Reconfigurable Petri Nets: Modeling and Analysis

Julia Padberg

Hamburg University of Applied Sciences, Germany

Abstract
The results of the research group forMA$_\ell$NET (funded by the German Research Council 2006-2012) on reconfigurable Petri nets are presented in this talk. We introduce a family of modeling techniques consisting of Petri nets together with a set of rules. For reconfigurable Petri nets not only the follower marking can be computed but also the structure can be changed by rule application to obtain a new net that is more appropriate with respect to some requirements of the environment. Moreover, these activities can be interleaved. For rule-based modification of Petri nets we use the framework of net transformations that is inspired by graph transformation systems. The basic idea behind net transformation is the stepwise modification of Petri nets by given rules. The rules present a rewriting of nets where the left-hand side is replaced by the right-hand side.

Motivation for this family of formal modeling techniques is the observation that in increasingly many application areas the underlying system has to be dynamic in a structural sense. Complex coordination and structural adaptation at run-time (e.g. mobile ad-hoc networks, communication spaces, ubiquitous computing) are main features that need to be modeled adequately. The distinction between the net behavior and the dynamic change of its net structure is the characteristic feature that makes reconfigurable Petri nets so suitable for systems with dynamic structures.

In this talk we first motivate the use of reconfigurable Petri nets and present their basic ideas. The concepts are discussed and are then given mathematically. We employ the notion of high-level replacement systems extensively to obtain rules and transformations of place/transition nets. These notions are then exemplified in a case study modeling scenarios of the *Living Place Hamburg*. Living Place Hamburg can be considered as a system of ubiquitous computing and ambient intelligence. Scenarios of the Living Place are modeled using reconfigurable place/transition nets providing a formal model of the internal system behavior of this system, so that this model helps us to improve our understanding of the modeled system. Subsequently we extend the theory to algebraic high-level nets, this employs again high-level replacement systems with nested application conditions as well as a individual token approach. These new concepts are illustrated and discussed in the case study *Skype* at length. The analysis of *Skype* as a concrete and typical existing Communication Platform is an example for a modeling methodology for Communication Platforms using an integrated modeling approach based on algebraic higher order nets.

The talk is concluded with a discussion of further results.