Week 4 Laboratory – ADC

This is the last of the formal laboratories for the course. From now on, you will use the lab sessions to work on the helicopter project. The first priority is ***Milestone 1 in Week 5***.

1. Outcomes:

- To learn how to use the ADC peripheral on the Tiva microcontroller.
- To explore the use of interrupts and ISRs.
- To explore the sampling theorem for analogue-to-digital conversion.
- To explore the use of data buffering in signal acquisition.
- To make progress towards Milestone 1 for the helicopter project (refer to the Milestone 1 specification).

2. Laboratory books:

Remember that your lab book (one per student) must be maintained over Weeks 2 to 5.

3. Source files:

You have been supplied with three new source files for this laboratory: **ADCdemo1.c**, **circBufTc**, **circBufT.h**

The source files can be found on Learn: **Section 1 | Laboratory source code | Week-4**

The Milestone 1 specification can also be found on Learn: **Section 2 | Helicopter project | Milestone 1**

4. Specification for Week 4:

4.1 Set up a new project for the Week-4 Lab (call it "Week-4Lab").

While this is not strictly necessary, it will help to keep your work in sections. Follow a similar procedure to that you used last week (see CCS_7_4_tutorial_Week_2_2018.pdf and the Week-3 lab sheet, if you need to). Copy the source files from Learn into your new project directory. Remember that you will need to set up the project properties as you did in Week 3 so that links are established to the OrbitOLED and ustdlib modules.

Note: It is also possible to copy an existing project in such a way that the project properties are maintained.

> Remember that you should only compile the .c files that are part of each program – use right click and "Exclude from Build" as required.

4.2 Compile, link and load ADCdemo1.c (needs access to circBufT.c and circBufT.h)

Run the program and operate the potentiometer on the Orbit board to alter the analogue input voltage between 0 and 3 V. Observe the 12-bit integer that results. Study the source code for ADCdemo1 in detail to understand how it works.

4.3 **Prepare a new version of the program** (say, ADCdemo2.c or miles1_v1.c) to change to the analogue input AIN9, PE4 (J1-05). Set up the bench power supply to provide a voltage between 0 and +3 V and set the current limit to 0.01 A. Use two banana-to-alligator cables and two of the mini cables that came with your Tiva to connect the input voltage and ground to the board.

Take care to check the voltage & polarity of the applied voltage BEFORE you turn on the supply output.

Check the operation of the program. The relationship between the displayed value and the voltage should be perfectly linear.

4.4 **Work out** what is an appropriate size for the circular buffer and appropriate sampling rate for measuring the helicopter height (refer to the Milestone 1 specification and Lectures 6, 7 and 8). Present a case in your lab book for the values you determine. It is reasonable to assume that the vertical motion of the helicopter and rig is limited to < 4 Hz. Test your sampling/buffering/averaging system by means of the function generator.

Again, check the voltage of the function generator output with the scope BEFORE you connect to the ADC input.

4.5 **Carefully read the Milestone spec** and make sure you understand exactly what is required. Carry on developing your code. Remember that the compliance of your program for Milestone 1 will be checked during your lab session in Week 5. **Don't leave your preparation to the last minute.**

5. Guidance:

- Prepare the new programs one step-at-a-time.
- Make new code as modular as possible, using appropriately designed and named functions. This will pay off when you come to build a much bigger program to control the helicopter.
- Test, test, and test once more. Make sure your tests cover the specification fully. A lot of problems with software occur because the developer has not been thorough in testing their code. Record how you have tested your code and save any special programs you may have used for testing.

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