EDF Report

- **System hyper-period = LCM(10,20,50,100) = 100 ms**
- **CPU load**

From simulation the execution time of the tasks using GPIOs is:

Button monitor tasks = 17us
Periodic transmitter = 17us
UART receiver = 15us

Calculated CPU load = $\frac{17us}{50} + \frac{17us}{50} + \frac{17us}{100} + \frac{15us}{20} + \frac{5}{10} + \frac{12}{100} = 62\%$

- **Check system schedulability using URM**

$$U = \sum_{i=1}^{n} \frac{C_i}{P_i} \leq n(2^{\frac{1}{n}} - 1)$$

$$n\left(2^{\frac{1}{n}} - 1\right) = 0.735$$

So, **U = 0.62 < 0.735, the system is schedulable.**

- **Check system schedulability using time demand**

T1 {P: 50, E:0.017, D:50}
T2 {P: 50, E:0.017, D:50}
T3 {P: 100, E:0.017, D:100}
T4 {P: 20, E:0.015, D:20}
T5 {P: 10, E:5, D:10}
T6 {P: 100, E:12, D:100}

$$w_i(t) = E_i + \sum_{k=1}^{j} ceil\left(\frac{t}{P_k}\right) * E_k$$

Tasks orders from the highest priority to lowest priority is:

T5 > T4 > T1,T2 > 3,T6

Task demand from the highest priority to lowest priority task:

Task 5 {P: 10, E:5, D:10}
$w_5(t) = E_5$
$w_5(1) = 5$
$w_5(2) = 5$
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$w_5(10) = 5$
$w_5(10)$ **< P (10), then T1 is schedulable**

Task 4 {P: 20, E:0.015, D:20}

$$w_4(t) = E_4 + [ceil\left(\frac{t}{P_5}\right) * E_5]$$

$$w_4(1) = 0.015 + [ceil\left(\frac{1}{10}\right) * 5] = 5.015$$

$$w_4(2) = 0.015 + [ceil\left(\frac{2}{10}\right) * 5] = 5.015$$

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$$w_4(10) = 0.015 + [ceil\left(\frac{10}{10}\right) * 5] = 10.015$$

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$$w_4(20) = 0.015 + [ceil\left(\frac{20}{10}\right) * 5] = 10.015$$

$w_4(20)$ < P (20), then T4 is schedulable

Task 1{P: 50, E:0.017, D:50}

$$w_1(t) = E_1 + [ceil\left(\frac{t}{P_5}\right) * E_5] + [ceil\left(\frac{t}{P_4}\right) * E_4]$$

$$w_1(1) = 0.017 + [ceil\left(\frac{1}{10}\right) * 5] + [ceil\left(\frac{1}{20}\right) * 0.015] = 5.032$$

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$$w_1(21) = 0.017 + [ceil\left(\frac{21}{10}\right) * 5] + [ceil\left(\frac{21}{20}\right) * 0.015] = 10.047$$

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$$w_1(50) = 0.017 + [ceil\left(\frac{50}{10}\right) * 5] + [ceil\left(\frac{50}{20}\right) * 0.015] = 25.062$$

$w_1(50)$ < P (50), then T1 is schedulable

Task 2{P: 50, E:0.017, D:50}

$$w_2(t) = E_2 + \left[ceil\left(\frac{t}{P_5}\right) * E_5\right] + \left[ceil\left(\frac{t}{P_4}\right) * E_4\right] + [ceil\left(\frac{t}{P_1}\right) * E_1]$$

$$w_2(1) = 0.017 + [ceil\left(\frac{1}{10}\right) * 5] + [ceil\left(\frac{1}{20}\right) * 0.015] + [ceil\left(\frac{1}{50}\right) * 0.017] = 5.049$$

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$$w_2(21) = 0.017 + [ceil\left(\frac{21}{10}\right) * 5] + [ceil\left(\frac{21}{20}\right) * 0.015] + [ceil\left(\frac{21}{50}\right) * 0.017] = 10.066$$

