Status of Effort

Add:

We have extended our open toolchain to use the TrueTime tool for the simulation-based analysis of controllers. We generate a plant and controller-specific TrueTime scheduler that mimics the execution semantics of the time-triggered platform, and use the actual functional code and actual schedule that has been generated by the toolchain for closed-loop analysis of the controller’s performance.

We have started work on a revised version of a time-triggered software platform that … (need more input here).

3.3.2 Prototype Tool Chain (Karsai, Sztipanovits)

Prototype toolchain. We continued our work on the prototype tool chain, based on the modeling language ESMoL. The toolchain has been extended with a TrueTime interface for timing analysis, and the functional and non-functional code generators have been significantly improved. The TrueTime interface makes the high-fidelity simulation based analysis of controller designs feasible. The actual functional code and the actual schedule (generated by other toolchain elements) are used in the analysis, hence the platform effects are directly observable. The TrueTime interface is now based on actual TrueTime ‘kernel’ that simulates the run-time platform’s scheduler.

For the STARMAC quadrotor helicopter control system we can generate platform-specific code from models, and run a time-triggered distributed controller in a hardware-in-the-loop configuration to detect design and software generation errors. We have a prototype integration of the CMU statistical model checking tools with our STARMAC model to analyze the robustness of our design to fault conditions. We also have a preliminary analysis of the delay effects of different data links with respect to the passivity assumptions in a simplified version of the quadrotor design.

As mentioned above, we are currently extending the FRODO virtual machine to support event-based task execution or communication. The online scheduler within FRODO now handles the dispatch of both time-triggered and event-based tasks. The time-triggered tasks maintain a higher priority than the event-based ones in order to not invalidate the TTA invariants.

We have experimented with model-based constructive control design approaches, including a custom modeling language for building and simulating simple passive digital controllers, and a prototype symbolic controller generation tool for nonlinear port-Hamiltonian control designs.

3.4 Testing and Experimental Validation (Tomlin, Sastry, Lee, Karsai)

Add:

We continue to refine the real-time simulation environment for the Stanford STARMAC qua-drotor aircraft control software. The interface between the plant simulator and the controller is ‘hard real-time’, and the xPC box simulates the real-time behavior of the plant with high-fidelity (e.g., inner loop control can be easily run at 100Hz). The control software is generated and con-figured with the tool chain. We have started investigating the use of small quadrotor devices from Ascension Technologies. We have worked on the communication interface, but the deployment of actual controller code on the platform is future work.