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Automated multi-paradigm analysis of extended and layered queueing models with LINE

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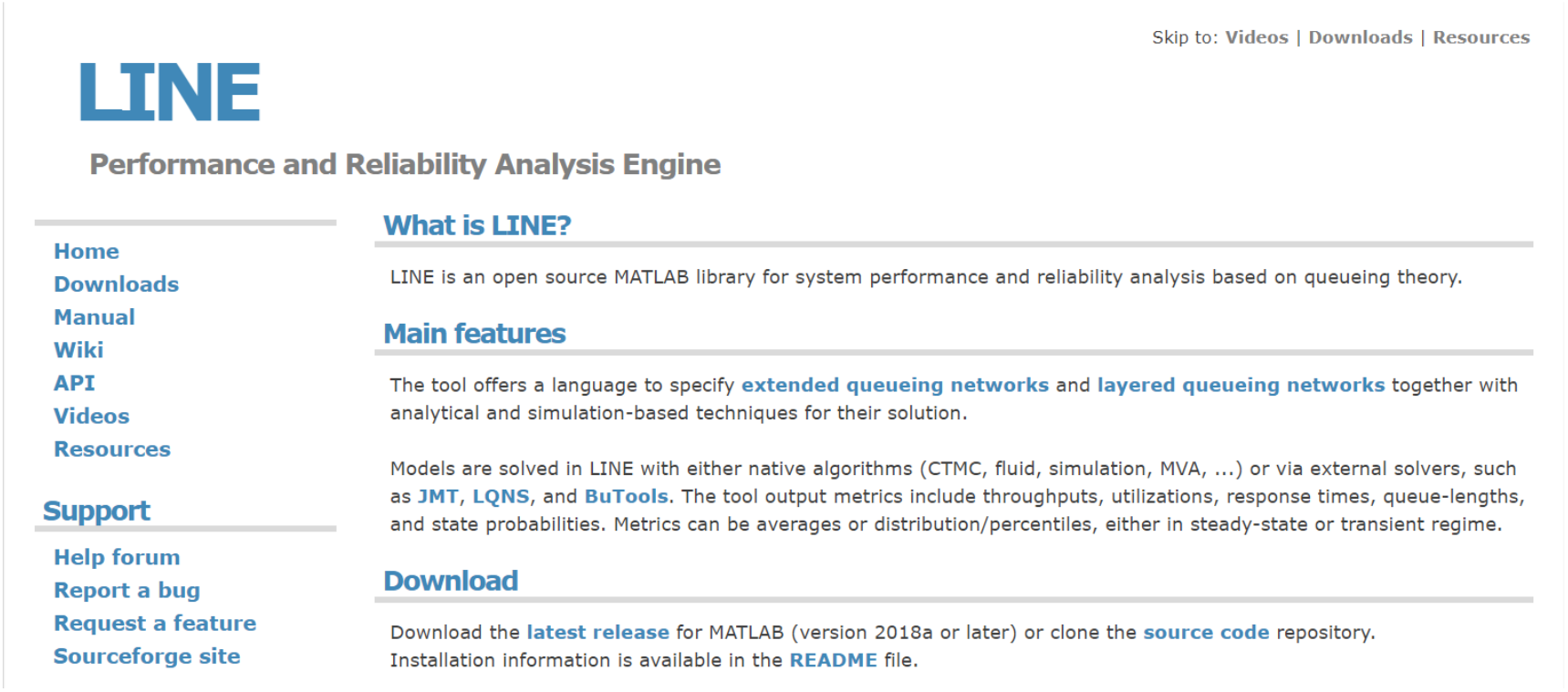
LINE Solver (line-solver.sf.net)

- MATLAB library for system performance and reliability analysis based on queueing theory
- Ver 2.0.0: Major tool overhaul and refactoring



What's new

I. Object-oriented language to model extended and layered queueing networks (EQNs / LQNs)
II. Model specification fully decoupled from analysis paradigm
III. Seamless integration with JMT, LQNS, BuTools solvers

Line in numbers:

