Werner Damm

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Prof. Werner Damm holds the Chair for Safety Critical Embedded Systems at the Carl von Ossietzky University of Oldenburg. He is the Scientific Director of the Transregional Collaborative Research Center AVACS (SFB/TR 14 Automatic Verification and Analysis of Complex Systems), the Director of the Interdisciplinary Research Center on Critical Systems Engineering for Socio-Technical Systems. He is a member of acatech, the German National Academy of Science and Engineering. Currently he is engaged as a director in the working group “highly automated systems” and, in the framework of acatech pushing on autonomous driving.

He is a member of the Board of Directors of the Applied Research Institute OFFIS, and the Chairman of the German competence cluster SafeTRANS, integrating leading companies and research institutes in the transportation domain, the co-founder and member of the steering board of the European Institute for Complex Safety Critical Engineering EICOSE, the Chairman of the Artemis Working Group Tool Platforms.

Werner Damm has been a member of various expert groups of the European Commission and the US National Science Foundation, notably on the topics of future strategies for Systems-of-Systems in Europe, and on Cyber-Physical Systems in the Transportation domain in the US.

His recent foundational research addresses mathematical models of embedded systems, systems-of-systems, and cyber physical systems, specification languages, hybrid systems, formal verification methods, formal synthesis, and real-time and safety analysis. This is complemented by applied research with industrial partners in avionics, automotive, space, and medical systems on system-and-safety development processes for safety related systems, where he pioneered contract-based systems engineering for functional requirements, safety and timeliness requirements, and stability requirements, the use of patterns for capturing such contracts, and tools for automatic test generation, consistency checking, and virtual integration testing based on formalized contracts.

Abstract: Beyond Crystal - A Metamodel for Systems of Cyber-Physical Systems

Cyber-Physical Systems (CPS) integrate systems and products perceiving, analyzing, and acting upon their environment in a highly automated way (smart systems), with cloud-based services, in order to address societal and business needs. Systems of Cyber-Physical Systems connect millions of such smart physical systems and humans with the Web for building solutions to societal challenges touching almost any aspect of our life. They constitute a core technology in the ongoing process of digitization of our society, creating a global market of several trillion US $. The sheer scale of CPS-based business opportunities has created a momentum that is completely changing the market dynamics, through penetration of traditionally separated market segments. The holistic approaches made possible through CPS enable smart-energy management, smart transportation, smart production and manufacturing, smart cities, smart healthcare management, smart logistics ... and thus promise to solve key societal challenges. Yet the area lacks the maturity of established engineering and scientific disciplines making it possible to predict properties of the constructed systems from their blueprints. It also lacks scalable principles of combining large heterogeneous ensembles of physical systems, humans, and cyber-systems while assuring that their emergent properties and behaviors meet the overall system objectives within quantifiable tolerances. In short: we are about to make our society completely dependent on a technology, whose risks have been insufficiently reflected upon.

The talk will present a metamodel for systems of cyber-physical systems, which allows to express and reason about major risks classes in failing to achieve the overarching objectives of the system, as well as to analyze trade-offs in restricting the degrees of freedom of individual actors to optimize global objectives.

The talk is based on joint research with Alberto Sangiovanni-Vincentelli, UCB.