Industrial Automation

Course Description

Production systems can be described as discrete event systems where the evolution is characterized by the occurrence of events. In the era of Industry 4.0 and highly flexible manufacturing, there is a need to provide adequate means for the modeling, analysis, design, and control of flexible production environments. This course introduces several modeling approaches for the mathematical description of discrete event systems, such as Automata, Petri Nets, and Markov processes. Each approach is presented in both theory and practice with examples taken from the industry. The approaches are grouped into logic – where only the logical sequence of events determines the evolution – and timed, where the time schedule of the events also plays an important role. Although simple discrete event systems can be analyzed mathematically, complex systems need the support of computer simulation. The main issues concerning the simulation of discrete event systems are addressed. The final part of this course introduces the concept of supervisory control, which aims at changing the properties of a given system to improve specified behaviors and fulfill defined design specifications. Supervisory control is addressed from both the theoretical and practical sides, describing how it can be implemented in a modern industrial environment. The course wraps up with a discussion of interesting applications for modeling and design approaches, for example, in the modeling and analysis of an industrial production unit. Additional conversation on topics like fault diagnosis, decentralized and distributed supervision, optimization, and adaptive supervision provide a contingent connection between classical industrial automation and the recent, (big) data-driven, flexible, Industry 4.0 advanced industrial automation.

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