

Chapter 106

Cyber Physical Control Systems

P. Venkata Krishna
VIT University, India

V. Saritha
VIT University, India

H. P. Sultana
VIT University, India

ABSTRACT

The focus of algorithmic design is to solve composite problems. Intelligent systems use intellectual concepts like evolutionary computation, artificial neural networks, fuzzy systems, and swarm intelligence to process natural intelligence models. Artificial intelligence is used as a part of intelligent systems to perform logic- and case-based reasoning. Systems like mechanical and electrical support systems are operated by utilizing Supervisory Control and Data Acquisition (SCADA) systems. These systems cannot accomplish their purpose, provided the control system deals with the reliability of it. In CPSs, dimensions of physical processes are taken by sensors and are processed in cyber subsystems to drive the actuators that affect the physical processors. CPSs are closed-loop systems. The adaptation and the prediction are the properties to be followed by the control strategies that are implemented in cyber subsystems. This chapter explores cyber physical control systems.

INTRODUCTION

Cyber Physical Systems is described to be an integration of computation and physical processes. The physical processes are observed and controlled by the embedded computers and networks. The computing process is affected by the feedback sent by the physical processes and vice versa. It has been realized that the financial and societal possibility of such kind of systems is larger than what is expected it to be. So, to develop the technology, huge amount of speculations are made throughout the world wide. The embedded systems, computers and devices which are embedded with software such as cars, toys, medical devices and scientific instruments whose main focus is not computation are the foundation to develop the new technology. The software and network which presents the abstraction and modelling,

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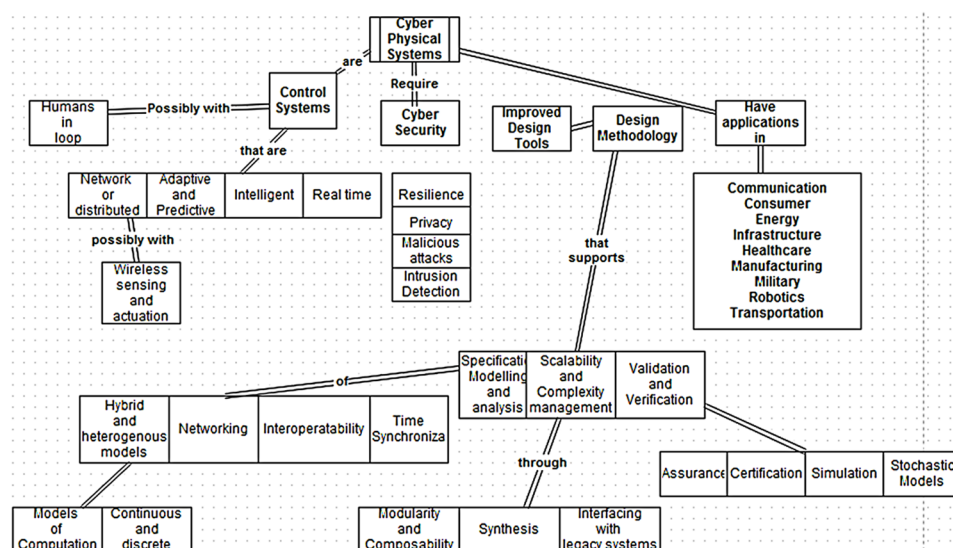
design and analysis techniques are integrated with the dynamics of the physical processes by the Cyber Physical Systems as shown in the Figure 1 (Sundar & Lee, 2012).

The CPS is categorized as engineering discipline whose main focus is the technology and has the very good basics and foundation in mathematical abstractions. The adjoin abstractions which are progressed over decades for modelling physical processes like differential equations, stochastic processes, etc., the abstractions that are developed over centuries in the field of computer science like algorithms and programs is one of the critical challenges in technology. A “procedural epistemology” is provided by the abstractions of the algorithms and programs [Abelson and Sussman]. The physical process abstractions focus mainly on the development of the system state over time whereas the computer science abstractions focus on the data transforming processes or computation processes.

The core physical properties like passage of time which require the progress of the physical world to be included in the discussion area are abstracted away by computer science as rooted in the Turing-Church view of computability (Zhang, 2012).

The progress of powerful methods and tools in the field of science and engineering has been evolved by the systems and control researchers. Some of these methods and tools include the time and frequency domain methods, state space analysis, identification of system, filtering, prediction, optimization, robust control, stochastic control, etc (Baheti & Gill, 2011). Simultaneously, the key advancements has been brought by the researchers in computer science field in the areas like new programming languages, real-time computing techniques, methods involved in visualization, compiler designs, embedded systems, architectures, systems software, approaches to guarantee the consistency of the system innovatively, security of the cyber world, fault tolerance. The formal and potential representation and the tools which are used for authentication purpose are also introduced by the computer science researchers (Baheti & Gill, 2011). The integration of the knowledge and engineering principles across these two disciplines is the main aspiration of Cyber Physical Systems in order to introduce novel CPS science and supporting technology

Figure 1. CPS applications



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