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Towards an Efficient Structural Analysis of Colored Petri Nets

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Abstract

This paper presents the *Backward reachability* which is a structural analysis method applicable to Colored Petri Nets (CPN). This method avoids the fastidious computation of simulation and the combinatorial explosion of reachable state space. The *backward reachability* provides the information about different ways of reaching a particular CPN marking. This evaluation considers the evolution of markings participating in each sequence leading to the desired state. The analysis is performed on an *inverse CPN* which is obtained by transforming original CPN according to given inversion rules. The work develops the rules allowing the definition of inverse CPN and presents some transformations that contribute to the analysis speed up. The main advantage of this method is that it allows to determine the sequence leading from any initial state to a given final marking without investigating all possible sequences.

Key words: Petri Nets, Backward Reachability, Model Analysis

1 Introduction

Modern systems (hardware/software) integrate an ever increasing amount of components. Their goal is to enlarge the range of proposed functions and thus make the product more attractive to the consumer. The second objective is to be able to propose new product versions by updating the fewest system part. When applied to critical domain, such as car driver protection or airplane collision warning, the system has to respect required dependability criteria. For this reason formal methods appear as early as the initial system design specification. It is in this context that the presented work applies a formal method approach to system modelling and analysis.

This study is interested on Petri Nets (PN) [13], and especially, Colored Petri Nets(CPN) [7]. They are considered as a powerful and recognized modelling tool. They are endowed with a big expressiveness and allow to represent the two aspects of a system: static thanks to the PN structure and dynamic thanks to the token evolution [1]. The PN analysis can be done in several manners: exhaustive reachable state space enumeration, simulation, structural analysis, etc. These methods allow to study request/action effects on the model behavior. Usually, the performed analysis is the forward one. That means, by knowing an initial state, possible final states are calculated. This is particularly adapted to the studies of performances and the quality of service (QoS) of systems. But, it is not adapted to find sources of some particular final states which can represent a system erroneous state. In such analysis, all possible initial configurations must

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