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$$w_2(50) = 0.017 + [ceil\left(\frac{50}{10}\right) * 5] + [ceil\left(\frac{50}{20}\right) * 0.015] + [ceil\left(\frac{50}{50}\right) * 0.017] = 25.079$$

$w_2(50)$ < P (50), then T2 is schedulable

Task 3 {P: 100, E:0.017, D:100}

$$w_3(t) = E_3 + \left[ceil\left(\frac{t}{P_5}\right) * E_5\right] + \left[ceil\left(\frac{t}{P_4}\right) * E_4\right] + [ceil\left(\frac{t}{P_1}\right) * E_1] + [ceil\left(\frac{t}{P_2}\right) * E_2]$$

$$w_3(1) = 0.017 + [ceil\left(\frac{1}{10}\right) * 5] + [ceil\left(\frac{1}{20}\right) * 0.015] + [ceil\left(\frac{1}{50}\right) * 0.017] + [ceil\left(\frac{1}{100}\right) * 0.017] = 5.066$$

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$$w_3(21) = 0.017 + \left[ceil\left(\frac{21}{10}\right) * 5\right] + \left[ceil\left(\frac{21}{20}\right) * 0.015\right] + \left[ceil\left(\frac{21}{50}\right) * 0.017\right] + [ceil\left(\frac{21}{100}\right) * 0.017] = 10.081$$

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$$w_3(50) = 0.017 + [ceil\left(\frac{50}{10}\right) * 5] + [ceil\left(\frac{50}{20}\right) * 0.015] + [ceil\left(\frac{50}{50}\right) * 0.017] + [ceil\left(\frac{50}{100}\right) * 0.017] = 25.098$$

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$$w_3(100) = 0.017 + [ceil\left(\frac{100}{10}\right) * 5] + [ceil\left(\frac{100}{20}\right) * 0.015] + [ceil\left(\frac{100}{50}\right) * 0.017] + [ceil\left(\frac{100}{100}\right) * 0.017] = 50.362$$

$w_3(50)$ < P (100), then T3 is schedulable

Task 6 {P: 100, E:12, D:100}

$$w_6(t) = E_6 + \left[ceil\left(\frac{t}{P_5}\right) * E_5\right] + \left[ceil\left(\frac{t}{P_4}\right) * E_4\right] + \left[ceil\left(\frac{t}{P_1}\right) * E_1\right] + \left[ceil\left(\frac{t}{P_2}\right) * E_2\right] + [ceil\left(\frac{t}{P_3}\right) * E_3]$$

$$w_6(1) = 12 + \left[ceil\left(\frac{1}{10}\right) * 5\right] + \left[ceil\left(\frac{1}{20}\right) * 0.015\right] + \left[ceil\left(\frac{1}{50}\right) * 0.017\right] + \left[ceil\left(\frac{1}{100}\right) * 0.017\right] + \left[ceil\left(\frac{1}{100}\right) * 0.017\right] = 17.066$$

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$$w_6(21) = 12 + \left[ceil\left(\frac{21}{10}\right) * 5\right] + \left[ceil\left(\frac{21}{20}\right) * 0.015\right] + \left[ceil\left(\frac{21}{50}\right) * 0.017\right] + [ceil\left(\frac{21}{100}\right) * 0.017] + \left[ceil\left(\frac{21}{100}\right) * 0.017\right] = 22.081$$

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$$w_6(50) = 12 + [ceil\left(\frac{50}{10}\right) * 5] + [ceil\left(\frac{50}{20}\right) * 0.015] + [ceil\left(\frac{50}{50}\right) * 0.017] + [ceil\left(\frac{50}{100}\right) * 0.017] + \left[ceil\left(\frac{50}{100}\right) * 0.017\right] = 25.112$$

