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Original Articles

Coloured Petri net scheduling models: Timed state space exploration shortages

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Abstract

The paper deals with the problem of timed state space generation and exploration in the frame of simulation–optimization approach for discrete-event systems. Coloured Petri net representation of a system is considered and corresponding techniques of timed state space generation and timed simulation are addressed. It is shown that the established simulation techniques do not perform adequately in some application relevant examples since in general, only a subset of a timed state space of a simulated system is represented. Two examples are provided to illustrate the effect of timed state space reduction. While the optimal solution is preserved within the reduced state space in one example, in the second example this is not the case and the optimum is missed. This indicates that the timed simulation technique has to be carefully designed in order to be suitable for the simulation–optimization approach.

Keywords: Petri nets; Manufacturing systems; Simulation; Optimization

1. Introduction

The quest for increased productivity, flexibility and competitiveness in present manufacturing industries, has forced new production policies to improve the customer quality of service which consider not only the quality and the price of the final product, but also time-to-market aspects. Modelling and performance evaluation play a vital role in the operational decision making activity, to deal with the best configuration to satisfy customer orders. Unfortunately, the required flexibility to improve the key performance indicators leads to a considerable amount of decision variables that must be properly evaluated in order to deal with the best possible operation scenarios. The role of performance modeling is to aid the decision making in an effective way.

Coloured Petri nets (CPNs) are a powerful framework for discrete-event modelling, simulation and analysis. In contrast to most system description languages, CPNs are state and action oriented at the same time—providing an

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