Speaker: M. Mendler (on joint work with Bruno Bodin, Partha Roop, Hugh Wang)

Title: Worst-case Reaction Time for Synchronous Programs - Studying the Tick Alignment Problem.

Abstract:

Synchronous programs are ideally suited for the design of safety critical systems as they provide
guarantees on determinism and deadlock freedom. In addition to such functional guarantees,
guarantees on timing are also necessary.

We study the problem of static worst case reaction time (WCRT) analysis of synchronous programs.
Concurrent threads in a synchronous programs must align during every reaction, and infeasible ticks
that never align in any instant must be ruled out for precision. This problem has been termed the
"tick alignment problem" (TAP).

While there have been many recent attempts at studying the TAP from the point of view of scalability
and precision, its fundamental computational nature is yet to be examined. Here we study the
TAP in the guise of a number theoretic formulation in order to not only explore its lower bound complexity,
but also to develop heuristics that work well in practice. The developed algorithm that is based on the
Maximum Weight Clique Problem. Extensive benchmarking reveals the relative superiority of the proposed
approach. While being optimal it is also more efficient compared to one of the most efficient of known techniques,
ILP_C, which uses iterative approximation with integer linear programming techniques. Finally, using insights
from the proposed TAP formulation, we develop a refinement of ILP_C, called ILP_CP, that excels
in comparison to all known techniques for WCRT analysis.