BACHELOR FINAL PROJECT

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Department of Mechanical Engineering
Systems Engineering Group

Student

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Title Dynamics of an Abstract Overflow Processing Network: The Discrete Case

Subject
Consider an abstraction of a production network: N nodes are numbered $1, \ldots, N$. Each node is equipped with a finite buffer of capacity K_i and with a processor which works at rate μ_i. Discrete jobs arrive to the nodes according to rates α_i. When a job arrives to node i and finds less than K_i jobs, it queues up and awaits processing. Jobs processed at node i can either leave the system or move to other nodes. Routing is probabilistic according to the proportions p_{ij} (the proportion of material leaving i which goes to j). We have $\sum_j p_{ij} \leq 1$.
When a job arrives to find a full buffer it is diverted (overflows) according to propositions q_{ij} similarly to the p_{ij}. Thus in general, the parameters of the model are the N dimensional vectors of K_i, μ_i and α_i and the $N \times N$ matrices of p_{ij} and q_{ij}. This system has been well studied for the non-overflow case in which the buffer sizes are infinite ($K_i = \infty$), in this case it is typically called a ”Jackson Network”.
A previous BEP project by Stijn Fleuren characterized the behavior of such a system for the case of continuous deterministic material flow. The purpose of this project is to use simulation experiments to see how the continuous system can be used to approximate a discrete stochastic system. A key question is to see how to scale the system parameters such that flow rates and sojourn times of the stochastic system are well approximated by the discrete system.

Assignment
The purpose of the project is to write a χ-simulation program which generates trajectories of $X(t)$ given the system parameters and the initial conditions. Writing such a program may first require understanding the basic mathematics of this network model.

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