Performance Engineering of Real-Time and Embedded Systems

What is this course about?



This course is about designing and measuring the performance of RT and Embedded systems.



Real-Time Systems

- Scheduling
- Control of systems

Embedded Systems

- VHDL light
- Maybe Hardware/software co-design

Research Project

- From one of several topic areas

in real-time or embedded systems



For some, the only thing that matters in real-time system design is scheduling.

- Explore the characteristics of some common scheduling algorithms
- Verify the performance of a small number of scheduling algorithms





The rubber meets the road when your real-time system is controlling a physical system.

 Get under the hood with the math for discrete real-time control.
✓Z-transforms light
✓Implementing a transform
>Exploration of controllers
✓Intuition for parameters
✓Proportional control
✓Proportional-Integral control
✓PID control





In embedded systems, hardware and software meet at a flexible boundary.



 Exposure (refresher) to hardware design - VHDL light
Maybe experiment with Impulse C or more likely use it in a research project How easy is it to move software functionality into hardware?

What are the performance gains?

How much do you need to know on both sides?





There is no textbook for the course.

- Lectures will provide necessary material.
- References to additional material will be given.
- The work will also rely on the documentation for the tools you will work with.



The course will be divided into two phases.

- Class exercises and short (~2 week) projects.
 - Experimenting with schedulers using QNX
 - Implementing discrete real-time controllers
 - Exposure to FPGA design in VHDL
- A longer "research" project
- Projects will be done in pairs one SE and one CompE – to the extent possible.



There will be more than strictly project work.

- There will be some class exercises usually directly related to the project work.
- There will be an exam on scheduling, and an exam on VHDL and the realization of discretetime transforms.
- The grad students will have additional activities.
 - RMA scheduling extras
 - Trends paper and presentation



You will work with a variety of tools in the course.

- QNX Momentics
- C/C++
- Control System Plant Simulator
- Xilinx tools for VHDL synthesis

It is doubtful you will work with this technologies.

- Java
- Web-based technologies



You will select a research project for the second part of the course.

- You will specify preferences for projects in several categories.
- I will assign you one of your preferred projects.
- You will create a specific project based on the general specifications I provide for the project category.
- I am not certain how easy or hard some of the work will be.
- I believe that in this problem-based learning environment you can discover the information you will need to meet your project goals.



You will design your research project to be fun and challenging.

Experimentation and exploration

















I am asking for your best efforts on the research project I assign you.

- You will be responsible for
 - Working on the project with your best efforts
 - Informing me when you have problems
 - Sharing successes and problems with the class
 - Attending class so I can discuss the assignments with each team
- If you succeed, you will be responsible for
 - Documenting what you accomplished and how it was done
- If you do not succeed, you will be responsible for
 - Providing an explanation of what was tried, how it failed, and what the next thing to try is



I am committed to making the course as interesting as possible.

- I will be responsible for
 - Giving you the information that you need
 - Getting resources when needed
 - Assisting you with problems
 - Working through issues
 - Grading not only on accomplishments but also

on your efforts



