PNPM'97 Tutorial

Approximate Methods based on Net-Driven Decompositions

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Description of the tutorial

A major drawback for the practical use of stochastic Petri net models lies in the state explosion problem originated when the exact solution of the associated continuous time Markov chain is achieved. This tutorial presents some ideas an examples on approximation techniques that try to overcome the state explosion problem within a divide and conquer strategy and with a strong exploitation of structural (qualitative) knowledge of the underlying Petri net model for both the decomposition and the solution phases.

The organization of the tutorial will be the following:

1. Principles of approximation techniques based on decomposition.

   First some general considerations on decomposition techniques are introduced. In particular, the following steps are identified in the analysis process:

   - Partition of the system into subsystems. The step includes the definition of rules for decomposition and the consideration of logical (qualitative) properties that must or can be preserved.
   - Characterization of subsystems. Definition of unknowns and inclusion of variables. Decisions related with consideration of mean values or higher order moments of involved random variables. Need of an skeleton (high level view of the model) and characteristics considered in it.
   - Estimation of the unknown parameters. Writing equations among the unknown parameters. Definition of the fixed point equation and considerations on existence and uniqueness of solution. Computational algorithm for solving the fixed point equation. Implementation aspects. Convergence aspects.

2. A technique with non-product form subsystems and product form skeleton.

   Description of the technique derived by Baynat and Dallery that can be applied when the model admits a decomposition with product form skeleton but non-product form subsystems.

3. A technique with non-product form subsystems and non-product form skeleton.

   Description of the techniques presented by Campos, Silva et al. for the solution of models that do not admit a decomposition with product form subsystems or product form skeleton.

4. Final comments and forthcoming research efforts.

   Some reflections on the practical use of decomposition techniques. The problem of the bad quality of temporal abstraction (in comparison to qualitative or logical abstraction). The need of a hierarchical approach with the possibility of using different techniques at each abstraction level.

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