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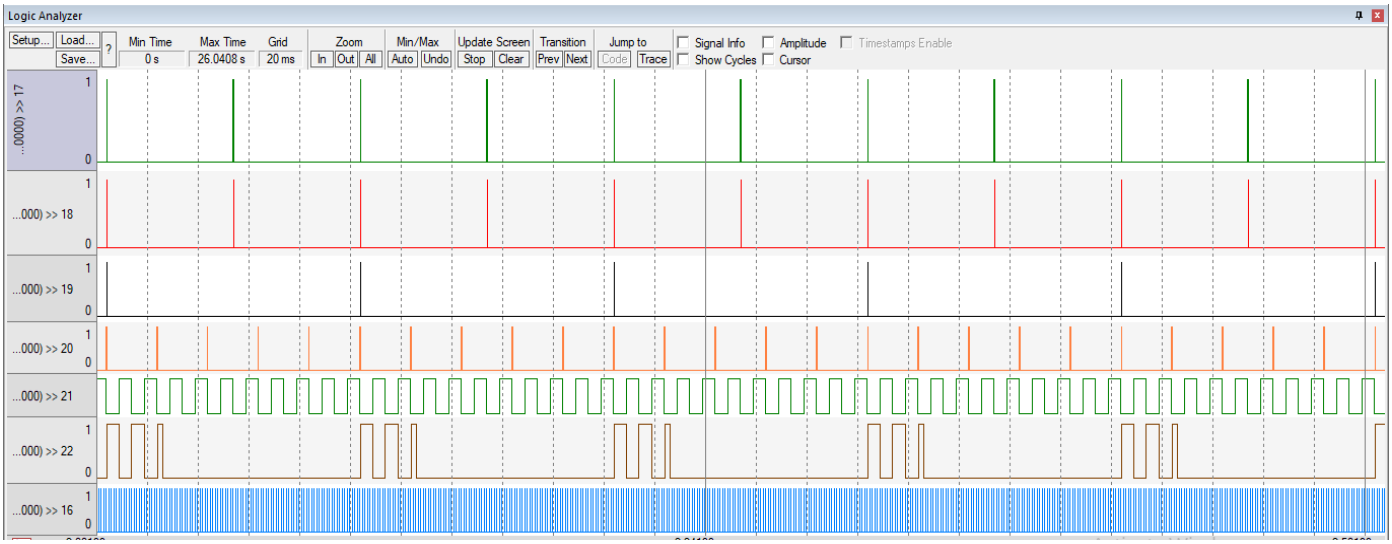
$$w_6(100) = 12 + [ceil\left(\frac{100}{10}\right) * 5] + [ceil\left(\frac{100}{20}\right) * 0.015] + [ceil\left(\frac{100}{50}\right) * 0.017] + [ceil\left(\frac{100}{100}\right) * 0.017] + \left[ceil\left(\frac{100}{100}\right) * 0.017\right] = 62.068$$

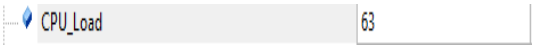
$w_3(100)$ < P (100), then T6 is schedulable

- Execution of all tasks using Keil simulator in run-time



- CPU usage time using timer 1 and trace macros

Simulated CPU load = 63%, and it's almost equal to the calculated CPU load value (62%)

