BACHELOR FINAL PROJECT

EINDHOVEN UNIVERSITY OF TECHNOLOGY
Department of Mechanical Engineering
Systems Engineering Group

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Student

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| Start | April 2010 |
| Finish | July 2010 |
| Title | Dynamics of an Abstract Overflow Processing Network |

Subject

Consider an abstraction of a material processing network: $N$ nodes are numbered $1,\ldots,N$. Let $i$ and $j$ denote generic indexes of nodes. Each node is equipped with a finite buffer of capacity $K_i$ and with a processor which works at rate $\mu_i$. Material is modeled as a continuous flow and arrives to the nodes according to rates $\alpha_i$. When material arrives to node $i$ and finds less than $K_i$ in the buffer then it either enters the buffer or is immediately processed if the buffer is empty. Material which is processed at node $i$ can either leave the system or move to other nodes. This follows the proportions $p_{ij}$ (the proportion of material leaving $i$ which goes to $j$). We have $\sum_j p_{ij} \leq 1$; in case the inequality is strict, the remaining material leaves the system.
When material 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 $K_i$, $\mu_i$ and $\alpha_i$ and the $N \times N$ matrixes of $p_{ij}$ and $q_{ij}$.
The state of this system can be represented by an $N$ dimensional vector $X(t)$, with $t \geq 0$ being a continuous time index. It is quite interesting to understand how the state evolves with time. It is further interesting to see if there is steady state behavior, and if so to quantify it in terms of the system parameters. In general, several aspects of this question are still open research question. Understanding the basics of such networks may be useful for the analysis and control of complex service and manufacturing systems.

Assignment

The purpose of the project is to write a simulation program (in either Mathematica, Maple or MATLAB) 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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