Flexible Scheduling

For every time-triggered task T:
- Runtime System
  - If the system has high priority event tasks that may preempt time-triggered tasks, using the relaxed constraints reduces the risk of missing LETs.
  - The background, then the response times of such events can be shorter with the relaxed constraints.
  - If the system has high priority event tasks that may preempt time-triggered tasks, using the relaxed constraints reduces the risk of missing LET deadlines.

Advantages

- Enlarging the search space for feasible schedules that achieve time-safety. In particular, an application that is declared unschedulable under the classical constraints may be declared time-safe by using the relaxed constraints.
- If the system has event-triggered tasks executed in the background, then the response times of such events can be shorter with the relaxed constraints.
- If the system has high priority event tasks that may preempt time-triggered tasks, using the relaxed constraints reduces the risk of missing LET deadlines or reduces the number of missed LET deadlines.

Relaxing Scheduling Constraints for Systems with Logical Execution Time Specifications

Patrick Derler, Stefan Resmerita

Example: Inverted Pendulum

Further Work

- Flexible Scheduling with modes
- Analysis of the overhead introduced by flexible scheduling
- Implementation

Scheduling of a Task \( T_1 \)

A Task \( T_1 \) reads from two time-triggered tasks \( T_2 \) and \( T_3 \) from an event-triggered task \( E \) and sensors, e.g., \( s_1 \) and \( s_2 \).

Definitions:
- \( p^u \): set of all ports that read from a task \( U \)
- \( p^e \): set of all ports that read from sensors

\[ t^u_{\min}(U,T) = \begin{cases} 0 & \text{if } t^u_{\min}(U,T) > t^u_{\min}(T) \\ \max_{\alpha,\beta} \{ t^u_{\min}(U,T) | t^u_{\min}(U,T) \leq t^u_{\min}(T) \} & \text{otherwise} \end{cases} \]

Static Scheduling Bounds

Dynamic Scheduling Bounds

A task can be released at \( t^r_{\min}(T) \) if \( \forall E \in E_{<T} \)

(C1) the current time is at least \( t^r_{\min}(T) \) and

(C1a) the last time \( t^r_{\min}(T) \) when an \( E \in E_{<T} \) produced an output before \( t^r_{\min}(T) \) is such that \( t^r_{\min}(T) + \delta_{\min}(T,P^E) \geq t^r_{\min}(T) \) or

(C1b) \( \forall E \in E_{<T} \) \( t^r_{\min}(T) + \delta_{\min}(T,P^E) \geq t^r_{\min}(T) \) or

(C2) the current time is equal to or exceeded \( t^r_{\min}(T) \).

Dynamic Scheduling Parameters

- Minimum preemption time by higher priority tasks