DARPA-SN-26-48
Future Program Announcement
Special Notice DARPA-SN-26-48
Organoid Cytomorphic Intelligence Resulting from Convergent Understanding and Information Transfer (O-CIRCUIT)
Defense Advanced Research Projects Agency (DARPA)
Biological Technologies Office (BTO)

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BACKGROUND:
The purpose of this Special Notice (SN) is to provide public notification of additional research areas of interest to the Defense Advanced Research Projects Agency (DARPA) Biological Technologies Office (BTO), specifically for the forthcoming **O**rganoid **C**ytomorphic **I**ntelligence **R**esulting from **C**onvergent **U**nderstanding and **I**nformation **T**ransfer (**O-CIRCUIT**) program.

When released, the solicitation will be made available at https://sam.gov/.

PROGRAM GOALS:
Modern computation involving AI training and inference has significant energy requirements. These demands impact our ability to boost warfighter performance at the edge, where restricted energy capacity affects operational longevity, compute capability, and data transfer latency. **O-CIRCUIT** envisions unlocking operational advantages by developing unconventional biological processing units (BPUs) for edge learning and inference with minimal power draw (mWh/day). O-CIRCUIT also envisions extending these BPUs to sensing physical stimuli and outputting instructions, such as directing drone navigation.

Such unconventional compute is possible – biology does it every day all the way down to the level of fruit fly brains (~140,000 neurons; < 6 mWh/day). O-CIRCUIT will demonstrate that it is possible to construct BPUs that have comparable size, weight, and power characteristics to naturally occurring neural structures to provide calibrated synthetic intelligence (training and compute memory) through convergent architecture and information management (connectivity and plasticity). To accomplish these goals, the **O-CIRCUIT** program will develop a platform at the confluence of organoid and synthetic biological intelligence where cell compositions, such as neural, glial, and immune cells, can be structured and composed (organically or synthetically) to perform complex training and inference tasks. The demonstration challenge problem will be developing trainable BPUs that provide sophisticated inference and drone guidance via neural olfactory sensing to showcase an all-biological, converged synthetic intelligence sense-compute-act system. The low energy, advanced computing capabilities of this unconventional bio-based computer will unlock the asymmetric edge advantages inherent to natural biological systems for the DoW.

The **O-CIRCUIT** program is a 42-month effort (18-month Phase 1; 12-month Optional Phase 2; 12-month Optional Phase 3) with two Task Areas: Task Area 1 (TA1), “Architecture”, and Task Area 2 (TA2), “Action”. TA1 will focus on building a BPU with enhanced learning capabilities

within a dynamic simulated game environment by exploring BPU architecture complexity, circuitry, health, and cell composition. TA1 calls for the BPU to play a video game (such as Ms. Pac-Man) close to human level proficiency, retain this proficiency at day timescales, and consume energy at rates comparable to natural neural systems. TA2 will focus on building and testing a biological olfactory sensor system integrated into a BPU, which will be integrated into a drone navigation system for biocompute-based chemotaxis. TA2 calls for the BPU to accurately detect tens of odorants and to proficiently navigate an unmanned drone towards an odorant within a window of limited time.

Proposed approaches will be required to address one of the two TAs, but addressing both TAs is also permissible. At the end of each phase, performers will be required to participate in capability demonstrations to evaluate BPU development progress. These demonstrations will be open to outside participants, with the explicit goal of ensuring that state-of-the-art technology is the hallmark of the O-CIRCUIT program. The final capability demonstration at the end of the program will assess fully integrated BPUs incorporated into a drone platform that can spatially navigate through complex chemical environments.

DARPACONNECT:
For those new to DARPA or national security, DARPA makes available a free, comprehensive resource via DARPAConnect on how to do business with the agency. In addition to DARPA 101 materials, relevant preparatory modules include "Making the Most of a Proposers Day" and "Understanding DARPA Broad Agency Announcements." Registration and access are free at http://www.darpaconnect.us/.

ADMINISTRATIVE:
This Special Notice does not constitute a formal solicitation for proposals. This notice is issued solely for information and program planning purposes and is not a Request for Information (RFI). Since this is not an RFI. DARPA will not accept any submissions against this notice. Interested parties to this notice are cautioned that nothing herein obligates DARPA to issue a solicitation. NO CLASSIFIED INFORMATION SHOULD BE INCLUDED IN ANY COMMUNICATIONS IN RESPONSE TO THIS SPECIAL NOTICE.

Please e-mail O-CIRCUIT@DARPA.mil if you wish to be added to our blast list for future program updates (i.e., Proposers' Day announcement, Program Solicitation publication, etc.).