Research Proposal: Computational resource management of multi channel controller

Hodai Goldman (Hodaig@cs.bgu.ac.il)
Department of Computer Science,
Ben-Gurion University of the Negev, Beer Sheva, Israel
Supervisor: Dr. Gera Weiss

July 24, 2016

1 Background and Problem Formulation

Todays computer power allows for consolidation of controllers where a single computer can regulate many control loops, each with its varying needs of computation resources. This brings two research challenges that we intend to attack in the proposed thesis:

- How to schedule control tasks in order to achieve good performance in terms of control measures (overshoot, convergence speed, etc.)?
- What is a good interface for co-design of scheduling and control?

While it is possible to build control systems using standard operating systems, either real-time or desktop with static or with dynamic scheduling schemes, there is an agreed opinion in the control community that these do not serve well for the purpose outlined above [**?**]. Specifically, desktop type operating systems (Windows, Linux, etc.) schedule for computational efficiency, but do not allow for control performance guarantees of the individual loops. On the other hand, real-time operating systems sacrifice some efficiency for timing predictability, but they do relate timing information with control performance. When using such operating systems for control engineers usually apply controllers that work in a fixed periodic manner so that control behavior becomes deterministic and control performance can be guaranteed. This is not efficient because resources can be better utilized if controllers act at higher frequencies when only when needed. In this work we will develop methods to combine the efficiency of desktop operating systems with the predictability of real-time operating systems in a way that is more suitable for control systems then periods and deadlines

The control loops that we are analyzing are here of the form shown in Figure **??**. A physical plant (controlled system) is connected via sensors and actuators...

The current state of the art is that control engineers design control tasks as periodic computations then they specify the required periodic frequency for the task and software engineers design a scheduler that ensures that the periodic frequency requirements are met usually using pre-computed knowledge of the expected (maximum) duration of the tasks. We claim that for control systems we can achieve better performance by using richer and more flexible set of requirements for the tasks. Specifically, we will develop tools with which the control engineers can specify in a natural way features of their control loop that the scheduler will use to allow for dynamic schedules that guarantee required control performance.

2 Case study: Vision based controllers for drones

3 Research Plan

3.1 the controller control system framework

our proposal.

TODO - add the figure from the poster and few words of this model TODO - maybe add %CPU arrow from scheduler to control law

3.1.1 Sensors (Computer Vision Based Sensor)

3.1.2 State Estimator

3.1.3 Control Tasks

3.1.4 Automata Based Scheduler

3.2 experimental environment

3.2.1 drones

3.2.2 Ardu-Pilot-Mega as base controller software

4 Preliminary Results

5 References

1. **Merav Bukra (thesis), GameComposer: A Framework for Dynamic Scheduling**
2. Rajeev Alur and Gera Weiss, RTComposer: A Framework for Real-Time Components with Scheduling Interfaces
3. APM