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Received: May 29, 2025
Tracking No. mb9-cnyj-c1ui
Comments Due: May 28, 2025 **Submission Type:** API

Docket: NSF-2025-OGC-0001
NITRD_FRDOC_0001

Comment On: NSF-2025-OGC-0001-0001
Request for Information: Development of a 2025 National Artificial Intelligence Research and Development Strategic Plan

Document: NSF-2025-OGC-0001-DRAFT-0177
Comment on FR Doc # 2025-07332

Submitter Information

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General Comment

See attached file(s)

Attachments

CRCNS 2025 RFI Neuroscience_Inspired_AI

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Name of Submitter:

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Area Recommended for Investment:

Neuroscience-Inspired Artificial Intelligence for Embodied Robotic Systems

Overview

Modern artificial intelligence (AI) systems, particularly large neural models (LNMs) such as Transformers, have achieved remarkable success in language processing. However, these models remain underexplored in domains requiring real-time, high-dimensional, and sequential decision-making—such as robotic control in complex environments. Moreover, current LNMs are computationally intensive, energy-inefficient, and lack the adaptability, long-term learning, and behavioral flexibility observed in biological systems. This call seeks bold, interdisciplinary research proposals that draw inspiration from neuroscience to overcome these limitations. We invite teams to explore how principles from biological nervous systems—such as modularity, developmental plasticity, predictive feedback, and embodiment—can be integrated into AI architectures to enable energy-efficient, adaptive, and resilient robotic intelligence.

Research Focus Areas

Proposals should address one or more of the following themes:

- Heterogeneous Neural Architectures: Incorporating brain-like modularity and specialization into LNMs to improve learning efficiency and generalization.
- Developmental Mechanisms: Modeling neural growth, apoptosis, and synaptic plasticity to reduce training costs and enhance adaptability.
- Temporal Dynamics: Embedding multi-timescale dynamics inspired by biological neurons to support long-horizon planning and control.
- Sensorimotor Prediction: Designing brain-inspired circuits for sparse encoding and real-time feedback in robotic systems.
- Embodied Intelligence: Co-designing physical robot platforms and AI control systems to study the interaction between body mechanics, sensing, and cognition.

Expected Outcomes

Proposals should aim to achieve the following outcomes:

- Novel AI architectures that integrate neuroscience principles
- Demonstrated improvements in energy efficiency, learning speed, and task performance
- Embodied robotic systems capable of complex and adaptive behavior
- Open-source tools, benchmarks, and datasets to support the broader research community

Proposal Requirements

Proposals must include:

- Multidisciplinary teams with expertise in neuroscience, AI/ML, and robotics
- Clear experimental validation plans using physical robotic platforms
- Quantitative benchmarks comparing proposed methods to state-of-the-art LNMs