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NAVY SBIR TRANSITION PROGRAM

SPOTLIGHT

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Metamagnetics leverages SBIR-funded adaptive filtering technology to support Navy reconnaissance mission

Reena Dahle, the director of product development at Metamagnetics, Inc., is accustomed to encountering disbelief when demonstrating her company's Auto Tune Filters® (ATFs®) at defense industry trade shows. "Not a lot of people know about the technology, so there's a learning curve," she says. "You explain it to them, show them a demo and then they are wowed. They think it's wizardry. That's the fun of it—when you get that wow factor."

Metamagnetics' ATFs® are radio frequency (RF) frequency selective limiters designed to efficiently mitigate electromagnetic interference. These passive devices work by establishing a power threshold level and attenuating any incoming signal that exceeds it, while allowing lower-power signals at other frequencies to pass through to the receiver without degrading the overall spectrum. This protects receivers and ensures they can detect signals of interest that might otherwise be lost.

ATFs® do not require power, control circuitry or software, and can respond to attenuate an incoming signal in less than 500 nanoseconds. Their lack of active components makes them ideal for harsh environmental conditions encountered in airborne, marine, and space applications. These features make ATF® devices well suited for DoD applications, especially on platforms constrained by size, weight and power (SWaP), such as unmanned aircraft.

In a recent project funded by the Navy Small Business Innovation Research (SBIR) program, Metamagnetics applied its ATF® technology to create an innovative solution for a co-site interference issue on the MQ-4C Triton unmanned aircraft system (UAS).

First deployed in 2020, the Triton is a high-altitude long-endurance autonomous aircraft that plays a key role in the Navy's Maritime Patrol and Reconnaissance Force (MPRF). Equipped with multiple sensors, it delivers persistent maritime intelligence, search and reconnaissance (ISR) capability, with one of its key features being a powerful long-range radar. However, this radar's high-power pulses can cause interference with other onboard surveillance systems and electronic support measures (ESMs).

As Triton's program management office, PMA-262, planned to install a new signals intelligence (SIGINT) system in Integrated Functional Capability (IFC)-4 of the aircraft, it became clear that a new interference mitigation technology would be required to maintain

operational effectiveness across the full spectrum.

Working with the Navy during SBIR Phase I and Phase II, Metamagnetics discovered that its existing ATF® technology alone would not meet the Navy's requirements. In response, the company developed the HACM, an advanced interference mitigation device that splits and reroutes incoming signals from the Triton's antenna to shield the ESM and SIGINT systems from radar emissions.

Image courtesy of the U.S. Navy.

The HACM was designed for deployment on the MQ-4C Triton UAS.

David Audette, a distinguished engineering fellow at Metamagnetics who oversaw the Phase II development of the HACM, explains that the device uses a multiplexer to divide the incoming signal into several different frequency bands. Only one of the bands includes the high-power radar frequency, and that's where the ATF® is placed. After passing through the ATF®, the signal is multiplexed back into a single path and passes to the receiver.

"Metamagnetics has a company culture where we don't just want to meet expectations, we want to exceed them," says Audette. "For Phase II, we were only required to deliver a design on paper. Instead, we delivered two working prototypes. The customer had something to test in their system to see how well it worked and what needed to be improved."

According to NAVAIR, the HACM improves frequency coverage by 50% for the MQ-4C's ESM and SIGINT systems compared to existing technology. This enhancement enables these systems to operate simultaneously with onboard radar, allowing the MQ-4C Triton to fulfill SIGINT reconnaissance missions formerly handled by the now retired EP-3 Ares II aircraft.

In 2023, NAVAIR awarded Metamagnetics a Phase III contract to further reduce the HACM's size and power usage, and to expand its frequency range. The HACM is slated for installation and testing in an operational environment on the MQ-4C Triton by 2026. "This is the first program I've been involved with that has gone to Phase III, so I'm excited about it," says Audette.

Both Audette and Dahle acknowledge that the SBIR program has been a key factor in Metamagnetics' progress developing and advancing its ATF® technology. Founded in 2009 by research professor and materials expert Vincent Harris, Metamagnetics spun out of the Center for Microwave Magnetic Materials and Integrated Circuits (CM3IC) at Northeastern

University. From its earliest days, the company focused on serving the DoD as its primary customer, working closely with SBIR technical points of contact and program managers to incorporate customer feedback and fine tune its technology to evolving DoD needs.

"SBIR has allowed us to be successful in driving the technology forward," says Dahle. "Extending the frequency of operation takes a lot of research and material development and we need funding for that. SBIRs have enabled us to push the technology to address new challenges the Department of Defense is identifying."

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The SBIR program also supports early-stage technologies with low technology readiness levels (TRLs) that require significant time and investment to mature into useful capabilities for the DoD.

"In our earliest SBIRs, the devices had narrow operating bandwidth and very high insertion loss. Although the technology sounded interesting, it didn't meet system performance requirements. Through SBIRs, we were able to dramatically improve the performance and make the technology much more functional for the end user," says Audette.

Metamagnetics has participated in several Navy SBIR Transition Program (Navy STP) cohorts with the HACM and other SBIR technologies. "It was really helpful in terms of networking and exposure—just getting our name out there," says Dahle. "When we attended the exhibit, a lot of people came to the showcase booth and inquired, and there was follow up from that. For small companies, that is very valuable."

For a technology as unique as Metamagnetics' offerings, Audette adds, "it helps us educate our potential customers about what our technology is and how it can help them."

A U.S.-based and veteran-owned small business, Metamagnetics has extensive industry experience working with the Navy, Army, Air Force, DARPA, and major U.S. defense prime contractors. Drawing on the expertise of its research scientists and engineers in RF, microwave, and millimeter-wave signal transmission and processing, the company develops next-generation materials and integrates them into components that enhance mission-critical radar, communication, and RF systems.

For more information, see www.mtmgx.com.

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