

MEEM 4990/5990: Getting Data in the Lab

Interim Project

Due In Class: 8:05 AM, Tuesday 15, 2016

Summary

Design the hardware for a data acquisition and control system. Document the design in a report which explains the system under test and how your hardware design addresses the needs of the system.

The project is designed to be complimentary with your research. If possible, work with your advisor to create a project that will advance your research or improve your laboratory. Furthermore, you will be required to complete the implementation of this project, including the software, for the final project. (Modifications to the design to allow for new information, impossible lead times, etc. will be allowed, but please try to consider all of these eventualities when designing the project.)

Requirements

- ☐ The system to be tested (measured, studied, etc.) must utilize at least ~~four~~ three channels total of input and output. Extra credit will be given for a reported fourth channel, (provided it is complete in the report, per the requirements below and uses a different sensor type).
- ☐ At least two of the channels must be of different major types (analog input, analog output, digital I/O, counter-timers, instrument control).
- ☐ At least one channel must utilize hardware-timed acquisition

For each channel:

- ☐ Find at least three candidate transducers (or actuators) and document their specifications including:
 - Measurement (or output) range
 - Measurement (or output) accuracy
 - Output (or input) range
 - Output (or input) impedance (if applicable)
 - Operational details (does it need a power supply? special care or fixturing?, etc.)
 - Cost (if the transducer/actuator is already purchased, find the cost anyway, but note that the cost to you is free)
 - Lead time (will you be able to acquire the transducer in time for the final project)?
- ☐ Choose the best transducer (or actuator) and justify your decision
 - Note, if the *best* transducer and the *chosen* transducer differ because, for example, you were limited by budget, or used a pre-purchased sensor, make a note of it. "Sensor X is best because it has infinite accuracy but it costs all the dollars and we already have sensor Y was already in the lab."
- ☐ ~~Choose cabling considering required cabling length, voltage, current, impedance, noise, grounding, and cost. (Extra credit if included.)~~

- ☐ ~~Choose connectors considering required voltage, current, safety, convenience and cost.~~
(Extra credit if included.)

NOTE: The report should include at least 9 candidate sensors/actuators. If multiple channels are expected to measure identical data (e.g., temperature at two different locations on a device), please research more sensors, rather than reporting the same three sensors twice, which would be dumb.

- ☐ Find at least three candidate data acquisition devices, systems or box instruments and document their specifications, including:
- Type and number of channels
 - Range, resolution, accuracy, sample rates and bandwidths for all channels
 - Input and output impedances (if applicable)
 - Operational details (computer interface, software driver, does it work with LabVIEW?, etc.)
 - Cost (if you already own it, find the cost anyway and note that the cost to you is free)
- ☐ Choose the DAQ system or systems that you will use with your transducers or actuators and justify your choice. Consider:
- Will this system allow me to complete my objectives for this experiment?
 - Will this system allow me to expand my experiment in any ways that I currently anticipate as likely?
 - Will these components be likely to be used in other experiments in the future and, if so, are they the best choice?
 - Cost
 - Lead times (can you get it in time to implement it for the final project?)
- ☐ Choose your computer system and intended software. If any of these need to be purchased, note the cost
- ☐ Ensure that you will be able to interface your DAQ system(s) to your computer and software.
- Is the hardware compatible?
 - Do device drivers exist for the hardware?
 - Do instrument drivers exist for the instrument, or is the protocol easy to implement?

Report

The report should be well organized and written in proper English. Figures should be used where appropriate. Your goal is to convince me that you have designed a good system, and therefore, any information necessary to prove that is acceptable. At the same time, I am not interested in the technical details of your experiment, except so far as I need to understand it to understand your DAQ system.

Reports shall be printed on letter paper and stapled or otherwise bound. Submit the report to me in class. ~~or in my MTU mailbox by the due date.~~

The following format should be observed:

- Title page
 - Including the project title (your choice), assignment title (“Interim Project Report”), class (“MEEM 5990: Getting Data in the Lab”), the date, and your name.
- Table of Contents
- List of Figures
- List of Tables
- Summary
- Explanation of the Experiment/System Under Test
 - Explain the goal of the experiment or test
 - Explain what you are measuring, controlling or testing
 - Identify the individual DAQ channels and the requirements for each channel
- Transducer/Actuator Trade Study
 - Detail your transducer/actuator trade study for each channel
 - Do not make your recommendations here. Save that for “Selected system”
- DAQ system trade study
 - Do not make your recommendations here. Save that for “Selected system”
- Selected system
 - Detail the complete selected system, justifying your transducer and DAQ system choices
 - Be sure to discuss the cabling and connector requirements that flow from your choices
 - Complete system budget (table)
 - Budget and lead time discussion
- References
 - URLs or other references for system component specifications
 - Anything else used to justify your decisions (“Similar to the experiment of Johnson [1]...”)

Grading

- System/Experiment Overview (15%)
 - Description is sufficiently complete to understand the system as it relates to DAQ
 - Description is concise
 - Describes DAQ channel/system requirements
 - Explains how the requirements arise from the system
- Transducer trade study (20%)
 - Three transducers/actuators studied for each channel (of at least four channels)
 - All relevant specifications are listed
 - References to sources provided
 - Specifications are related to system requirements
- DAQ system trade study (20%)
 - At least three systems are studied
 - All relevant specifications are listed

- References to sources provided
 - Specifications related to transducers/actuators and the experimental system
- Final system design (25%)
 - Justification for decisions
 - Budget
 - Budget analysis
- English clarity, grammar, spelling, etc. (10%)
- Report clarity, formatting, figures, etc. (10%)

Special Note on Box Instruments

This project is primarily designed with DAQ systems like the NI multifunction boards in mind. You are welcome to use box instruments (oscilloscopes, custom thermocouple readers, etc.) that have computer interfaces (serial, GPIB, USB, Ethernet), particularly if that is the only way to accomplish your experiment goals. However, we will not actually talk about how to do this until late in the class, and certainly not before this assignment is due. Therefore, you may wish to consider other approaches.