Applied Research with Emerging Memory Systems in Unmanned Vehicle Autonomy: SWaP at the Edge

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Applied research across national security priorities [1] have an ever-increasing need for edge device and distributed system applications for real-time computation, analysis, and information sharing. Technologies such as unmanned vehicle autonomy and connected infrastructure are poised to significantly benefit from edge computing advancements that emerging memory systems promise [2]. However, current commercial unmanned aerial vehicles (UAV) are significantly impacted by size, weight, and power (SWaP) concerns, limiting the mission capabilities and duration for potential UAV applications. Reducing weight and power needs for each edge-device-enabled UAV broadens the UAV (and related device) mission application including shared sensing and analyses, mission delegated decision, and coordinating mission details as the mission evolve. This is increasingly important as the mission or application space demands greater numbers of connected devices.

While many emerging memory technologies may still be in early research and development, several of the emerging memory technologies and concepts show promise to address these SWaP concerns while providing improved system performance in reducing power consumption, real-time processing, and lower latency. To leverage these technologies into prototype systems such as UAVs, sensors, network components, and other devices, it will be essential to generate emerging memory components and devices rapidly, reliably, and with incremental modifications. With infrastructure in place to support this, applied research teams will be able to focus efforts on the end-user needs, advancing the early stage emerging memory systems from the laboratory into prototypes for demonstrating capabilities at relevant scales and in relevant environments, where there are increased demands from variations in temperature, weather, pressure, operation time, complex network traffic, and other aspects to move the technology forward as efficiently as possible.

References

1. U.S. Army, “Army Modernization Strategy: Investing in the Future.” 2019.
2. Moosavi, S., Weaver, A., and Gopalswamy, S., "Localization in Global Positioning System–Denied Environments Using Infrastructure-Embedded Analog-Digital Information," *Connected and Automated Vehicles* 6(4):447-458, 2023.