- 40+ algorithms
- 13 types of analyses
- 13 sched./routing strategies
- 100+ lang. classes
- 14 node types
- 4 metrics

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JMT Integration

Seamless two-way integration:

- Define a model in MATLAB, visualize it in JMT
- Define a model in JMT, auto-generate LINE script

MATLAB R2018a - academic use

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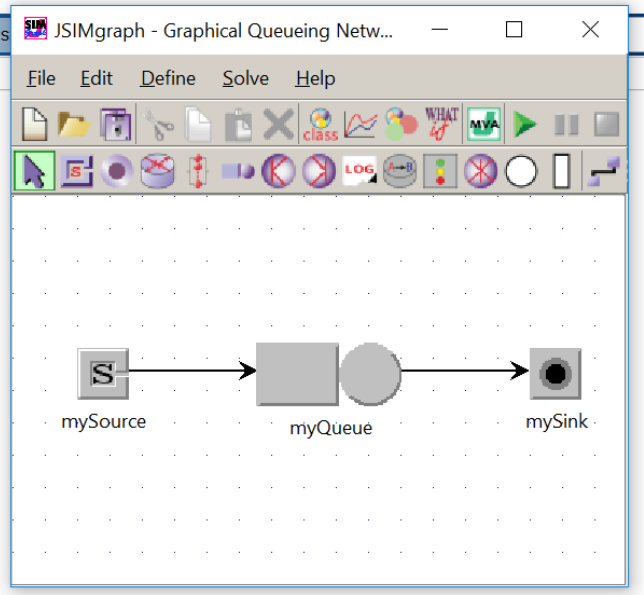
```
>> model = Network('M/M/1');
source = Source(model, 'mySource');
queue = QueueingStation(model, 'myQueue', SchedStrategy.FCFS);
sink = Sink(model, 'mySink');
oclass = OpenClass(model, 'myClass');
source.setArrival(oclass, Exp(1));
queue.setService(oclass, Exp(2));
model.link(Network.serialRouting(source,queue,sink));
SolverJMT(model).getAvgTable
ans =
  2×6 table
    Station        Class        QLen        Util        RespT       Tput
    ___________    _________    ________    ________    ________    _______
    'mySource'     'myClass'         0           0           0     0.99694
    'myQueue'      'myClass'     0.90717     0.49595     0.98731     0.99547
>> model.jsimgView
JMT Model: C:\Users\csg\AppData\Local\Temp\jsimg\tp187cd49a_9e52_4d4a_9b55_a4c0dc0a0bf8.jsimg
```



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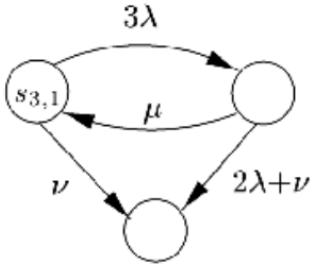
EQN Analysis

Continuous-Time Markov Chains

SolverCTMC(**model**).getAvg



Fluid ODEs

SolverFluid(**model**).getAvg

$$\frac{d\boldsymbol{x}(t)}{dt} = F(\boldsymbol{x}(t)), t \geq 0,$$

Java Modelling Tools

SolverJMT(**model**).getAvg

Mean-Value Analysis

SolverMVA(**model**).getAvg

$$Q_i(N-1) = \frac{N-1}{N} Q_i(N)$$

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EQN Analysis

Matrix-Analytic Methods

SolverMAM(**model**).getAvg

$$P = \begin{pmatrix} B_0 & B_1 & B_2 & B_3 & \cdots \\ A_0 & A_1 & A_2 & A_3 & \cdots \\ & A_0 & A_1 & A_2 & \cdots \\ & & A_0 & A_1 & \cdots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$$

