Special Notice
Request for Information:
Materials for Physical Compute in Untethered Robotics
DARPA-SN-26-76
April 27, 2026

Defense Advanced Research Projects Agency
Microsystems Technology Office
675 North Randolph Street
Arlington, VA 22203-2114

Request for Information (RFI)
Special Notice DARPA-SN-26-76

Materials for Physical Compute in Untethered Robotics
Defense Advanced Research Projects Agency (DARPA)
Microsystems Technology Office (MTO)

Posting Date: April 27, 2026
Responses Due: May 27, 2026 at 2:00 p.m. Eastern Time (ET)
Technical POC: Julian McMorrow, MTO Program Manager
E-mail: DARPA-SN-26-76@darpa.mil

RFI DESCRIPTION:
The Defense Advanced Research Projects Agency (DARPA) Microsystems Technology Office (MTO) seeks information on **physical intelligence applied to untethered autonomous robotic technologies with dynamic and low-latency adaptive functionality in unconstrained environments**. The Department of War (DoW) typically operates in environments with limited communication or human intervention, where autonomy coupled with rapid maneuverability and adaptive reflexes dictate mission completion. Robotics possessing physical intelligence—the encoding of sensing, actuation, control, learning, adaptation, and decision-making directly into the body—offers a promising path towards advancing the DoW's mission. Progress in today's autonomous robotics focuses on two paths, increasing sensor density and increasing data transfer volume, to enhance artificial decision-making. Both paths come at the cost of reduced energy efficiency, speed, and information security, for which current progress occurs orthogonal to the DoW mission. DARPA is interested in disruptive concepts at the material, component, and kernel level that represent significant advances beyond current practice for fielding robust robotics.

Approaches resulting in incremental improvement and mere description of existing capabilities or prior work without a clear vision for advancing the field are not of interest. Responses to this RFI may be used to inform future program development.

BACKGROUND:
The field of robotics has experienced transformative progress over the past two decades, both physically and in computation intelligence. Driven primarily by investment in humanoid robotics, increases in machine perception, planning, and learned control have produced robots of remarkable capability. Yet these systems still require constant internal data processing, with either the end-users or data centers, creating delayed actions through latency and consuming power for data transmission. Physical hardware, such as actuators, mechanisms, joints, wiring harnesses, and structural materials that give a robot its ability to physically act, are fixed and finite once assembled in a complete system, yielding a robot with small behavior diversity. Therefore, current robot capabilities are limited in ever-changing and contact-rich environments.

In unconstrained or ill-defined environments, mission success is dictated by a robot's ability to readily adapt and execute on non-predefined commands to complete mission-critical tasks. Actuation or sensing that encompasses multiple functions enhances behavior diversity, such as the number and type of actions a robot can perform, giving rise to a greater probability of success. While ultimately robots with embodied intelligence will be able to independently perceive, act, and decide on tasks critical to mission success, the focus of this RFI is on the development of materials embedded with sensing, processing, and actuation. This RFI seeks to understand the interaction of physical hardware technologies—such as materials, mechanisms, actuators, sensors, and structural elements with distributed compute algorithms for control, sensing, and autonomy—needed to enable robotic systems that can perceive, adapt, and act in unconstrained and extreme environments. Of particular interest are advances in physical intelligence where sensing, actuation, and computation are co-designed and seamlessly integrated at the material and hardware level into macro systems capable of interacting with physically denied or harsh environments.

REQUESTED INFORMATION:
DARPA seeks innovative insights on material-centric approaches that embed computation directly within a material's structure, either distributed throughout their physical volume or embedded within their intrinsic properties. The aim is to understand how these materials could enable or fundamentally limit robotics operating in unrestricted or ill-defined environments. Responses are welcome from all capable sources including, but not limited to, private or public companies, individuals, universities, university-affiliated research centers, not-for-profit research institutions, and U.S. Government-sponsored labs. Responses should address one or more of the following areas. For each area addressed, respondents are highly encouraged to identify quantifiable metrics that define not only the current state-of-the-art, but also what revolutionary progress would look like, with supporting rationale for why those metrics capture meaningful progress.

