EL2450 Homework 2

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1 Rate Monotonic scheduling

Task 1: Explain what Rate Monotonic scheduling means.
In Rate Monotonic scheduling, each task is given a fixed priority based on its task rate. The task with the highest priority is then run at all times.

Task 2: Are the three tasks schedulable?
Calculating the utilization factor U from

$$U = \sum_{i=1}^{n} \frac{C_i}{T_i} = \frac{6}{20} + \frac{6}{29} + \frac{6}{35} = 0.68 \tag{1}$$

To be schedulable, the condition

$$U \leq n(2^{\frac{1}{n}} - 1), \tag{2}$$

where n is the number of processes. Calculating for this example with 3 tasks, the condition becomes

$$0.68 \leq 3(2^{\frac{1}{3}} - 1) = 0.78 \tag{3}$$

which holds, therefore the taskset is schedulable with RM scheduling.

Task 3: What are the differences in control performance between the different pendulums?
All pendulums are asymptotically stable and have similar control performance. The performance is shown in Figure 1.

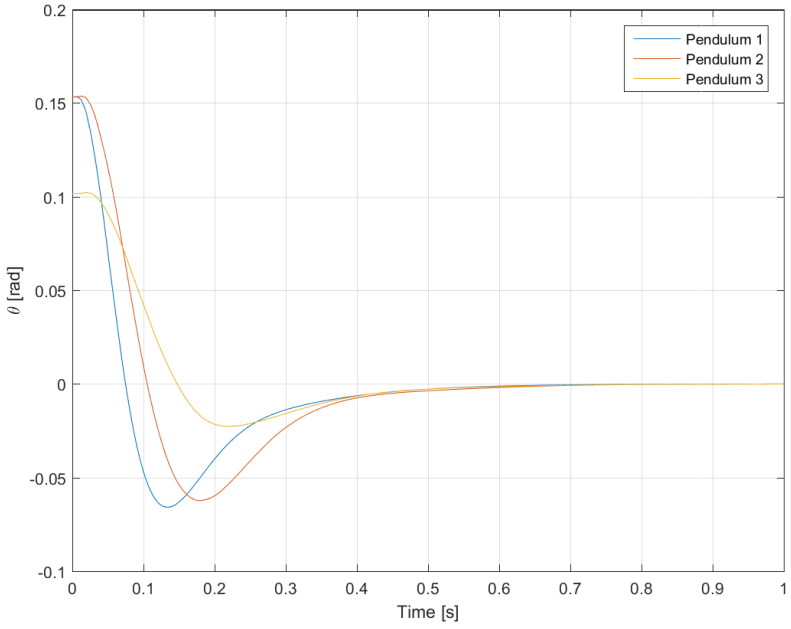

Figure 1: Performance of pendulums under rate monotonic scheduling.

Task 4: Compare against the schedule in the model. Does it match?
As can be seen below in Figure 2, the schedules match. The tasks are schedulable as stated in q2.

