

Modulbezeichnung	Engineering Industrial Cyber-Physical Systems
Semester	WPF
ECTS-Punkte (Dauer)	5 (1 Semester)
Art	Wahlpflichtfach
Studentische Arbeitsbelastung	70 h Kontaktzeit + 80 h Selbststudium
Voraussetzungen (laut BPO)	
Empf. Voraussetzungen	
Verwendbarkeit	Mall
Prüfungsform und -dauer	Klausur 1,5h oder mündliche Prüfung
Lehr- und Lernmethoden	Vorlesung
Modulverantwortlicher	A. W. Colombo

Qualifikationsziele

ICPS are not merely networked embedded systems but software-intensive, distributed systems with the capability to evolve, to adapt in a structural and behavioral manner, to collaborate and to generate emergent behaviors not specified during the design phase. These new industrial infrastructures are complex System of Systems (SoS) that are empowering new sophisticated engineering, enterprise-wide monitoring, control and management approaches. To this end, also supporting engineering tools need also to be networked and integrated in and with different phases of the ICPS Life Cycle, from e.g. design trough development, commissioning, deployment, operation and maintenance of the digitalized industrial environment.

Lehrinhalte

Applying the 5 Mayer principles and the standard IEC 62890, the students will learn, using examples and case studies from real industrial ICPS, the product and production system engineering life cycle with the value streams it contains. Life cycles in various dimensions that are of relevance to the engineering of ICPS will be studied, such as e.g.: (i) Product; (ii) Production Order; (iii) Factory: A factory also has a life cycle, it is financed, planned, constructed and recycled. A factory integrates production systems and machines from various manufacturers; and (iv) Machine: A machine is ordered, designed, commissioned, operated, serviced, converted and recycled. The students will learn how to deal with a consistent data model during the whole life cycle of an ICPS and how to combine value chain for types and instances of ICPS in a unique model. Engineering Methods, based on High-level Petri Nets Theory, Queue Theory, Process Algebra and Functional Analysis, for modelling, qualitative and quantitative analysis, validation and prototype implementation of ICPS will be learnt by applying them to real industrial ICPS case studies.

Literatur

- Jamshidi, M.: Systems of Systems Engineering. Principles and Applications. CRC Press, Taylor & Francis, Group, Boca Raton, 2009.
- IEC CD 62890: IEC 62890: Life-cycle management for systems and products used in industrial-process measurement, control and automation.
- Maier, M.: Architecting principles for systems-of-systems. John Wiley and Sons, 1998.
- Towards a European Roadmap on Research and Innovation in Engineering and Management of Cyber-Physical Systems of Systems. Available: www.cpsos.eu.
- Murata, T.: Petri Nets: Properties, Analysis and Applications. Proceeding of IEEE 89.
- Fokkink, W.: Introduction to Process Algebra. Springer Verlag 2007.
- Adan, I., J. Resing: Queueing Systems. Department of Mathematics and Computing Science, Eindhoven University of Technology, The Netherlands.
- Groote, J.F., M.R. Mousavi: Modeling and Analysis of Communicating Systems. MIT Press, 2015.

Lehrveranstaltungen

Dozent	Titel der Lehrveranstaltung	SWS
A. W. Colombo	Seminar "Life Cycle Engineering of ICPS"	1,0
G. Veltink	Mathematical Modelling of ICPS	2,0