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Prof. H. Holden Thorp
Editor-in-Chief
Science Robotics

March 28, 2024

Dear Prof. Thorp,

I am submitting our manuscript, "*Tackling AI Sustainability: Collective Learning for Energy Efficiency*," for publication in Science Robotics. Fernando Díaz Ledezma co-authors this work.

Our research discusses the energy demands of embodied artificial intelligence (EAI) agents: physical systems that interact with the world. We examine their energy requirements within the context of the rapid proliferation of deployed units, emphasizing their need for continuous interaction with the physical environment for learning. Our study evaluates the limitations of current learning paradigms, specifically the computational energy needed for EAI system learning processes akin to purely computational AI. We find a significant increase in energy demands with conventional learning approaches involving large groups of EAI agents learning multiple skills without effectively using accumulated knowledge.

We advocate collective learning as the ideal paradigm for networked EAI agents. Capitalizing on the growing population of EAI systems, collective learning enables efficient sharing, aggregation, and utilization of past and current knowledge. By employing a model of the idealized target dynamics of knowledge exchange, our research reveals the substantial benefits of collective learning in reducing energy and time requirements for acquiring multiple skills. We position it as the natural solution to the energy challenges of EAI.

I confirm that this manuscript has not been previously published and is not being considered by any other publisher.

For all correspondence related to this manuscript, please contact me at haddadin@tum.de.

Thank you for your time and consideration. Please inform me of your decision at your earliest convenience.

Sincerely,

Prof. Dr.-Ing. Sami Haddadin
Executive Director of the Munich Institute of Robotics and Machine Intelligence (MIRMI),
Chair of Robotics and Systems Intelligence,
Technical University of Munich (TUM)