TRC2400 Computer Programming
ECE2071 Computer Organisation and Programming

Laboratory Session 3

Week 4 – Semester 1 2011

IMPORTANT – MARKING

You will receive marks for preliminary work and lab completion by completing quizzes on Blackboard
All quizzes receive equal marks and these will be scaled to give a final lab mark worth 10% of your final assessment.
You MUST complete the preliminary work quiz BEFORE midnight of the day before your lab otherwise you will receive a zero mark for the lab exercise (both preliminary and completion mark)
You must start the completion quiz before the end of your laboratory period (you will need the demonstrator to enter a password which will only be provided when you complete the lab)

1. Objectives

This laboratory gives you practice and develops understanding of arrays.

2. Preliminary work

Before coming to the lab you should complete the preliminary work quiz on Blackboard. This week's quiz will cover your understanding of the points above and also the exercises in this prac.

3. First Exercise

In many different applications including image processing, digital hearing aids, cochlear implants, and many other cases of digital signal processing computers are used to process sensor signals to reduce noise or otherwise enhance the signals. In this exercise you will write a C program to implement a median filter.

A median filter smoothes signals corrupted by impulse noise. It is implemented by sliding a window including an odd number of samples over the input data. The input samples within the window are ordered (organized with the highest value at one end of the list through to the lowest at the other end) and the sample in the middle is the median.

In our case n = 3 so a window containing three samples is moved along the data sequence advancing one sample at a time. After the window is moved the computer selects the median value within the window and this becomes the output signal. In terms of data values the median is the value which is in the middle (there are an equal number of values greater than the median as there are less than the median). For instance, if the window contains {10.7, 29.1, 15.4} then the median value is 15.4.
Here is a set of data for you to try your program out on:

```
{0.00, -0.07, 0.08, -0.01, 1.44, 0.00, 0.00, 0.07, -0.01, 0.00, 0.97,
0.96, 1.02, 0.93, 0.9, 0.24, 1.01, 1.04, 1.01, 1.02}
```

The correctly filtered data is:

```
{0.00, -0.07, 0.00, -0.01, 0.08, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.96, 0.97, 0.96, 0.93, 0.90, 0.90, 1.01, 1.01, 1.02}
```

Note that the first two values are simply copied without change because three values are needed to compute the median as shown in the table below.

Time step	Input	Moving window	Output
0	0.00	(0.00, ,)	0.00
1	-0.07	(-0.07, 0.00,)	-0.07
2	0.08	(0.08, -0.07, 0.00)	0.00
3	-0.01	(-0.01, 0.08, -0.07)	-0.01
4	etc.		

4. Second Exercise

In power electronic switched-mode regulators an electronic switch (a field-effect transistor or bipolar junction transistor) rapidly connects and then disconnects the input power source and the output load (see Figure 3.1a).

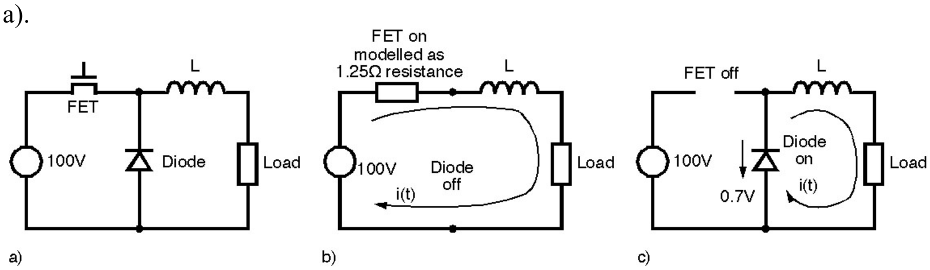

Figure 3.1

When the FET is conducting (Figure 3.1b) current flows through the FET (modeled as a 1.25Ω resistance), inductor L and into the load. When the FET stops conducting the inductor L produces a back emf and current flows from the inductor through the load and diode (modeled as a forward voltage drop of 0.7V) and back to the inductor (Figure 3.1c). Current flow in the FET and diode are as follows:

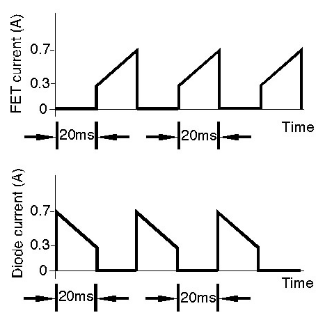

Figure 3.2 Current waveforms in the FET and diode.

Write a program to estimate the average power dissipation in the diode and FET by using Simpson's rule. You will recall that you covered Simpson's rule in ENG1060 revise this material if you are unsure. Approximate each current waveform by 20 rectangles over one period of the waveform. The base of each rectangle corresponds to 2ms and the height to the corresponding height from the current waveforms.

The 'on' characteristic of the FET can be approximated by a resistance (1.25Ω in this case). FET power dissipation is then:

$$p(t) = R_{fet} i^2(t)$$

The diode is assumed to have a constant forward voltage drop of 0.7V. The diode power dissipation is:

$$p(t) = 0.7 i(t)$$

So, for each current/time rectangle you can calculate a power/time rectangle (one each for the diode and FET). To find the total average power dissipation you add up the power dissipated for each 2ms time period (over which you assume the current is constant) and divide by the total number of time periods.

Results for power dissipation are: diode power= 0.17W, FET power = 0.15W. (Your results may vary a little depending on details of your implementation)

5. Conclusion

Please note that marks will not be allocated to people who do not attend their allocated lab and complete the appropriate quizzes by their deadline. Under no circumstances will marks be recorded after the laboratory period is finished.

RAR 17/2/2009; WHL 17/3/2010, RAR 22/2/2011