ECE 18-316
INTRO TO DATA STORAGE
FALL 98
<u>INSTRUCTION SHEET: LAB # 5: Read Sensors</u>

Due Wednesday, 11/11/98

<u>In Class</u> or <u>To Jie Zou Before Start of Lab Section (1:30 PM)</u>
<u>Late submissions will not get credit</u>

<u>Purpose:</u>
The purpose of this lab is to acquaint students with the differences between inductive and magnetoresistive read heads. Specifically, the velocity dependence of the output from both types of sensors, and the effect of biasing on the MR sensor will be examined.

<u>In Class:</u>
<u>Setup</u>
1.1) Organize yourselves into groups of three (at most) students and find a lab bench for your group to work at. As usual, please stick to the same bench and the same lab group all semester.

1.2) Connect the read head device control box as instructed in the OIS for this equipment. Observe the static precautions discussed in the OIS for all handling of this equipment.

1.3) Get a magnetic mat from the TA, and cover it with a single sheet of paper. Use a pen to outline the location of the mat under the paper for reference.

<u>Inductive Sensor:</u>
1.4) Set up the box to read back form the inductive sensor. This requires proper setting of the selection switch, and high gain on the amplifier.

1.5) Swipe the inductive sensor down the magnetic strip smoothly at about 10 cm/s, or so. With the scope set up as described in the OIS, you should be able to see a sinusoidal waveform appear on the scope. Be sure to orient the head properly to capture the signals. To capture these waveforms, press run/stop, and capture, as discussed in the OIS for the computer interface. Be sure to zoom in sufficiently that you can identify locations of individual peaks, and their amplitudes.

1.6) Collect 10 different signals, at varying velocities, from approximately 2 cm/s to 50 cm/s, attempting to be as constant in your head-to-media velocity as possible in each case. Try to pick a consistent method of swiping the sensor, such that the only influence on the signal amplitude is the speed of the swipe. Discard any data taken for high velocities where you have saturated the output amplifier. Save all scope traces for later processing by Matlab, as discussed in the computer interface OIS from Lab 1 (available on the class web site).

Magnetoresistive Sensor:
1.7) Set up the box to read back from the MR head. This requires proper setting of the selection switch, and low gain on the amplifier.

1.8) Set up the bias voltage to about 2 V.

1.9) Repeat 1.5-1.6 using the MR sensor.

1.10) Vary the bias voltage from 0 to 4 Volts in increments of 0.25 V, while scanning in a repeatable way, at a velocity of your choosing. Maintain the relative position of the MR sensor and the magnetic mat, such that the only thing changing the output is the bias field. Record the average amplitude (p-p) of the readback for each amplitude. You do not need to record the actual waveforms in this part.

Write-up: (Each student should submit his or her own write-up following the standard format)
To be included in Results:
2.1) Examine a plot of each waveform each waveform captured in 1.6, and find several evenly spaced peaks with similar amplitudes. Assuming that the peaks come from transitions on the magnetic mat that are spaced at 1 mm intervals, calculate the velocity of the sensor in each case. Record the amplitude of these peaks. Make a plot of peak amplitude versus sensor-to-mat relative velocity, and include it in your report as Figure 1.

2.2) Repeat this exercise for the data collected in 1.9, and include it as figure 2.

2.3) Using the amplitudes collected in 1.10, make a plot of sensor relative sensitivity as a function of bias voltage, and include it as Figure 3 in the report.

To be included in Discussion:
2.4) Make a sketch of one possible magnetic configuration within the mat that would give rise to the observed behavior.

2.5) Given that the original function of this mat was to stick to highly permeable ferromagnetic surfaces, discuss the advantages of the magnetic configuration that you drew, relative to a single large saturated domain. The use of the concept of magnetostatic charge in this analysis may prove extremely helpful.

2.6) Explain the difference in Figs 1 and 2, in terms of the sensor physics.

2.7) Describe how the bias electrical voltage is turned into a bias magnetic field by the MR wand.

2.8) Discuss at least two advantages offered by a properly biased sensor over an unbiased one, for sensing fields.