Quantitative
Modeling
In
Parallel
Systems

Part 2
Structural, Temporal and Stochastic Properties of Unbounded Free-Choice Petri Nets

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Abstract In this paper, we show how a decomposition of a free choice Petri net into a "routing" network and marked graph subnetworks (i.e. linear subnetworks in the [max, +] setting) leads to new methods and algorithms to test structural as well as temporal properties of the net. The paper primalily focuses on the class of SI-free choice nets, defined in the paper. We show how this decomposition in linear subnets allows to:

- (in the untimed case) check liveness in polynomial time;
- (in the timed case) establish evolution equations which allow to represent the system as a coupling of two linear systems, one $(\min, +)$-linear, and the other $(+, \times)$-linear;
- (in the stochastic case) check stability, i.e. the fact that the marking remains bounded in probability.

The main tools for proving these properties are graph theory, exotic algebras and ergodic theory.