Consiglio Nazionale delle Ricerche

CNR ISTC ISTITUTO DI SCIENZE E TECNOLOGIE DELLA COGNIZIONE

SDPS 2023

TOWARDS A SUPRA-DISCIPLINARY DESIGN AND PROCESS SCIENCE

Workshop Session: Intellectualized Cyber-physical Systems

Interacting with Intelligent Cyber-Physical Systems: How to make sense of smart agents?

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Formal Modeling of General and Domain Concepts

Ontology-based Artificial Intelligence

Knowledge Representation

Areas of interest:

- Cyber-physical systems
- Socio-technical systems
- Information analysis, classification, integration
- Product and process modeling (e.g. in manufacturing)

CPSs

CPSs are extremely important to us.

At the same time they grow beyond our understanding.

LEARNING CPSs

With the increasing capabilities of exploiting learning techniques, we are giving to CPSs the capacity to self-optimise their behaviours and to provide enhanced services beyond our prevision.

Learning in a flexible adaptive system is extremely useful… and a challenge as we might not understand what the system becomes.

When CPS's complexity is too complex

Usually we:

- predict and monitor behaviours,
- adapt structure and substitute faulty components,
- update and upgrade functionalities

If things get complicated, we increase the (data and behaviour) **models**, **visualization techniques**, **perspectives** and **simulations.**
We even try to integrate "all" our knowledge into **Digital Twins**.

At some point this process stops (complexity theory) and CPSs become **independent agents** co-habiting with us (Dennett's view).

What can we do?

ON APPLIED ONTOLOGY

It is the (formal) explication of the concepts and principles that we use to understand the world.

If we have the **same ontology**, we might still understand the world in different ways. However, we can understand each other's, i.e., we can reliably establish **communications**.

INTELLIGENT CPSs

When an **engineered evolving** agent is beyond our understanding, we

- break it in pieces;
- constrain its activities;
- rely on behavioural studies.

Due to the fact that "CPSs are extremely important to us"

our best option is to investigate how to mix structural analysis (**traditional approach**) and behavioural studies (**new techniques**).

A challenge asking to integrate today's understanding of

TRUST, **DEPENDABILITY** and **RELIABILITY**

CHALLENGE

Intelligent CPSs are a new kind of rational agent

I suggest to study them using the **conceptual tools** that we use for the **biological agents** we already live with.

We need to start thinking how this can be done

Thank you!