This form is a summary description of the model entitled “Flexible Manufacturing System (FMS)” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.

Description

This Petri net is extracted a benchmark used for SMART. It models a flexible manufacturing system.
References

http://www.cs.ucr.edu/~ciardo/SMART/

Scaling parameter

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter description</th>
<th>Chosen parameter values</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>The scale factor is a value that changes the initial marking of places P1, P2 and P3 (M(P1)=M(P2)=M(P3)=N)</td>
<td>2, 5, 10, 20, 50, 100, 200, 500</td>
</tr>
</tbody>
</table>

Size of the model

Although the model is parameterized, its size does not depend on parameter values.

- number of places: 22
- number of transitions: 20
- number of arcs: 50

Structural properties

- ordinary — all arcs have multiplicity one
- simple free choice — all transitions sharing a common input place have no other input place
- extended free choice — all transitions sharing a common input place have the same input places
- state machine — every transition has exactly one input place and exactly one output place
- marked graph — every place has exactly one input transition and exactly one output transition
- connected — there is an undirected path between every two nodes (places or transitions)
- strongly connected — there is a directed path between every two nodes (places or transitions)
- source place(s) — one or more places have no input transitions
- sink place(s) — one or more places have no output transitions
- source transition(s) — one or more transitions have no input places
- sink transitions(s) — one or more transitions have no output places
- loop-free — no transition has an input place that is also an output place
- conservative — for each transition, the number of input arcs equals the number of output arcs
- subconservative — for each transition, the number of input arcs equals or exceeds the number of output arcs
- nested units — places are structured into hierarchically nested sequential units

- 2 arcs are not simple free choice, e.g., the arc from place “M2” (which has 2 outgoing transitions) to transition “tM2” (which has 2 input places).
- 9 transitions are not of a state machine, e.g., transition “tM1”.
- 5 places are not of a marked graph, e.g., place “P1”.
- 9 transitions are not conservative, e.g., transition “tM1”.
- 4 transitions are not subconservative, e.g., transition “tP12M3”.
- the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
Behavioural properties

**safe** — in every reachable marking, there is no more than one token on a place.

**deadlock** — there exists a reachable marking from which no transition can be fired.

**reversible** — from every reachable marking, there is a transition path going back to the initial marking.

**quasi-live** — for every transition \( t \), there exists a reachable marking in which \( t \) can fire.

**live** — for every transition \( t \), from every reachable marking, one can reach a marking in which \( t \) can fire.

Size of the marking graphs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of reachable markings</th>
<th>Number of transition firings</th>
<th>Max. number of tokens per place</th>
<th>Max. number of tokens per marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>( N = 2 )</td>
<td>3444 (^{(f)})</td>
<td>16,311 (^{(s)})</td>
<td>3 (^{(f)})</td>
<td>12 (^{(f)})</td>
</tr>
<tr>
<td>( N = 5 )</td>
<td>2,8950E+6 (^{(v)})</td>
<td>2,3527E+7 (^{(w)})</td>
<td>5 (^{(k)})</td>
<td>21 (^{(v)})</td>
</tr>
<tr>
<td>( N = 10 )</td>
<td>2,501E+9 (^{(e)})</td>
<td>2,7568E+10 (^{(aa)})</td>
<td>10 (^{(ab)})</td>
<td>36 (^{(ac)})</td>
</tr>
<tr>
<td>( N = 20 )</td>
<td>6,0292E+12 (^{(sc)})</td>
<td>8,1442E+13 (^{(sc)})</td>
<td>20 (^{(af)})</td>
<td>66 (^{(ae)})</td>
</tr>
<tr>
<td>( N = 50 )</td>
<td>4,2403E+17 (^{(sh)})</td>
<td>6,6135E+18 (^{(sh)})</td>
<td>50 (^{(aj)})</td>
<td>156 (^{(ak)})</td>
</tr>
<tr>
<td>( N = 100 )</td>
<td>2,7031E+21 (^{(al)})</td>
<td>?</td>
<td>100 (^{(am)})</td>
<td>306 (^{(an)})</td>
</tr>
<tr>
<td>( N = 200 )</td>
<td>1,9536E+25 (^{(ao)})</td>
<td>?</td>
<td>200 (^{(af)})</td>
<td>606 (^{(aj)})</td>
</tr>
<tr>
<td>( N = 500 )</td>
<td>2,7006E+30 (^{(ar)})</td>
<td>?</td>
<td>500 (^{(as)})</td>
<td>( \geq 1506 (^{(at)})</td>
</tr>
</tbody>
</table>

\(^{(o)}\) in the initial marking, some places have several tokens (the number of which depends on \( N \)).

\(^{(p)}\) stated at MCC’2014 by GreatSPN and Lola on all instances, and by Tapaal on 5 instances.

\(^{(q)}\) stated by CÆSAR.BDD version 2.0 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

\(^{(r)}\) computed at MCC’2013 by Alpina, GreatSPN, ITS-Tools, Marcie, Neco, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.

\(^{(s)}\) computed at MCC’2014 by Marcie.

\(^{(t)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(u)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(v)}\) computed at MCC’2013 by Alpina, GreatSPN, ITS-Tools, Marcie, Neco, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.

\(^{(w)}\) computed at MCC’2014 by Marcie.

\(^{(x)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(y)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(z)}\) computed at MCC’2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.

\(^{(aa)}\) computed at MCC’2014 by Marcie.

\(^{(ab)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(ac)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(ad)}\) computed at MCC’2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.

\(^{(ae)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(af)}\) computed at MCC’2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.

\(^{(ag)}\) computed at MCC’2014 by Marcie.

\(^{(ah)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(ai)}\) computed at MCC’2014 by Marcie.

\(^{(aj)}\) computed at MCC’2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, and PNXDD.

\(^{(ak)}\) computed at MCC’2014 by Marcie.

\(^{(al)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(am)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(an)}\) computed at MCC’2013 by GreatSPN, ITS-Tools, and Marcie; confirmed at MCC’2014 by GreatSPN and PNMC.

\(^{(ao)}\) computed at MCC’2014 by GreatSPN and PNMC.

\(^{(ap)}\) computed at MCC’2013 by ITS-Tools; confirmed at MCC’2014 by GreatSPN and PNMC.

\(^{(aq)}\) computed at MCC’2014 by GreatSPN and PNMC.

\(^{(ar)}\) computed at MCC’2014 by PNMC.

\(^{(as)}\) computed at MCC’2014 by GreatSPN and PNMC.

\(^{(at)}\) lower bound given by the number of initial tokens.