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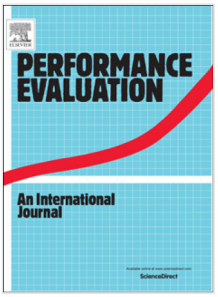

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PII: S0166-5316(17)30090-1
DOI: http://dx.doi.org/10.1016/j.peva.2017.03.001
Reference: PEVA 1894

To appear in: *Performance Evaluation*

Received date: 7 October 2015
Revised date: 12 February 2017
Accepted date: 4 March 2017

Please cite this article as: S. Distefano, F. Longo, M. Scarpa, Marking dependency in non-Markovian stochastic Petri nets, *Performance Evaluation* (2017), http://dx.doi.org/10.1016/j.peva.2017.03.001

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Marking Dependency in non-Markovian Stochastic Petri Nets

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Abstract

Marking dependency is a powerful tool that allows different firing time distributions to be associated with a stochastic Petri net transition, depending on the marking. Through this feature, the modeler can easily and compactly represent advanced properties and behaviors of the system. While a semantics and specific solution techniques have been provided for generalized stochastic Petri nets thus covering homogeneous Markovian aspects, in the non-homogeneous/non-Markovian case marking dependency still needs to be investigated. To fill this gap, this paper provides a formalization of marking dependent semantics in non-Markovian stochastic Petri nets (NMSPNs) and a solution technique, based on phase type distributions and Kronecker algebra, able to deal with such a feature allowing both transient and steady-state analyses. To motivate the actual need of marking dependency in NMSPN modeling and to demonstrate the potential of such a feature as well as the validity of the proposed solution technique a case study on a multi-core CPU system with power management facilities is explored.

Keywords: Marking dependency, non-Markovian stochastic Petri nets, phase type distributions, Kronecker algebra, power management, multi-core CPUs.

1. Introduction

Markovian models have been widely used to represent complex systems and quantitatively analyze their non-functional properties. Their success is due to the modeling expressiveness and the effectiveness of the corresponding analysis methods. However, nowadays, information and communication technologies (ICT) aim at automating, enhancing, and improving processes and systems towards higher quality standards, while there are several real phenomena for which the Markovian memoryless assumption does not hold. For example, different activities and events in complex systems (e.g., timeouts, control signals, exceptions) have to be stochastically represented by non-exponentially distributed

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