Introduction to Discrete Event Simulation

1 Elevator System

In this assignment you are asked to use MATLAB to model a three floor elevator system. The model should consist of the following elements:

Elevator: The distance between floors is d and the elevator has a jerk

$$j = \frac{da}{dt} = \frac{d^2x}{dt^2} = \frac{d^3s}{dt^3}$$

bounded by a given constant $|j| \leq K$. Given the distance and the jerk the elevator should move between floors in the minimum time. Moreover the elevator should have an embedded logic of how to select the next floor by taking into consideration different factors like the current floor(s) and the state of all the buttons at the different floors.

People Inside: There should be a matrix that carries information about people that are inside the elevator, their floor destination and the time they have entered the system. The number of people inside the elevator should be less than a predefined number C.

People Outside: The people outside of the elevator could be modeled by a 3x3 matrix where represents people that are in floor i and want to go to floor j. The diagonal entries of this matrix are 0. The arrival of people in each floor and for each direction, should follow a Poisson process with arrival rate λ, which for simplicity here will be the same for each matrix entry.

Internal Buttons: Three buttons will be used to model the possible destinations of the elevator. One button for each floor will exist and will have the value true if someone has that floor as a destination.

External Buttons: There will be two (up, down) buttons on each floor in order to model the requests made to the elevator.

2 Problems

1. Create a simulation of the elevator system using an event driven technique. A good place to start is reading the paper (especially parts 2,3 and 4) "Event-Driven Modeling and Simulation of an Digital PLL". You may use Matlab by default or any other modeling tool of your choice.
2. Estimate, using the simulation, the total average time a person needs to go to his destination. The total time consists of the waiting time in the queue of a floor and the time spent inside the elevator. The average should be provided per starting and destination floor.
3. Experiment with the parameters: λ, C, K and d to see how the wait times are affected.
4. Experiment with different policies for the next floor selection algorithm.
5. **Extra Credit**: Model multiple elevators and see what happens to wait times as a function of the number of elevators.