

## 2IN70 - Track 2: Real-Time Architectures

### Practical Training - Exercises 7 -

Today we will analyze the schedulability of a real-time application implemented in the  $\mu\text{C}/\text{OS-II}$  real-time operating system.

#### 7.1 Analyzing the schedulability of a real-time system

In this exercise you will gain insight into the schedulability analysis of a real-time system. You can assume deadlines equal to periods, i.e.  $\forall i : D_i = T_i$ . The CodeWarrior project for this exercise is in the directory `exercise7_1`. *Note that the RTI interrupt frequency is set to 1 kHz, meaning that the tick period is 1ms. Keep this in mind in your timing analysis.*

1. Study the code. **Which utilization based analysis applies to this system (i.e. for dependent or independent tasks)? Motivate your answer.**
2. **Determine the blocking time for each task and the ISR. Motivate your answer.**

Assume that the critical section inside of the `ATDReadChannel()` function takes 2.102ms.

3. **Compute the utilization of the complete system (including the tick ISR overhead, but excluding the context switching and the TaskStart). Based on this utilization, is the system schedulable? Motivate your answer.**

Assume the following execution times:

$\tau_i$	$C_i$ (ms)
<code>OSTimeTick()</code>	0.09
Task1	2.103
Task2	2.103
Task3	2.103

4. **Add a fourth task with the lowest priority, which reads the analogue input connected to the ATD converter on port PAD14 with  $\varphi_4 = 3\text{ms}$  and  $T_4 = 20\text{ms}$  and turns on the D26 led if and only if the value exceeds the `PAD14Threshold`. Compute the utilization of the new system. Based on this utilization, is the new system schedulable? Motivate your answer.**

Assume that  $C_4 = 2.103\text{ms}$ .

5. **Compute the worst-case response time for all the four tasks and the tick ISR. Is the system schedulable? Motivate your answer.**