APPROXIMATE PERFORMANCE ANALYSIS OF COMPUTING PROCESS BY AGGREGATED HSPN WITH FUZZY PARAMETERS

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One of the most widespread modern formalisms, used for the model-based performance and dependability evaluation of complex computing systems and networks, with discrete-continuous processes, are the fluid stochastic Petri nets (FSPN) [1] and the hybrid stochastic Petri nets (HSPN) [2] in which one or more finite places (buffers) can hold fluid rather than discrete tokens. However, an FSPN or HSPN model with $N \geq 3$ buffers cannot be exactly analyzed analytically [1, 2], thus justifying the development of approximation methods.

In this paper, is developed an approximate-aggregate method for performance analysis of $HSPN$ with fuzzy parameters model, called $FHSPN$, of a multiprocessing production pipeline (MPPL) system with $SV_i,\ i=1,2,\cdots,N$ servers and with finite storage capacity buffers b_i between them. The method consist in a decomposition of initial model into $FHSPN_i$, $i=1,2,\cdots,N-1$ sub-models, called dipoles, each consisting of an aggregate $u_{i,1}$ of arrival SV_i (resp. $u_{i,2}$ of departure SV_{i+1}) continuous timed transition and b_i buffer between them. Each $u_{i,1}$ and $u_{i,2}$ are controlled by the discrete part which contains only 2 places and 2 discrete timed transitions that render the active or passive state of $u_{i,1}$ and $u_{i,2}$. The quantitative attributes of $FHSPN_i$ are approximately aggregated from those of the initial $FHSPN$ model.

For performance analysis of dipoles and MPPL, a method is proposed whereby the average credible rates of the respective states change and the average credible processing speeds of the respective dipole servers are determined based on an iterative fixed-point algorithm to numerical evaluation of the specified performance indicators. The accuracy of the proposed method has been validated by numerical simulations experiments.

The approach described in the paper can be further generalized to study hybrid systems from domains with dynamically reconfigurable behavioral characteristics that are conditioned by specified events at the design stage.

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