hollywood movie, but says the potential for researchers in all disciplines is huge.

"All of this allows researchers to see data in new ways and pick out patterns and explain scientifically why something is occurring," he said. "These are powerful tools."

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