

## **IEEE Systems, Man and Cybernetics Magazine**

### **Special Issue Theme:**

#### **"Cognition for Intelligent Control of Cyber-Physical Systems"**

Cognition and Intelligent Systems are important forerunners in smart development. These technologies lead to the emergence and development of new and innovative automation tools and cyber-physical systems. This area of research is already blooming but the practical applications are still in the planting stage. This is because the addition of advanced cognition algorithms and techniques to Cyber-Physical Systems can greatly enhance the current state of development. There is still a lot of room for improvement in this area of application. This special issue covers the major developments, limitations, and future scope in the area of cognition for intelligent control of cyber-physical systems.

Cognition is an inclusive term which covers processes where transformation, elaboration, reduction, recovery, storage, and usage of the sensory input takes place. The major functions of cognition that would lead to intelligent control of Cyber-Physical Systems are perception, reasoning, attention, memory, knowledge representation, and problem-solving. The design of Cyber-Physical Systems with the required cognitive capabilities and functions is the current requirement and area of interest. In the future, these systems may be inherently designed to act intelligently on all aspects through cognition. However, currently, cognitive cyber-physical systems try to integrate technologies such as Machine Learning (ML) and Artificial Intelligence (AI) for making smart systems in the field of transportation, manufacturing, construction etc. The existing cognitive models with relatively lesser complexity i.e., low cognitive and biological fidelity includes but are not limited to the Gabor-wavelet V1 model, Hodgkin and Huxley model, and multi-compartment single-neuron model. Few of the more complex models include deep neural networks, DCNN, Recurrent deep neural networks, Spaun, Blue brain project etc. Apart from these, specifically related to perception, Long Short-Term Memory (LSTM) recurrent neural network, and convolutional neural network architectures are playing a major role. In the area of attention, feature integration theory, signal detection theory, and CODE theory of visual attention are contributing a lot. Similarly for memory, episodic control, neural episodic control, and hierarchical episodic control are the major computational models. However, the major challenge that the current research community faces is the integration of model-free and model-based techniques, reduction in the amount of data required, autonomy through meta-learning, integration of distributed and hierarchical algorithms etc. Future research can focus on overcoming these limitations in order to largely enhance the state of existing cognitive cyber-physical systems.

### **The topic of interest includes the following:**

- Innovative techniques to improve the learning mechanism in neural adaptive control in intelligent cyber-physical systems.
- Enhancing the integration of model-free and model-based algorithms for achieving cognition capabilities in cyber-physical systems.
- Methods to increase the attention in critical cyber-physical system applications through neural network adaptive controllers.
- Design of intelligent cyber-physical systems in process control systems.
- Innovative computational models for cognition and intelligent control in cyber-physical systems.
- Semantically enabled cyber-physical systems for flexible monitoring of e-commerce processes.
- Development of cognitive cyber-physical systems based on biological systems.
- Linked data and knowledge graphs for cognition in industrial cyber-physical systems.
- Development of a framework for human interaction in cognitive and intelligent cyber-physical systems.
- Situation awareness in intelligent cyber-physical systems for smart transportation using cognition principles and models.

### **Important Dates:**

Paper Submission Deadline	<b>December 15, 2022</b>
Author Notification	March 05, 2023
Revised Papers Submission	May 19, 2023
Final Acceptance	July 22, 2023

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