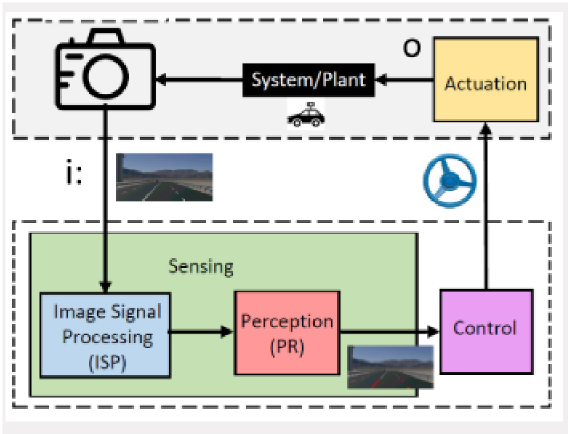
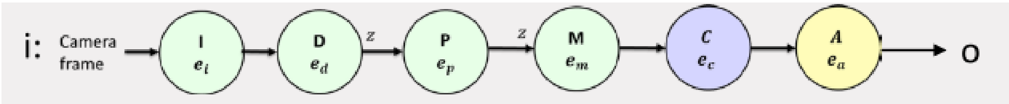
2_2_Sequential_Model

For the Sequential Model, we will use the following example to illustrate



The process of the DIC system is shown in the following SDF Graph



It consists of:

- The image-signal **(pre-)processing (I)** subtask converts the RAW image in the Bayer domain to pixels in the RGB domain.
- After the image processing, we **detect** the regions-of-interest (RoI) in the RGB image frames (D).
- RoI are **processed (P)**, and, subsequently, the controller state (the lateral deviation in LKAS example) is computed by the RoI merging (M) subtask
- The **control algorithm (C)** then computes the controller input u[k] (steering angle in our LKAS example) and feeds it to the actuation (A) task
- The total number of RoI detected by D determines the **workload z**;
- z implies the production of processed data from task D to task P, and, correspondingly, the consumption rate of the data task P to task M

The time information of each component in this system is shown as follows

- Camera frame rate 100 FPS.
  - $f_h = 10ms$
- I: pre-processing that converts RAW image to RGB pixels; e_i= 5ms
- D: detect RoI(s); e_d= 5ms

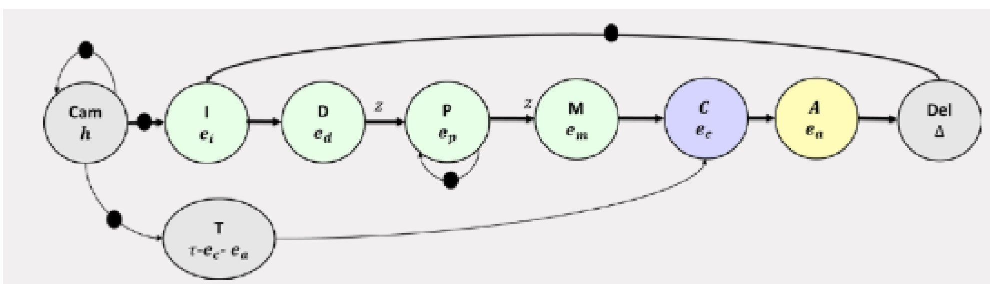
  Workload z = number of RoIs = 6
- P: RoI(s) processing; e_p= 10 ms
- M: RoI(s) processing; e_m= z∗ 3 ms = 18 ms
- C: control computation; e_c= 0.5 ms
- A: actuation; e_a= 0.5 ms

1. Timing Analysis

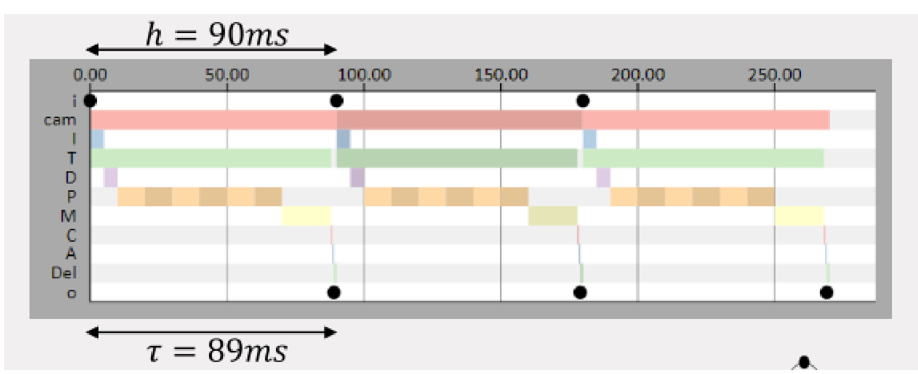
Then we can analyze the timing of the system:

- sensor-to-actuator delay $\tau = 89$ms
- sampling period $h = \lceil \frac{\tau}{f_h} \rceil f_h = 90$ms

Because the actor in the SDF will be executed as soon as allowed, so, we can add several element to enforce constant sampling period h as shown in the following figure:



- Actor Cam is added to enforce constant sampling period h; Cam fires every h time unit
- Actor T is added to enforce constant sensor-to-actuator delay τ
- T has execution time = $\tau - e_a - e_c = 88$ms
- Actor Del with $\Delta = h - \tau = 1$ms



2. Controller Design

Then we will have a system in which $\tau < h$, we can build a control system which has “small delay”

Summary

- sequential model: $\tau < h$