TO: Prof. Pierre-Emmanuel Gaillardon, Course Instructor
FROM: David Venegas
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SUBJECT: Pre-Lab 06 (Analog)

1. **What is hysteresis and how does it help prevent bad behavior on digital inputs?**

Hysteresis changes the voltage threshold depending on the currently detected digital state. This makes it impossible for a signal to consistently hang around the trigger point. For example, once a signal is interpreted as digital high, the threshold for transitioning to digital low moves downwards, and requires a very low value to move to the low state. Even if the analog value remains near the original threshold voltage for detecting a logic high signal, small ripples won't cause unwanted transitions since the threshold moved.

2. **What is quantization?**

Converting analog to digital is similar to setting up a range of increasing threshold values and counting how many the input signal crosses. Because of this, the fewer threshold values there are, the more granular the result and less information received about the input signal. This is the basis of quantization. Quantization is the process of mapping a high-resolution signal to a manageable lower-resolution one.

3. **What does Nyquist theory explain? What is the problem with sampling a signal too slowly?**

Nyquist theory explains the relationship between how often you sample an input signal and whether or not you'll be able to tell what it is afterwards. Nyquist theory states that in order to represent an input signal by sampling its value periodically, the sampling rate MUST be at least twice the frequency of the fastest signal. If it isn't, then you'll either not be able to recognize the output at all, or you will have higher-frequency signals aliasing, and falsely appearing as slower ones.

4. **The maximum resolution of the ADC is 12-bits. How many quantization steps/values does this give us?**

4096 step resolution.

5. **What are the steps to perform an ADC calibration?**

a. Set the desired operating mode, data resolution, and trigger source.
b. Start the ADC calibration.

- Calibration can only be performed when the peripheral is stopped, don't set any enable/start bits (other than in the RCC peripheral) before attempting to start a calibration process.

c. Wait for the hardware to signal that the calibration has completed.
d. Set the peripheral enable.
e. Wait until the ADC ready flag is set.
f. Start the ADC conversion.

6. What's the difference between right and left-aligned data in the DAC registers?

The left-aligned mode is typically used for selecting the upper bits of a 16-bit number, allowing the DAC to act on 16-bit data without any conversion or shifting. (with some minor loss in precision provided by low-order bits).

7. What DAC register would you use to write 8-bit right-aligned data? (use the peripheral reference manual)

8-bit right alignment: the software has to load data into the DAC_DHR8Rx [7:0] bits (stored into the DHRx[11:4] bits).

8. Name something you found confusing or unclear in the lab manual. If everything was clear, simply answer that you didn't have any issues.

Question 6 and 7 was little bit trickier to understand. As for DACs/ADCs, I took a class in data converters as well as Digital Signal Processing, so I am familiar with the subject.