ECE-486 Laboratory 6, Spring 2009
Due April 27

1 Lab Objectives

Implement a differential phase shift keying (DPSK) demodulator.

2 Assignment

Figure 1 shows the complex receiver front end that you implemented in Lab 4. For this lab, the complex receiver output is to be processed by a a DPSK demodulator. The DPSK signal is described by:

Sample Frequency:	$F_s = 48$ ksps
Data Rate:	$R_b = 500$ bits/sec
Bit Period:	$T_b = 2$ msec/bit, $N_b = 96$ samples/bit
Carrier Frequency:	$F_c = 12.5$ kHz

For testing, you'll need to generate a DPSK signal for a known data sequence. Source code for a DPSK modulator can be downloaded from the course web site. You'll need to run the modulator on one computer while testing your demodulator on a second computer. The modulated signal is created on the left-channel and the right-channel provides a 2 ms pulse which occurs each time the fixed binary data sequence is repeated.

The demodulator shown in Figure 2 processes the complex output of your receiver front-end created for Lab 4. FIR integrators are used to average this signal over one bit period. You may implement the FIR integrator using your modified convolution routine from Lab 2. The impulse response of your FIR filters consist of 1's for one bit period.

$$h(n) = \begin{cases} 1 & n = 0, 1, \ldots, 95 \\ 0 & \text{elsewhere} \end{cases}$$

After averaging over a bit period the signal is passed through a limiter to normalize the input samples (divide an input by its magnitude). The DPSK output data sequence is obtained by comparing the phase for the current bit period to that of one bit period ago. If the phase between the current output and output one bit period ago is the same then the demodulator should output a "1", and otherwise it should output a "0". As shown in Figure 2, the phase comparison is implemented by introducing a one bit period delay of an input sequence, finding a conjugate and multiplying by a current input sequence. Since the magnitude of the integrator outputs have been limitted, the result is

$$\exp(j2\pi\theta(n)) \exp(-j2\pi\theta(n - N_b)) = \exp(j2\pi(\theta(n) - \theta(n - N_b))).$$

The real part of the result gives an indication of the transmitted bit

$$\cos(2\pi(\theta(n) - \theta(n - N_b))) \begin{cases} \approx 1 & \text{no phase shift (transmitted 1)} \\ \approx -1 & \pi \text{ rad phase shift (transmitted 0)} \end{cases}$$

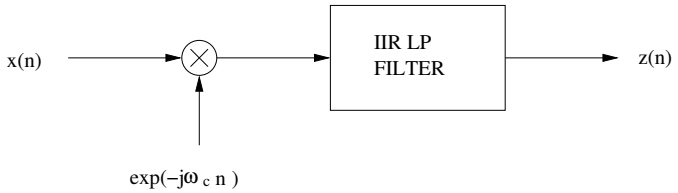

Figure 1: Front end of a receiver.

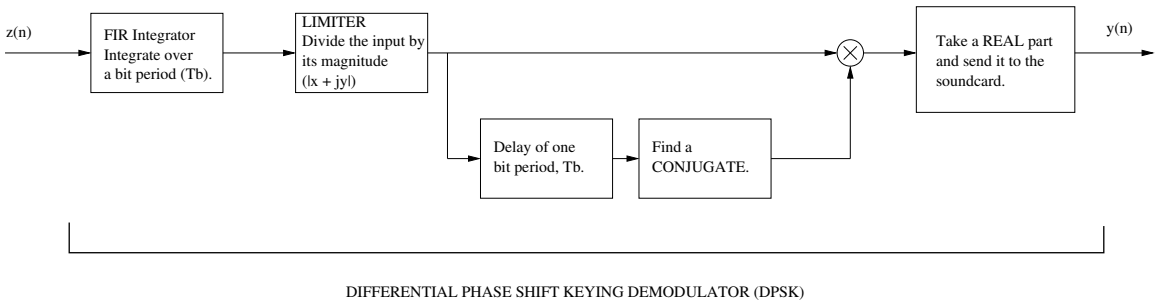

Figure 2: Differential Phase Shift Keying (DPSK) demodulator.

This real part of the result should be writen to the DAC and compared to the actual transmitted sequence.

3 What should be handed in:

Each group needs to hand in source code listings and documentation showing how you tested your routine and results showing that it works.

1. Hand in:

   - A brief written description of your demodulator.
   - Commented Source Code Listings.
   - Documentation showing how you tested your routine, and results showing that it works.

   Listings and documentation will be collected at the beginning of class on the due date.

2. Create a TAR archive containing all C source code files (.c and .h files) required to implement your DPSK demodulator. Include the 'Makefile' required to compile your real-time program. The TAR file should be labeled lab6.tar and uploaded on the ECE 486 website. The TAR file must be uploaded before class (11:00 AM) on the due date.

3. Meet with the TA during your assigned group meeting time in the week of the due date.

ECE-486 Spring 2009 Lab Group Evaluations
Return by May 1

Name : _____

The list below identifies groups that were used for the lab portions of this course. You must evaluate the members of your group (including yourself) based on the level of "engagement" of the group members in the lab work.

Assign a number between one and five to each student in your group:

(1) Best Rating: The group member was very engaged, participated in the implementation of the lab, tried to understand the lab, and contributed to the best of their ability.

(5) Worst Rating: The group member rarely showed up for lab work, except possibly at demonstration times. The group would have functioned just as effectively without the group member.

This is your chance to send me a message... It's OK to give every member of your group a score of (1), if that's how you feel. The ratings you provide will be kept confidential. They will be considered (along with our own observations) in helping to determine how the "instructor evaluation" portion of the grade will be assigned.

To get credit for completing this form, you must give a numerical ranking to all members of your group *including yourself*. (I encourage you to also give more detailed written comments as well—but they are not required.) Don't forget to tell me your own name, so that I can give you credit for filling out this form!

1. Michael Gagne [ ]; Matthew Jones [ ]; Gary Jordan [ ]
2. Nate Broyer [ ]; Fred Schwaner [ ]; Tom McGuan [ ]; Rob England [ ]
3. Seth Kimball [ ]; Nate Cunningham [ ]; Jeff Holeway [ ]
4. David Hunter [ ]; Evan McLellan [ ]; David Chamberlain [ ]
5. Jeremy Dear [ ]; Timothy Faulkner [ ]; Lin Lin [ ]
6. Rob King [ ]; Noah Winter [ ]; Hicham Mziguir [ ]; Zhao Cai [ ]
7. Revant Shah [ ]; Nate Reimensnyder [ ]; Rob England [ ]; Tariq Majeed [ ]