Dottorato di Ricerca

Ingegneria per l'Innovazione e lo Sviluppo Sostenibile

Università degli Studi della Basilicata — Scuola di Ingegneria

PhD Lecture "Cyber-Physical Models in Quantitative Theory of Networked Embodied Intelligence"

Fabio Bonsignorio - *Visiting Professor*

Introduction by Sorin Dragomir

Lezione I: 9 Settembre, ore 10:30-12:30
Lezione II: 10 Settembre, ore 10:30-12:30
Lezione III: 16 Settembre, ore 10:30-12:30
Lezione IV: 17 Settembre, ore 10:30-12:30

Aula Coriolis, 3th floor
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Abstract

In the coming decades we will need to dramatically increase work productivity not only to cope with a shrinking work-force and growing number of people in old and very old age in developed countries, but also to mobilize resources to help the ecologically sustainable development of the global economy and provide food and infrastructure to billions of more people.
A steep progress in Robotics and AI seems a dramatic necessity in this context.
Luckily, the current wave of innovation in Robotics, integrating Machine Learning, Probabilistic Robotics, and some AI is already having significant impact on our economy and our society.
However, it is a widespread opinion that Robotics still need much more robustness, safety, lower manufacturing costs, and reduced control complexity and effort; while it aims to more and more complex and adaptive behaviors in open ended environments.
A foundational approach to Embodied AI, disrupting both Robotics and AI, is often referred to as 'Morphological Computation', i.e., the outsourcing of computation from the controller to body-environment interactions of the system. The concept is often used to describe rather different phenomena in the literature. While there seems to be a consensus about the importance of embodiment, there is still no clear definition of how the embodiment of an agent – and typically of an intelligent robot – should actually be defined. Many of the conceptual definitions of embodiment that have been proposed so far do not provide much more than the common sense understanding of embodiment, which is why some researchers believe that an operational and quantitative approach - i.e. 'Morphological Computation' is important.
There are already different approaches to quantify embodiment. Examples from the field of information theory have been developed by the author and by a handful of other researchers.
The course will review the existing different concepts and quantifications of embodiment and will show how they overlap and differ, thereby leading to a better understanding and a clearer picture of what actually is meant as 'embodiment' and 'Morphological Computation'.
It is thought that a clearer understanding of the basic quantitative physical aspects of embodiment may pave the way to radically new and significantly more effective approaches to the modeling and control of intelligent robots (with rigid and soft body parts) perceiving and acting stochastically in unstructured and partially known open ended environments.
Moreover, the research methodology requires to be improved if we want to ground paradigm and modeling choices on experimental evidence.
To what extent, under which conditions – and critically in which timeframe - will it be possible to achieve the necessary advancements to be able to exploit robots to dramatically increase productivity and for elder care? Which mathematical challenges will arise? Are those bottlenecks to AI and robotics development?

Biography

Fabio Bonsignorio è professore alla Facoltà di Elettrotecnica e Calcolo all'Università di Zagabria dove ha la European Research Area Chair in AI for Robotics. E' CEO and founder di Heron Robots (www.heronrobots.com), azienda deep-tech, che scommette sull'innovazione radicale basata sulla ricerca di base più avanzata sulla IA Fisica. È stato visiting professor all'Istituto di BioRobotica della Scuola Superiore Sant'Anna dal 2014 al 2019, Banco de Santander Chair of Excellence in Robotics alla Università Carlos III di Madrid, dove è stato professore dal 2010 al 2014, dopo vent'anni di lavoro nell'industria hi-tech. È il principale sostenitore nella comunità robotica globale della necessità di rendere 'riproducibile' la ricerca in Robotica e IA. È un pioniere nelle applicazioni della blockchain alla Robotica e IA.