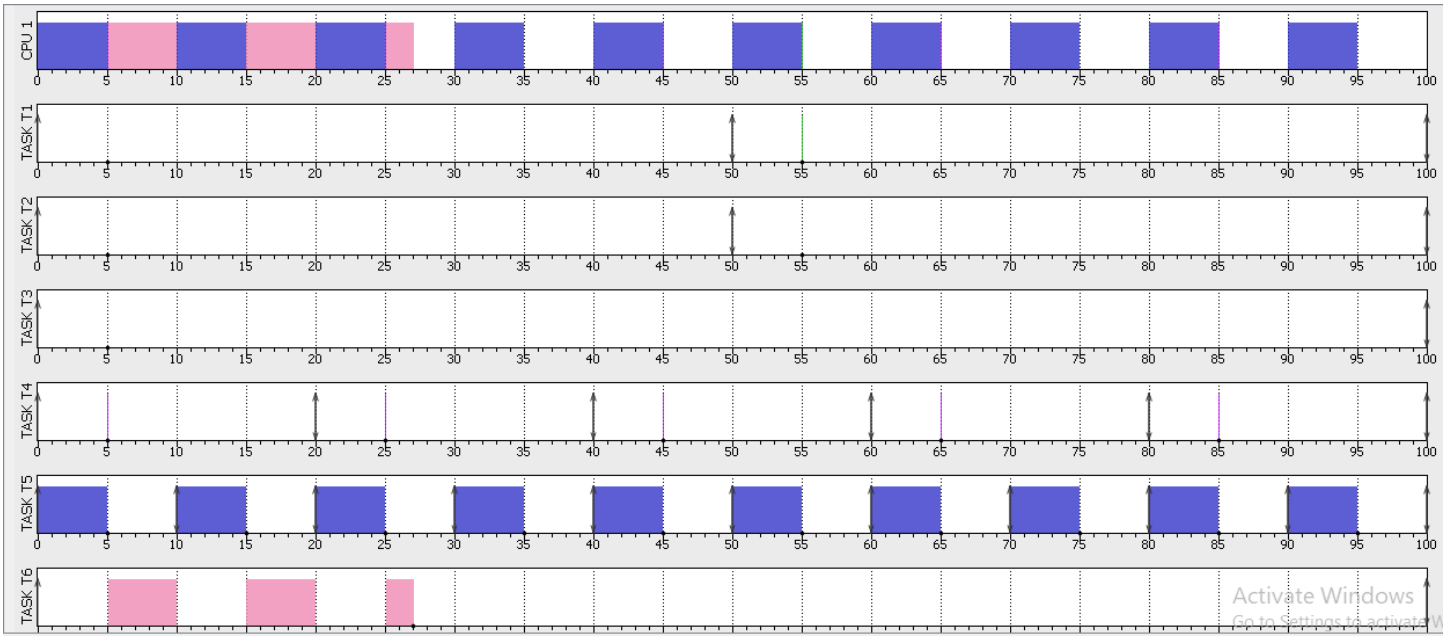


- **Using Simso offline simulator**

1. Tasks

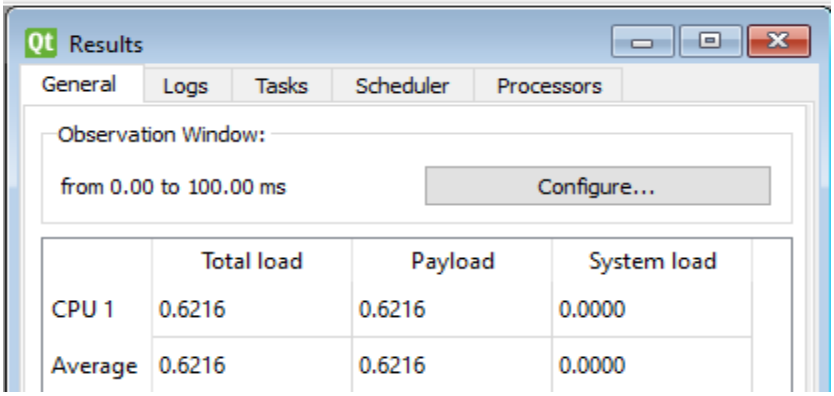
id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	Followed by
1	TASK T1	Periodic	☐ No	0	50	-	50	0.017	
2	TASK T2	Periodic	☐ No	0	50	-	50	0.017	
3	TASK T3	Periodic	☐ No	0	100	-	100	0.017	
4	TASK T4	Periodic	☐ No	0	20	-	20	0.015	
5	TASK T5	Periodic	☐ No	0	10	-	10	5	
6	TASK T6	Periodic	☑ Yes	0	100	-	100	12	

2. Grantt



Comment: there is no task miss its deadline, so the system is schedulable

3. Results



Comment: The CPU load is almost the same as the calculated and the measured from the Kiel using trace hooks.