1. Actuation and Sensing
Currently, every physical task a robot performs, such as grasping, manipulating, and traversing, requires first perceiving its environment (sensing), then analyzing how to interact with the environment (processing), then finally accomplishing the task (actuation). These sensing-processing-actuation loops are among the most environment-dependent components in any robotic system. DARPA seeks information on ***material-centric approaches*** for actuation and sensing for unconstrained environments, including but not limited to:

a. Existing state-of-the-art applications of physical intelligence in robots, including their inherent limitations, implementation timescales and projections (Moore's law equivalent), and driving performance metrics. Of particular interest are those affiliated with soft robots whose degrees of freedom are not limited to fixed joint mechanics.
b. Pathways to develop foundational, high-quality materials, interfaces, and assembly schemes to overcome the above-mentioned limitations and set a precedent for future applications.
c. Novel material-centric architectures with all three modalities—sensing, processing, and actuation—that perceive, differentiate, and send signals based on different state variables (e.g., pressure, ion concentration, temperature, light, etc.).
d. Embedded proprioception at the component or kernel level to provide real-time hardware state information, enabling awareness and autonomy for regeneration, fatigue, or graceful degradation.
e. State-of-the-art technologies for harvesting energy, transducing energy, and storing energy, including limitations, implementation timescale, and performance metrics.
f. Scalable pathways from materials to systems, in order to develop revolutionary technologies to overcome the above-mentioned limitations.

2. Dynamic and Adaptive Closed-Loop Compute
Robotic decisions are guided by the underlying computational models and algorithms, where the desirability of an outcome is governed by the magnitude of data that feeds these models. Large data requires more power to transmit and longer computation times to decide, potentially resulting in the

failure of a task. Materials with the ability to perform physical computation that are embedded in sensors and actuators enable efficient closed-loop computations that eliminate the need for data transmission.

DARPA seeks information on *material-centric* physical computing tied to materials and dynamic and adaptive closed-loop computation, including but not limited to:

a. Existing state-of-the-art implementations of material-centric physical computing, including their inherent limitations and driving performance metrics.

b. Pathways to develop novel computing capabilities that (i) adapt to change based on the physical state of the system, or (ii) reduce closed-loop latency, or (iii) possess single pass learning, or (iv) address the above-mentioned limitations.

c. Multi-modal compute using multiple different input signals or state variables (e.g., pressure, ion concentration, temperature, light, etc.) simultaneously without signal loss or degradation, such that signals do not need to be converted or transformed when sending, receiving, or processing signals.

d. Rapid online adaptation to changing external stimulus with the goal of eliminating model-dependent learning pipelines that limit real-world and long duration deployment.

e. Physical computing that promotes closed-loop linking of sensing, actuating, and computing, such that a robot's perception can direct tasks autonomously.

Responses that address interactions and dependencies across multiple challenge areas are strongly encouraged. The material-centric approach is deeply coupled within the two areas outlined above. DARPA is particularly interested in concepts where an advance in one area fundamentally reshapes what is achievable in others.

The following are not of interest to the current RFI:

- System-level mission concepts or operational architectures without corresponding identification of the enabling hardware technologies or hardware science gaps that must be closed.
- Architectures that cannot be made mobile or deployable.
- Incremental improvements to existing hardware without a clear path to transformative capability.
- Software, algorithms, autonomy architectures, or AI/ML approaches that do not identify a fundamental physical intelligence-centric approach as the core contribution.
- Processing or interpretation of sensor data by conventional central processing unit (CPU) or graphics processing unit (GPU).

WORKSHOP:

DARPA plans to hold a follow-up in-person workshop in June or July 2026 in Arlington, VA, for the purpose of reviewing and discussing current and future research relevant to this RFI, discussing the submissions received, developing new insights, and identifying challenges. Information discussed at this workshop may assist in the formulation of possible future areas of DARPA research related to robotics technologies for embodied intelligence and related matters. Topics and discussion will remain at the unclassified level.

Workshop space is limited. Invitations to attend the workshop will be extended to respondents based on 1) the relevance of their submission to at least one of the two areas in the requested information section above, and 2) relevance to DARPA's mission to create and prevent technological surprise for national security.

