

Modeling, Analysis and Design of Critical Systems

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Abstract

Our work on critical systems targets a number of problem areas and applications, all requiring the development of models for analysis and verification, and tools for decision making. This talk focuses on four different problem areas, each requiring a different modeling framework and solution approach.

We begin by exposing our new Petri nets modeling framework, Extended Timed Petri Nets (ETPN), useful in modeling a special class of hybrid systems, with a weak continuous component and a strong discrete one, encountered when dealing with modern man-made, embedded and real-time systems. We discuss a supervisory control problem based on this framework, along with other related issues dealing with model transformation and complexity.

Our second problem addresses operating high-demand and high-performance virtualized data centers (DCs). We focus on the development of tools, based on operations research models and techniques, for the management of these DCs, while striving to improve user applications performance and productivity. We focus on the problem of virtual machines (VMs) placement in geographically distributed data centers. We consider communicating VMs assigned to data centers that are connected via a backbone network. We aim to plan and optimize the placement of VMs in data centers so as to minimize the IP-traffic within the backbone network along with user service interruption.

Our third problem deals with security and in computer systems, services and protocols. We use the property of opacity to capture secrecy-related problems. We focus on the development of an on-line method for the efficient verification of opacity in models based on automata. We also extend opacity with the introduction of a quantification measure.

Our fourth problem deals with sensor networks and their use in precision agriculture. We show that the development of application-oriented infrastructure management techniques, such a routing protocols, is important for modern Fog/IoT networks.

Throughout our talk we discuss several research perspectives and applications linked to modern technologies, such as IoT, Web Services and Cloud/Fog computing.