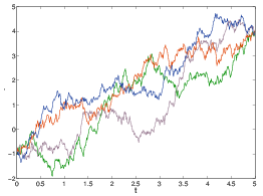
Normalizing Constant

SolverNC(**model**).getAvg

$$Q_i(N-1) = \frac{N-1}{N} Q_i(N)$$

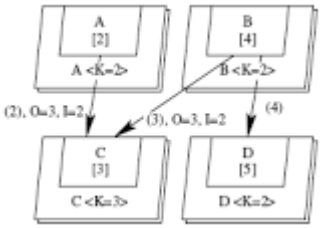
Stochastic Simulation

SolverSSA(**model**).getAvg



LQNS/LQSIM

SolverLQNS(**lqnmodel**).getAvg



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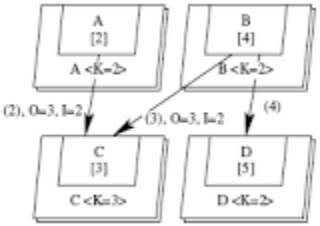
Parametric Solvers (LQN, Rand. Env.)

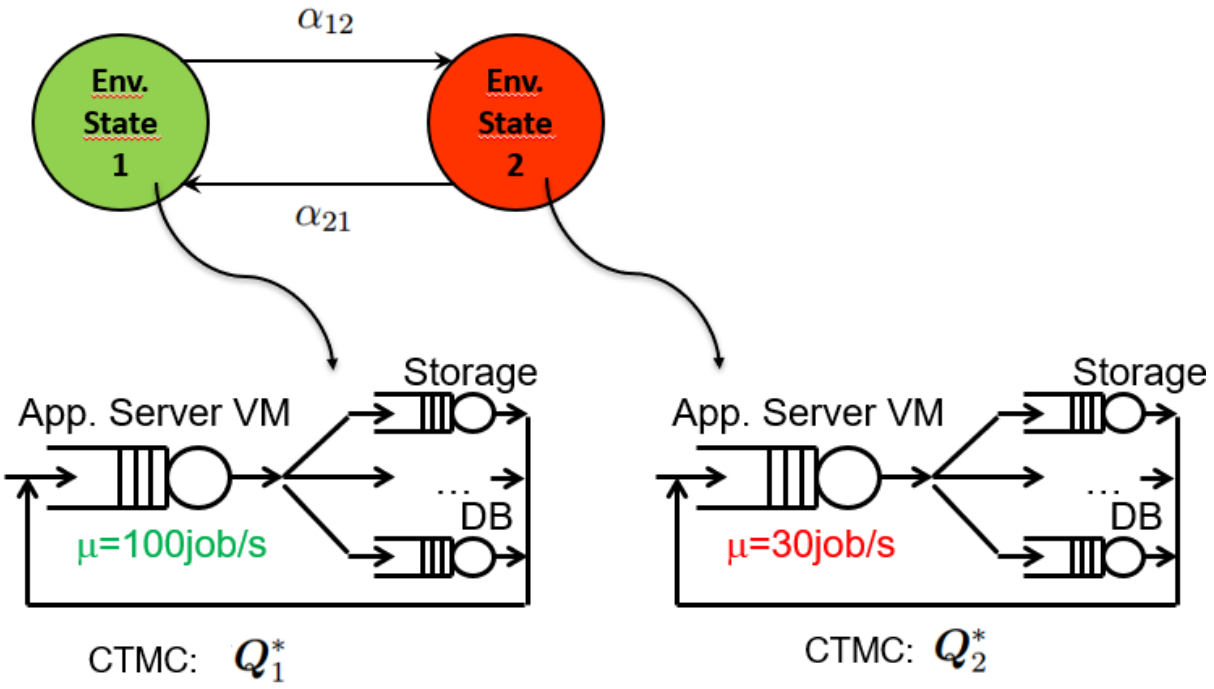
Line Layered Solver

SolverLN(**model**, @(**layer**) SolverJMT(**layer**))



SolverEnv(**models**, **env**, @(**submodel**) SolverFluid(**submodel**))

Random Environments



Demos

1. A M/M/1 queue
2. A multiclass M/G/1 queue
3. Machine interference problem
4. Round-robin load balancing
5. Modelling a re-entrant line
6. A queueing network with caching
7. Response time distribution and percentiles
8. Optimizing a performance metric