

Monitoring timing constraint of CPS is a necessary process to evaluate their correct behavior. This issue becomes more crucial in safety critical systems because an online monitoring tool can take a suitable action at timing violation situation. However, existing monitoring approaches are not efficient enough, in terms of computation time and required memory, since they are future based and test the timing at each sampling time. Although an online monitoring tool can stop or do proper action at timing violation, a non-efficient tool can cause a catastrophe because providing the results might not be fast enough to prevent an incident. However, some monitoring tools cannot be implemented online because their algorithms are memory demanding and the required data exceeds the provided memory.

TMA (Timestamp-based Monitoring Approach) is a method to monitor timing constraints of a system utilizing the events' timestamps. Since CPS timing behavior are generally defined base on analog signals when they crosses some thresholds, it is enough to monitor the time at which a signal crosses its corresponding threshold (e.g. If signal  $s_1$  rises above 5 volts, then within 5 seconds, signal  $s_2$  should fall below 3 volts). Obviously, when a signal goes above a threshold (rising edge), stays there until it crosses its threshold again to come to the below (falling edge). Hence, it can construct a Boolean signal according to threshold crossing. Therefore, it is enough we just keep the threshold crossing timestamps since between each pair of rising and falling edges, the Boolean signal value is constant (continuously true or false).

Based on this view, TMA just works on the timestamps to evaluate a timing constraint. This approach is applied on either event-based TTL timing constraint (L, F, P, S, C) or level-based ones (G, E, U). Since TMA calculation to evaluate timing constraints is based on the timestamps, its complexity is  $n$  which is the maximum number of events on a signal.