Homework #4 assignments

In this assignment you will refine the design of your instrument by answering some (preferably all) of the questions posed during on 2012/2/15. Be prepared for 35 minutes of presentations.

1. **Magnetometer:** Ryan Jackson, David Park

   (a) Do we need, or might we need, the set/reset strap?

   (b) If we need it, design a circuit that can provide the signal needed.

   (c) How will the bar magnet of the ADC affect the magnetometer? Can this be alleviated by applying an offset to the magnetometer chip?

   (d) What is the required power of the system?

   (e) What is the output range of the magnetometer for a $\pm 100\,\mu$T range of natural fields (i.e. excluding the bar magnet)?

   (f) Design a circuit which will map that range to the input range of the ADC.

   (g) Settle on the number of bits for the ADC, and ideally a specific ADC as well.

   (h) Since this is a 3-axis magnetometer does that mean 3 ADCs, or one ADC with three inputs, or a multiplexer?

   (i) What parts should be ordered for lab testing?

2. **Dosimeter:** Charles Bernson, Vinny Ravindran

   (a) A default resolution baseline is being able to get several measurements showing increasing radiation level the satellite passes through the south-atlantic anomaly. How big a radiation dose is a passage? What is the radiation dose in an average orbit? The answers will depend on the altitude and inclination of the orbit, so it will be a range.

   (b) What radiation dose resolution does the above information imply if we want several measurements through the south-atlantic anomaly?

   (c) What is the best strategy then for biasing the dosimeter? 0 V? 9 V? It will influence the answer to the following questions

   (d) How many bits of ADC are required to be able to resolve that? Are the 16 bits of the MSP 430 ADC sufficient?

   (e) What stability of the current source is required to match the ADC bit resolution?

   (f) How does that current source stability compare to commercially available devices?

   (g) Design the circuit including the current source, biasing, switches, and calibration, including connections to the MSP 430.

   (h) Can we get our hands on rad-hard BJTs to build a current mirror?

3. **Electrical Health Monitor:** Tom Hall, Alan Huynh

   (a) Settle on a range of measurement amplitudes (make it a large range).

(b) Settle on a automatic system or a feedback system in which the gain is controlled by the MSP430.

(c) Design the circuit which will AC sample and adjust the gain.

(d) If MSP 430 feedback, how will the adjustment algorithm and circuit work?

(e) Settle on specific statistical measures to compute and give algorithms for their computation within the constraints of the memory and computing power of the MSP430. E.g. MS and time-averaged power spectrum.

(f) What is the algorithm for computing the entropy on the C&DH?

(g) If we compute the entropy of the I^2C bus, how do we sample the bus, and what is the algorithm for computing the entropy?

(h) Discuss methods for sampling the current on the solar panels. How is the signal transferred to the EHM board safely?

(i) Settle on which signals will be sampled, and how that many signals can be sampled by the EHM.