University of Rhode Island Department of Electrical and Computer Engineering
ELE 435: Communication Systems

FM Modulation and Demodulation Procedure, Report and Grading Format

1   Report Format

1. Briefly explain the procedure (what you did in the lab)

2. Show the Results/plots, you can use excel or a snap shot or draw it by hand.

3. Following is a brief procedure

   (a) Modulation

      i. Set VCO to 10KHz, and Audio Oscillator to 1KHz. Set VCO to LO

      ii. Set up the experiment as shown in Figure 2 of FM-Generation By VCO

      iii. Check the output of the VCO, you should be able to see the FM signal. You may want to set the oscilloscope to SINGLE SEQ mode to look at the results.

      iv. Also connect the FM signal to the Spectrum Analyzer and analyze the spectrum.

      v. Vary the frequency slightly (f_0) of the VCO and Show the FM signal and its spectrum. Comment on what differences if you see any. Show plots for two values and you may want to run for other values

      vi. Also vary the GAIN of the VCO and Show the FM signal and its spectrum. Comment on what differences if you see any. Show plots for two values and you may want to run for other values

      vii. Try DC input instead of sin input of the Audio oscillator and check the FM signal

   (b) Demodulation.

      i. Initially provide a 2 KHz $\sin(\omega t)$ from MASTER SIGNALS module as the input to COMPARATOR (UTILITIES module) and look at the output of the TWIN PULSE GENERATOR. (shown in figure 3: demodulator model). You should be able to see an impulse train

      ii. Now give the FM signal as input and look at the output of the HEADPHONE AMPLIFIER. It should be a sinusoid with freq about 1KHz (the freq of the Audio Oscillator). If you change the frequency of the Audio oscillator the demodulated signal frequency should change. You may want to look at the impulse train output, by looking at the output of the TWIN PULSE GENERATOR

4. Answer the following questions

   (a) What is the Angle modulation, and explain briefly how it is different from Amplitude Modulation.

   (b) What is PM and FM, and explain briefly how they are different from each other.

   (c) What is instantaneous frequency or frequency

   (d) What is modulation index β or frequency deviation

   (e) How does β affect bandwidth, power of an FM signal

   (f) List atleast 3 properties of Bessel Functions/coefficients

   (g) Show the spectrum of an FM signal

   (h) What is the spacing between the spectral lines

   (i) Express the amplitude of an nth component in terms of Bessel coeff

   (j) Define Bandwidth of an FM signal

   (k) Define Narrowband Angle-modulated signal

   (l) What is Armstrong method or indirect method

   (m) Briefly explain Hilbert transform and its properties (Page 659 of the textbook)

You can work in groups but everybody should submit an individual report. If you are working with somebody, please list their names.