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# Embodiment of Intelligence and Computing for Robots and Robot Vision Applications

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## I. Short Bio

Jorge Dias has a Ph.D. on EE and coordinates the Artificial Perception Group from the Institute of Systems and Robotics from the University of Coimbra, Portugal. He is Full Professor at Khalifa University, Abu Dhabi, UAE and Deputy Director from the Center of Autonomous Robotic Systems from Khalifa University. His expertise is in the area of Artificial Perception (Computer Vision and Robotic Vision) and has contributions on the field since 1984. He has been principal investigator and consortia coordinator from several research international projects, and coordinates the research group on Computer Vision and Artificial Perception from KUCARS. Jorge Dias published several articles in the area of Computer Vision and Robotics that include more than 300 publications in international journals and conference proceedings and recently published book on Probabilistic Robot Perception that addresses the use of statistical modeling and Artificial Intelligence for Perception, Planning and Decision in Robots. He was the Project Coordinator of two European Consortium for the Projects "Social Robot" and "GrowMeUP" that were developed to support the inclusivity and wellbeing for of the Elderly generation.

## II. Abstract

The developments in data-based, digital artificial intelligence and learning capabilities in computation, algorithms and cognition have tremendously grown in the past decades, while the development of robots' bodies, morphology and materials has lagged behind. This keynote addresses this challenge and how computational aspects of implementing robotic and computer vision algorithms are currently addressed to deal with multi- sensor data with spatial probabilistic distributions. The current digital tools and simulators are convenient and practical for exploring the quantitative behavior of specific computing neural networks, but their performance is largely dependent of supercomputing capacities. Even the largest supercomputing systems to date are not capable of obtaining real-time performance when running simulations large enough to accommodate multiple areas and layers of computing. Custom digital systems that exploit parallel graphical processing units (GPUs), field programmable gate arrays (FPGAs) or memristors offer good capabilities in computer efficiency, and resilience. In this talk we present the design of a memristor based hybrid-in memory processing architecture of computer vision. The design includes circuitry that controls and enables the in-memory processing of arithmetic operations through memristor cells, sense integrators and other peripheries in order to perform the needed modules for the implementation of the algorithm. In the talk we also address our current attempt to implement efficient "haze removal" CNN to remove the distortion from underwater images. Restoring the underwater images without distortion is important since it increases the quality and performance of the machine learning programs which improves the marine robotics.