The workshop format will be a combination of group discussion and formal presentations. Based on DARPA's interests and RFI submissions, DARPA may invite white paper submitters to provide further information in formal presentations at the workshop. DARPA intends to provide further details on the workshop via email to the RFI respondents invited for workshop attendance by June 10, 2026.

SUBMISSION INSTRUCTIONS:
Responses to this RFI should be submitted no later than 2:00 p.m. ET on May 27, 2026.

Unclassified responses should be submitted to DARPA-SN-26-76@darpa.mil. NO CLASSIFIED INFORMATION SHOULD BE SENT TO DARPA-SN-26-76@darpa.mil.

Classified responses should be coordinated with DARPA prior to submission. Respondents wishing to provide a classified response should send an e-mail to DARPA-SN-26-76@darpa.mil with the subject line "Classified Coordination Requested." Respondents should allow at least three (3) business days for processing requests. NO CLASSIFIED INFORMATION SHOULD BE SENT TO DARPA-SN-26-76@darpa.mil.

If proprietary information is submitted, it must be appropriately and specifically marked. It is the respondent's responsibility to clearly define to the Government what is considered proprietary data. Any proprietary information should be clearly labeled as "Proprietary." DARPA will disclose submission contents only for the purpose of review by DARPA staff, other Government agencies, or DARPA Support Contractors/SETAs.

NOTE: DARPA intends to conduct individual discussions with respondents as necessary to gain a full understanding of the technical and partnership models submitted. DARPA will contact respondents individually via e-mail.

FORMAT INSTRUCTIONS:
Responses to the RFI should be concise. Respondents should submit a single integrated response addressing the areas described above. DARPA will only review responses submitted as an unprotected Microsoft Word/PowerPoint document or PDF file. Technical responses are limited to no more than 4 pages per requested area using 11-point font and 1-inch margins on 8.5-inch by 11-inch page size. Technical responses addressing both requested areas can be a maximum of 8 pages. Effective responses that can be provided in fewer pages are encouraged. Any submitted material in excess of these limits may or may not be reviewed without confirmation.

Responses should adhere to the following formatting instructions:

1. Cover page (1 page)
    a. Title
    b. Organization(s)
    c. Respondent's technical and administrative points of contact (names, addresses, phone and fax numbers, and email addresses)
2. Technical response (4 pages maximum, or 8 if both requested areas are addressed)
    a. A discussion of the capabilities/challenges addressed
    b. Theoretical and/or simulation discussion
    c. Development strategy (especially versus requested metrics)

    d. Identification of current data (if any)
    e. Estimated time to availability and risk assessment (technical and other)
3. References (2 pages)
    a. All references to previously published work. If applicable, include a list of Government sponsors of previous or ongoing work and their contact information.
4. Summary slide
    a. One slide that summarizes the main idea and development strategy, visually and succinctly indicating new insights, main objectives, underlying technical mechanisms, fundamental assumptions and limitations, key innovations, expected impact, and/or other unique aspects of the response.

DARPACONNECT:

Entities who have not worked with DARPA before are encouraged to learn more about DARPAConnect, an initiative established to facilitate collaboration between DARPA and potential performers. The DARPAConnect team offers customized support, resources, and guidance on how to prepare your ideas for high-impact conversations with DARPA program managers. Please visit DARPAConnect.us to access a digital hub of online resources, including a curriculum for self-paced learning, personalized support, and in-person and virtual events. You can use the contact form at DARPAConnect.us or email the DARPAConnect team directly at darpaconnect@darpa.mil to request assistance.

ADMINISTRATIVE:

This announcement contains all information required to submit a response. No additional forms, kits, or other materials are needed. All administrative and technical questions should be directed to DARPA-SN-26-76@darpa.mil. Please refer to the Special Notice number (DARPA-SN-26-76) in all correspondence.

This RFI is issued solely for information and program planning purposes and does not constitute a formal solicitation for proposals or proposal abstracts; any so sent will be disregarded. In accordance with FAR 15.201(e), responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. Submission of a response is strictly voluntary and is not required to propose to subsequent Announcements (if any) or Solicitations (if any) on this topic. DARPA will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that DARPA is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI.