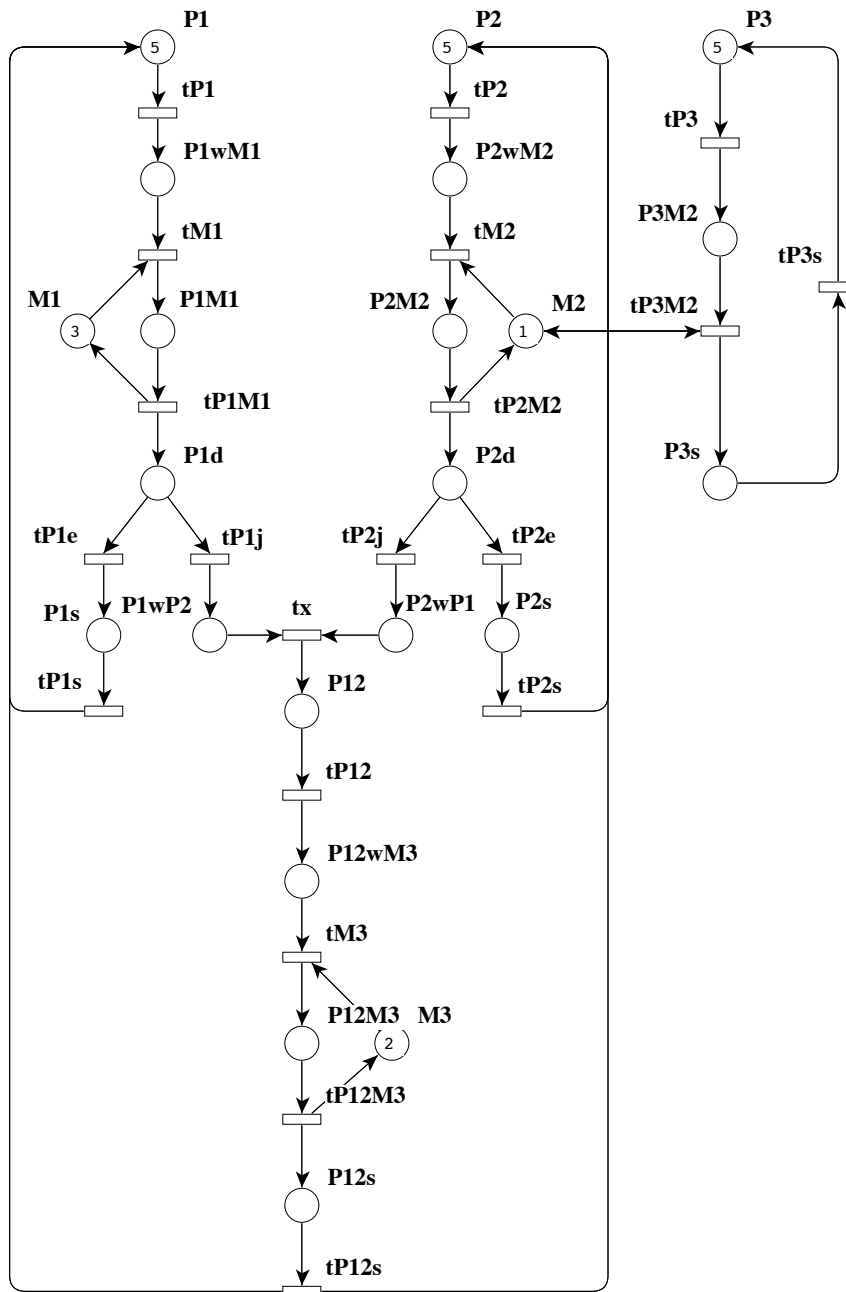


This form is a summary description of the model entitled "Flexible Manufacturing System (FMS)" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. 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

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

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* ✗ (a)
- extended free choice** — *all transitions sharing a common input place have the same input places* ✗ (b)
- state machine** — *every transition has exactly one input place and exactly one output place* ✗ (c)
- marked graph** — *every place has exactly one input transition and exactly one output transition* ✗ (d)
- connected** — *there is an undirected path between every two nodes (places or transitions)* ✓ (e)
- strongly connected** — *there is a directed path between every two nodes (places or transitions)* ✓ (f)
- source place(s)** — *one or more places have no input transitions* ✗ (g)
- sink place(s)** — *one or more places have no output transitions* ✗ (h)
- source transition(s)** — *one or more transitions have no input places* ✗ (i)
- sink transitions(s)** — *one or more transitions have no output places* ✗ (j)
- loop-free** — *no transition has an input place that is also an output place* ✗ (k)
- conservative** — *for each transition, the number of input arcs equals the number of output arcs* ✗ (l)
- subconservative** — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ✗ (m)
- nested units** — *places are structured into hierarchically nested sequential units⁽ⁿ⁾* ✗

(a) 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).

(b) transitions “tM2” and “tP3M2” share a common input place “M2”, but only the former transition has input place “P2wM2”.

(c) 9 transitions are not of a state machine, e.g., transition “tM1”.

(d) 5 places are not of a marked graph, e.g., place “P1”.

(e) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(f) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(g) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(h) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(i) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(j) stated by [CÆSAR.BDD](#) version 1.7 on all 8 instances (2, 5, 10, 20, 50, 100, 200, and 500).

(k) transition “tP3M2” is not loop free.

(l) 8 transitions are not conservative, e.g., transition “tM1”.

(m) 4 transitions are not subconservative, e.g., transition “tP12M3”.

(n) 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* ✗^(o)
deadlock — *there exists a reachable marking from which no transition can be fired* ✗^(p)
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* ✓^(q)
live — *for every transition t , from every reachable marking, one can reach a marking in which t can fire* ?

Size of the marking graphs

Parameter	Number of reachable markings	Number of transition firings	Max. number of tokens per place	Max. number of tokens per marking
$N = 2$	3444 ^(r)	16 311 ^(s)	3 ^(t)	12 ^(u)
$N = 5$	2.8950E+6 ^(v)	2.3527E+7 ^(w)	5 ^(x)	21 ^(y)
$N = 10$	2.501E+9 ^(z)	2.7568E+10 ^(aa)	10 ^(ab)	36 ^(ac)
$N = 20$	6.0292E+12 ^(ad)	8.1442E+13 ^(ae)	20 ^(af)	66 ^(ag)
$N = 50$	4.2403E+17 ^(ah)	6.6135E+18 ^(ai)	50 ^(aj)	156 ^(ak)
$N = 100$	2.7031E+21 ^(al)	?	100 ^(am)	306 ^(an)
$N = 200$	1.9536E+25 ^(ao)	?	200 ^(ap)	606 ^(aq)
$N = 500$	2.7006E+30 ^(ar)	?	500 ^(as)	≥ 1506 ^(at)

- ^(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 Marcie.
^(af) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ag) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ah) computed at MCC'2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and PNXDD.
^(ai) computed at MCC'2014 by Marcie.
^(aj) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ak) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(al) computed at MCC'2013 by GreatSPN, ITS-Tools, and Marcie; confirmed at MCC'2014 by GreatSPN and PNMC.
^(am) computed at MCC'2014 by GreatSPN and PNMC.
^(an) computed at MCC'2014 by GreatSPN and PNMC.
^(ao) computed at MCC'2013 by ITS-Tools; confirmed at MCC'2014 by GreatSPN and PNMC.
^(ap) computed at MCC'2014 by GreatSPN.
^(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.