The Enterprise of the Future as a Complex Cognitive System

Track proposed by:

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Description

Cognitive Manufacturing Systems were addressed primarily in the context of Industrie 4.0 and considered as an application of the concept of cognitive computing/ cognitive technologies in manufacturing enterprises.

The goal of cognitive computing is to simulate human thought processes in a computerized model. Using self-learning algorithms, data mining, pattern recognition and natural language processing, the computer system should be able to mimic the way the human brain works.

Businesses can use it to incorporate all kinds of risk factors into a decision before providing a company with a recommendation about an investment or a location to build a new satellite office.

The possibilities for this technology in the future are enormous, and no industry or socio-economical area will be left untouched by it in the next decade.

This is the reason for, the term of "**enterprise of the future**" is not necessarily linked with manufacturing, but can be extended in education, e-health, agriculture, transportation, smart communities – practically any system that suppose complex networking of autonomous and goal-oriented entities, whose emerging behavior has to adapt to a highly dynamical and loosely defined environment.

Cognitive computing systems are informally known as systems that use different techniques in order to simulate human thought processes.

This process uses many of the same fundamentals as AI, such as machine learning, neural networks, natural language processing, contextual awareness and sentiment analysis, to follow the problem-solving processes that humans do day in and day out. IBM defines the result of cognitive computing as "systems that learn at scale, reason with purpose and interact with humans naturally."

It is the role of the research community to come out with a coherent model of the cognitive control concept, underlining its differencies with respect to other enterprise control paradigms and solutions, as well as the context in which it will become advantageous, the methodology and the pre-requisites for implementing it.

One way to approach this problem is to focus on properties of a cognitive system, as:

- **Contextual** – Understands and extracts contextual elements such as meaning, time, location, process and others based on multiple sources of information. For example, it may be fed with data such as road, ambulance, injury and wreckage and come up with the context of a vehicular accident.
- **Adaptive** – This is the learning portion. It adapts to new information and stimuli to resolve ambiguity and tolerate unpredictability. In relation to context, this characteristic takes care of feeding on dynamic data and then processing it in order to form the eventual context and come up with solutions or conclusions.

- **Interactive** – The system is able to interact with users so that the users can define their needs, as well as connect with other devices and systems.
- **Iterative and stateful** – The systems must aid in the definition of the problem by asking the right questions and finding additional sources of information if a problem is incomplete or ambiguous. They must also be able to remember previous interactions and processes and return to the state at previous points in time.

Paradigms as Cyber-physical Systems and technologies as IoT and IoS represent important supportive concepts, but the focus of the Complex Cognitive Systems approach is towards knowledge-based systems, behavioral modeling, model-driven software engineering, verification & validation of emergent behavior, evolutionary algorithms – which should be both practically oriented (in terms of goals and data mining) and theoretically supported (in terms of models). Achievement of control/ management goals is mostly based on communication and cooperation between subsystems, using cognitive, eventually biologically inspired problem-solving techniques, based on adaptive sensing definition and focus.

The track welcomes papers which focus on applying the cognitive approach on complex networked systems with qualitatively and quantitatively defined goals, acting in dynamic environments.

Choice of an IFAC technical committee for evaluation (via the choice of the first keyword): TC 3.2. Computational Intelligence in Control

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Link to a web page to further describe the track (optional but recommended) – none yet