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NAVY SBIR TRANSITION PROGRAM

SPOTLIGHT

Company: ChromoLogic LLC
Website: www.chromologic.com
POC: Matthew Brehove, Lead Scientist
Phone: 424-210-0394
Address: 1225 South Shamrock Avenue
Monrovia, California 91016

ChromoLogic LLC brings cutting-edge neuromorphic computing to Naval experimentation at Silent Swarm 25

ChromoLogic LLC is active in the emerging field of neuromorphic computing, a discipline that seeks to mimic the way the human brain processes information. This new computing paradigm replaces the dense matrix operations of traditional analog neural networks with sparse spiking neural networks that can operate at far lower power. As defense systems increasingly rely on battery-powered autonomous platforms to gather sensor data, and on artificial intelligence (AI) to help interpret that data, reducing power requirements to extend battery life is critically important.

Through a series of Navy SBIR awards, ChromoLogic has developed innovative technologies to accelerate the Navy's adoption of low-power neuromorphic computing. The company's Spiking Neural Network Modeler (SpiNNMo) helps developers convert traditional analog neural networks into spiking neural networks that can run on neuromorphic hardware. In its most recent SBIR Phase II, ChromoLogic applied SpiNNMo and its innovative conversion process to an experimental neuromorphic processor from Intel called Loihi, which shows promise for delivering the low-power, real time AI processing the Navy is seeking.

"These are very different from normal AI chips," said Dr. Matthew Brehove, lead scientist at ChromoLogic. "Rather than running like GPUs that do dense matrix multiplication, they are designed to efficiently simulate networks of spiking neurons that work more like those in the human brain. Each neuron acts as a discrete entity, holding a bit of information and sending signals to neighboring neurons through asynchronous spikes. For a long time, academics and companies have worked to realize this approach in silicon to take advantage of its energy efficiency."

The ChromoLogic team at Silent Swarm 25.

As an end use case for this effort, ChromoLogic focused on drone detection. The company trained a spiking neural network installed in a video surveillance camera to detect objects crossing its field of vision and distinguish unmanned aerial systems from other objects, such as birds. Using neuromorphic technology in surveillance systems could extend battery life and improve reliability, allowing such systems to supplement or replace radar.

"If you set out 50 of these cameras around a

region to monitor the sky and report incoming drones, you want the batteries to last a long time. Minimizing power usage was the impetus for this project," Brehove explained. While the initial testing is done with cameras, the core compute platform could be readily adapted to other sensor modalities, such as RF and audio.

In future projects, ChromoLogic plans to install spiking neural networks on UAVs to gain energy efficiencies that enable improved autonomous functioning.

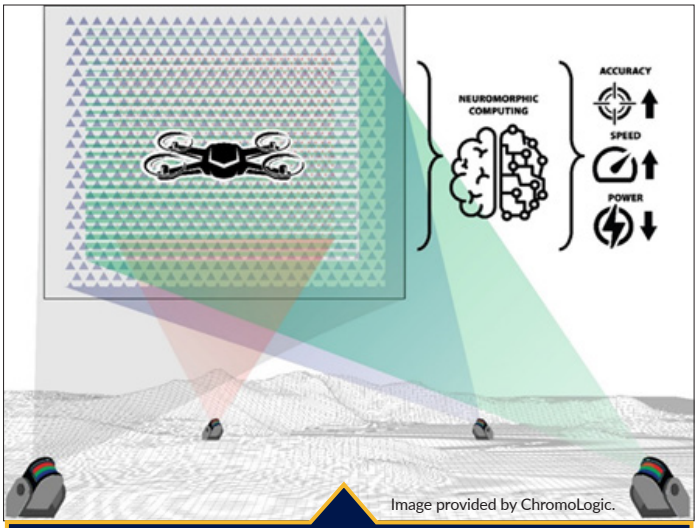

Image provided by ChromoLogic.

ChromoLogic is deploying its Spiking Neural Network Modeler (SpiNNMo) to run a spiking neural network on neuromorphic processers for drone detection.

