Concept Note - Ulysseus Proposals

FUNDING INSTRUMENT

PROGRAMME : Horizon Europe
ACTION/CLUSTER DESTINATION : COST
TOPIC: Robotics (Engineering and technology)
DEADLINE: 23/10/2024
DURATION: 48 months
BUDGET: average funding received amounts to 600,000 EUR (over 4 years)

PARTNERS

LEAD PARTNER: UniGe (IT)

OTHER PARTNERS:
USE (ES) *TBC*
UNiCA (FR) *TBC*
TUKE (SK) *TBC*
UCG (ME) *TBC*
UM (DE) *TBC*
MCI (AT) *TBC*
HH (FI) *TBC*
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DESIRED EXPERTISE

Cognitive, neuro- and social science
Computational science and neuroscience
HRI
Robot behavior
Cognitive architecture
Cognitive robotics
AI and ML

DEADLINE FOR THE EXPRESSION OF INTEREST:

September 10th, 2024

PROJECT SUMMARY

(TENTATIVE) TITLE: Active Inference and Robot Bodies
ACRONYM: AInRB
KEY WORDS: Cognitive Robotics, Artificial Intelligence.
TAGS: UniGe Innovation Hub in Robotics, WP6

ABSTRACT :
One of the major obstacles to a full-scale adoption of robots to carry out tasks in common, everyday environments is the lack of a principled, comprehensive understanding of two key components in intelligent behaviors, that is, (i) the underlying cognitive principles which may inform robot behavior while interacting with the environment and the humans therein, and (ii) the relationship between such cognitive principles and the variety of robot embodiments.

Traditionally, approaches to the design of a robot cognitive architecture have explored the interplay of sensing, reasoning, and action, even introducing within symbolic, logic-based formalisms normative behaviors loosely informed by tenets of cognitive science. Conversely, the recent popularity of such artificial intelligence approaches as multi-modal foundation models has led to the design of end-to-end neural architectures with impressing performance in several niche applications.

However, despite their intrinsic, conceptual and methodological differences, both traditional and recent approaches suffer from relevant limitations as far as the design of a cognitive architecture is concerned. Most notably, they still share a “sense-plan-act”, dataflow-like approach which do not consider recent advances in cognitive science and neuroscience research, and they are conceptually based on a sharp, Cartesian, separation between the robot body and the robot “mind”, whereas the design of a modern cognitive architecture should leverage the implications of Moravec’s paradox about the interplay between cognitive aspects and computational as well as sensorimotor cognitive aspects.

The goal of AInRB is to support the conversation and accelerate the discussion for a normative approach to the design of a cognitive architecture for robots which is (i) informed by the latest theories in cognitive science and neuroscience and (ii) can leverage both the robot body and “mind” to support advanced robot cognitive capabilities.

PROJECT DESCRIPTION

AInRB is designed to establish a robust interdisciplinary network in the field of cognitive robotics. Robotics is the central focus of the UniGe Innovation Hub (IHR), a key component of Ulysseus European University alliance, and it is treated as a multi- and inter-disciplinary field in which innovation and collaboration can be sought across various disciplines.

Within Ulysseus European University framework, AInRB aligns with the objectives of Work Package 6 (WP6) on Equality, Diversity, and Inclusion (EDI) as well as Community Engagement (CE). In this context, UniGe leads WP6, aiming to integrate EDI principles into all partner activities. This includes fostering a diverse and inclusive environment within the robotics field, ensuring broad community engagement, and promoting European citizenship. The integration of these elements supports the development of a more inclusive and socially responsible approach to technological advancement.

Therefore, AInRB aims to pursue the following objectives:
SO1. Develop a normative framework that integrates Active Inference with principles of robot embodiment and morphological computation for designing advanced robot cognitive architectures.
SO2. Identify and model major open challenges in robotics as instances of the proposed theoretical framework, comparing with existing solutions and proposing initial design-level implementations.
SO3. Implement and refine software models of robotic use cases, evolving them from theoretical mockups to advanced models, increasing technology readiness with each iteration.
SO4. Map and allocate model structures to specific robot embodiments, integrating decentralized processing units and soft materials for optimized hardware-software interaction.
SO5. Synthesize best practices and guidelines for next-generation cognitive architectures, assessing their implications across various contexts and exploring social, ethical, and legal considerations.

In order to achieve these objectives, AInRB will propose a series of activities such as meetings, conferences and training schools, including specific activities related to participatory design and living labs.