

EE249 Homework 4

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*Goal of HW4 is to model hybrid systems in HyVisual and architectures in Metropolis. **General Comments:** an answer to a problem is neither right nor wrong (but there are exceptions of course). I would rather consider your homework as solutions to design problems. I could argue that your solution is inefficient and you could argue the same about mine. Grade is established mostly on the reasoning that you follow to answer the questions. Hence it is in your interest to justify your claims. You can use any kind of sources as long as you include references.*

Problem 1: We want to build a simplified model of an elevator. As you may have noticed there is a specific pattern that the elevator follows to go from one floor to another. After you step in the elevator and the doors close, it starts increasing its speed until a cruise speed is reached. When the distance to the destination is smaller than a certain value, the speed decreases until a landing speed is reached and finally the elevator stops at the desired floor.

We can define few parameters. To reach the cruise speed the elevator moves with a constant acceleration equal to $a = 0.5g$ where $g = 9.81m/s^2$. The cruise speed is $v_c = 4km/h$. The braking distance (the distance needed by the control algorithm to stop the elevator) is $x_b = 1m$. Finally the landing speed is $v_l = 0.1m/s$.

The behavior of the elevator and control algorithm can be informally described as follows. The elevator waits a new command of the form "go to position x_T ". During this phase the acceleration and the speed are $\ddot{x} = 0, \dot{x} = 0$. When the command is issued the system changes the state and goes to an acceleration state where the new equations are $\ddot{x} = a$. Two things may happen:

- the cruise speed is reached: then the system has to go in the cruise state where the new equation is $\ddot{x} = 0$, namely constant speed.
- the distance of the elevator from the target is less than or equal to the braking distance and the speed is less than the cruise speed: then the system has to go directly to the deceleration state. This means that the target position was so close to the starting position that the elevator didn't have time to reach the cruise speed.

If the distance to the destination becomes smaller than or equal to the braking distance while the elevator is cruising, the elevator has to decelerate.

When the speed drops down to the landing speed, the elevator has to move with constant speed v_l until the target is reached (within a tolerance that you can decide), and finally has to stop (ideally the speed can go to zero in zero time, in practice this cannot happen).

QUESTION 1.1: describe an hybrid model of the system that I have informally explained.

QUESTION 1.2: build such a model using HyVisual and plot position and speed of the elevator to go from position 0.0 to position 10m and from position 10m to $-5m$.

Problem 2: Complete the example we started during lab session. Download the files at:

<http://www-cad.eecs.berkeley.edu/~polis/class/ee249/labs/lab6/ee249lab6.zip>

You need to:

- write the code of `CpuScheduler`
- write the top level scheduling and scheduled netlist
- fill up the code on all other objects that are incomplete

The results that you have to produce are the following:

RESULT 2.1: one trace of start and end of `execution3`;

RESULT 2.2: average delay in the execution of `execution3`.