"Right now, UAVs can dodge obstacles in their paths, such as trees and power lines, but they react a little too slowly and struggle in challenging weather conditions. Enabling UAVs to fully utilize their speed, navigation, and maneuvering capabilities requires a fundamentally new paradigm in AI computing," Brehove said. "Our end goal is to install Loihi processors on UAVs running spiking neural networks, allowing them to complete missions at lower power and higher speeds, which translates to longer range."

During its most recent SBIR Phase II project ChromoLogic's Navy technical point of contact suggested deploying the technology in the field to gather additional data that would enhance its ability to convert and train neural networks. Working with the Department of the Navy SBIR Experimentation Cell, ChromoLogic selected Silent Swarm, an experimentation exercise organized by the Naval Surface Warfare Center Crane Division, as the best opportunity to collect video data of a wide range of flying drones in real-world conditions.

Silent Swarm 25 focused on experimenting with new and emerging technologies employed on small unmanned systems, including unmanned surface vessels, land vehicles and airborne systems. Because Intel's Loihi processor is not yet commercially available, ChromoLogic collaborated with the Air Force Research Laboratory, which provided a Loihi processor for use during the event and also gave ChromoLogic access to historical data to expand its drone library.

During the two-week event held along the shore of Thunder Bay in Alpena, Michigan, ChromoLogic took part in vignette experiments that divided participants into teams with opposing goals. ChromoLogic achieved its primary objectives, capturing 175 minutes of video footage across multiple imaging modalities and performing live data analysis using the Loihi neuromorphic processor.

During a vignette experiment in which one team attempted to advance undetected against the other, ChromoLogic also achieved its stretch goal of reporting lines of bearing of detected drones to teammates via the Team Awareness Kit (TAK), a software application widely used by the military for data sharing during operations.

"We're able to say now that not only have we built a spiking neural network model and run

it on Loihi, but we did it deployed in a Navy experimentation event," said Brehove. "We put our solution in the field, put it through its paces and developed new ways of building models for it."

ChromoLogic has developed many technologies for the U.S. military and other federal agencies, but Silent Swarm 25 was Brehove's first large-scale Navy experimentation event. It was an exciting environment, he said. "Similar to us, most of the groups had projects of relatively low technology readiness levels. The event director emphasized that we were not there to show polished technologies or controlled demonstrations. We were there to test the technology until it breaks, see how people actually use it, and learn from the experience."

That experimental approach was a good fit for ChromoLogic's technology at its current stage of development, and to neuromorphic computing itself, according to Brehove. "Neuromorphic computing is a very exciting field with a lot of potential, but it is still a nascent field. Emerging from academic work, it has yet to make a commercial splash. While we are pursuing follow-on work, the technology is not yet ready for commercialization. The underlying hardware, Intel's Loihi chip, won't be available on the market for a few years."

Algorithms designed for neuromorphic hardware can run on today's conventional computing platforms, Brehove explained, but without delivering the energy efficiency gains they are designed to achieve. "In the neuromorphic field, we focus on hardware-software codesign, building specific silicon and specific algorithms so that their integration creates energy advantages."

As ChromoLogic waits for the commercial market to catch up, the company plans to adapt certain aspects of its technology for today's conventional hardware platforms.

For innovative solutions ready to scale up production to address current customer needs, Brehove appreciates the transition support programs the Department of the Navy provides for its SBIR participants.

"The Navy SBIR Transition Program has been extremely helpful as it puts you in front of customers, gives you a chance to demonstrate your technology, connects you with private capital, and provides other support."

ChromoLogic LLC has participated in SBIR/STTR programs since 2007, receiving numerous awards from the Navy, other military branches and federal agencies. The company's mission is to incubate and commercialize disruptive solutions in medical, aerospace and security markets. Its culture is creative, collaborative, multi-disciplinary, and dedicated to a shared commitment to lifesaving and life-transforming scientific advancement.

In 2015, ChromoLogic spun out its supply chain protection assets with venture capital support to form Covisus, Inc. (www.covisus.com), a company focused on ensuring the authenticity and traceability of products in regulated industries, including aerospace, medical devices, microelectronics, and manufacturing. The award-winning technology is currently being deployed with U.S. Air Force depots. For more information, visit www.chromologic.com.

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