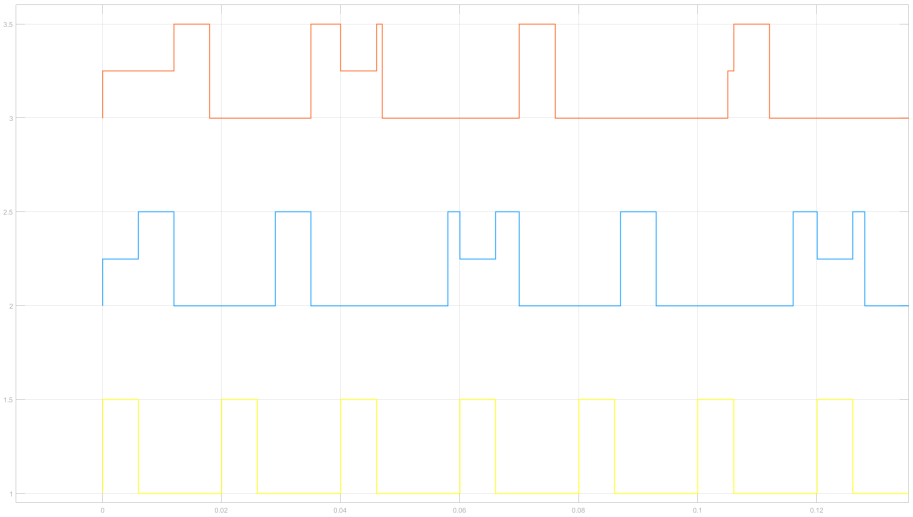

Figure 2: Schedule for pendulums when computation time of all is 6 ms. Yellow is small pendulum, blue is medium and red is big.

Task 5: Setting the execution time for all three processes to 10ms, what are the differences with respect to control performance?
For this execution time, the CPU utilization factor becomes

$$U = \sum_{i=1}^{n} \frac{C_i}{T_i} = \frac{10}{20} + \frac{10}{29} + \frac{10}{35} = 1.1. \tag{4}$$

The utilization factor is thus larger than one which means that the processes is not schedulable. This is seen in Figure **??** where the small pendulum is no longer stable because of the fact that the deadlines are missed.

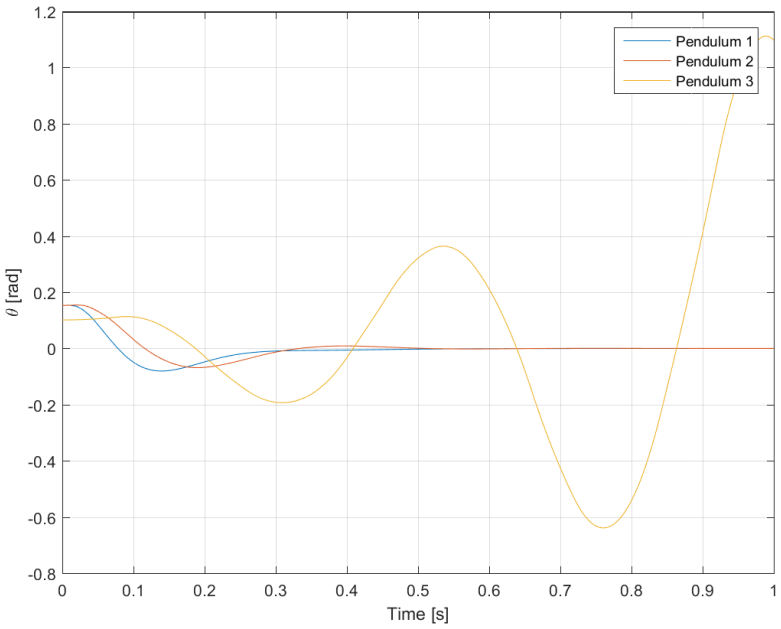

Figure 3: Performance of pendulums under rate monotonic schedulingi with computation time 10 ms for each task.

2 Earliest Deadline First, EDF

Task 1: Explain how EDF works. What are the advantages and disadvantages of the approach compared to RM?
In EDF, the task that has the closest deadline to the current time is always run. The advantage of this is that the processor can be fully utilized if the the scheme is schedulable. Another advantage is that tasks will not get starved if the processor is overloaded and deadlines are missed since the dynamic prioritization will handle allow all tasks to get processing time. One Advantage is that it can be difficult to predict which tasks are run when since there is no fixed priority.

Task 2: Assume the execition time is changed back to 6 ms. Are the tasks schedulable with the EDF? Please motivate your answer and costruct part of the corresponding schedule manually.
EDF is schedulable as long as CPU utilization is lower than 100 %. The utilization factor is the same as the answer q2 from RM, 0.68. Since $U = 0.68 \leq 1$ holds, the task set is schedulable with EDF.