

Embodied Lifelong Machine Learning/AI for Robotics/Autonomous Systems to Attain Industry 5.0

S. Jagannathan

Curators' Distinguished Professor

Rutledge-Emerson Endowed Chair Professor of Electrical and Computer Engineering

Professor of Computer Science

Missouri University of Science and Technology

301 W 16th Street, Rolla, MO 65409, USA

sarangap@mst.edu

Abstract

Machine learning (ML)/artificial intelligence (AI) is making advances faster than the society is able to absorb, understand and assimilate them in areas such as image recognition, natural language processing, and data analytics; at the same time feedback control that employ AI and ML are becoming more pervasive and critical. Embodied ML/AI represents a paradigm shift in the design and development of intelligent cyber-physical systems, where emphasis is placed on the integration of physical interaction of machine and cyber system to facilitate adaptive decision-making. This embodiment is realized through an interplay of sensing, control, and actuation, where AI not only interprets data but directly interacts with physical process. Embodied AI systems permit new avenues for a broad range of manufacturing applications mainly in robotics and human-machine interaction for industry 5.0. Application of embodied learning controllers can be found in areas as diverse as process control, energy or smart grid, civil infrastructure, healthcare, manufacturing, automotive, transportation, entertainment, and consumer appliances. This talk presents an historical overview and recent advances to enable embodied AI for robotics/autonomous systems for industry 5.0 and possible promising future directions.

Keywords

Embodied, Lifelong Machine Learning, Robotics, Autonomous Systems

Biographies

Dr. Jagannathan Sarangapani (or S. Jagannathan) is a University of Missouri Curators' Distinguished Professor and Rutledge Emerson Endowed Chair at the Missouri University of Science and Technology (former University of Missouri-Rolla). He served as Interim Director of Intelligent Systems Center and served as the Site Director for the graduated NSF Industry/University Cooperative Research Center on Intelligent Maintenance Systems for over 13 years. He has a joint appointment with the Dept of Computer Science and the Dept. of Engineering Management and Systems Engineering. Prior to joining the Missouri S&T, he was employed at University of Texas at San Antonio and Caterpillar Inc. His research interests include learning and adaptation, deep learning based adaptive and neural network control, networked control systems/cyber physical systems, sensor networks, prognostics, and autonomous systems/robotics. He has coauthored over 500 peer reviewed journal and refereed IEEE conference articles, several book chapters and seven books. He holds 21 patents with several pending. He so far supervised the completion of 37 doctoral students and 32 M.S. students. He received research funding from various federal agencies and industries such as Boeing, Caterpillar, Honeywell and others. He served as the co-editor for the IET Book series on Control from 2010-2012, and in a number of IEEE Conference Organizing Committees including Chair of IEEE CSS Tech Committee on Intelligent Control. He is a Fellow of IEEE, US National Academy of Inventors, IET (UK), and Institute of Measurement and Control, UK and Asia Pacific Artificial Intelligence Association. He received NSF Career Award

in 2000, Caterpillar Research Excellence Award in 2001, Presidential Award for Research Excellence at University of Texas in 2001, Boeing Pride Achievement Award in 2007, 2021 University of Missouri Presidential Award of Excellence: Sustained Career and several Faculty Excellence and Teaching Excellence Awards at Missouri S&T, and many others.