Lab 1: Prelab

Joshua Emele <jemele@acm.org>

October 1, 2015

1 Theory Problems

1.1 Spectrum of AM modulated signals

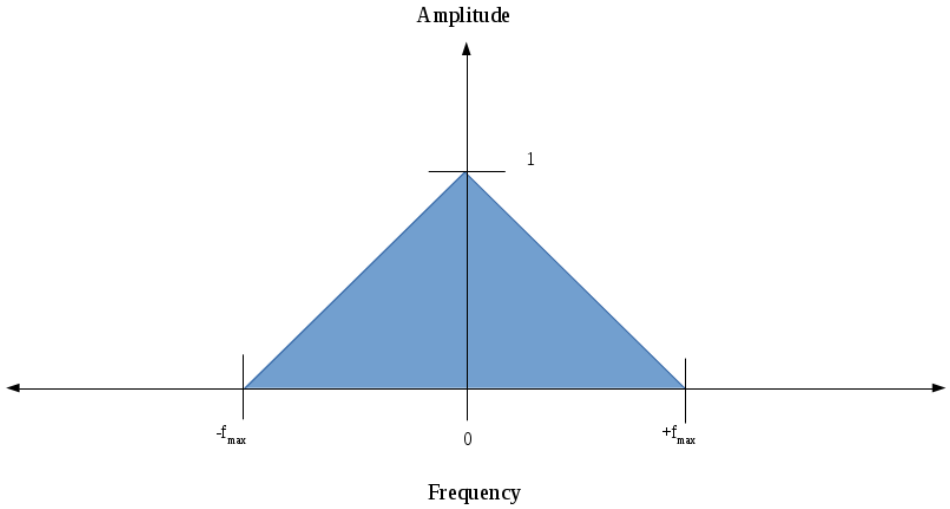

Figure 1: **Describe figure 1... here**

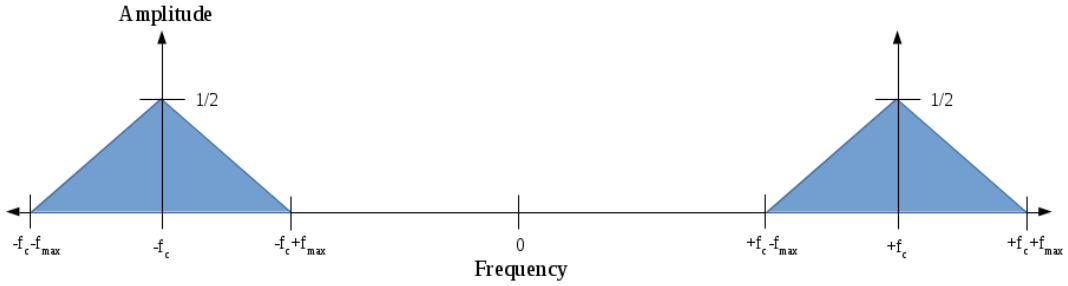

Figure 2: **Describe figure 1a... here**

1.2 Frequency demodulation errors

1.3 Phase demodulation errors

An AM signal $\tilde{s}(t) = A\ cos(2\pi f_c t)$ where A is a constant is demodulated by $cos(2\pi f_c t + \phi)$ where ϕ represents a phase error.

An expression for the demodulated signal $d(t, \phi)$ as a function of the phase error ϕ is given by:

$$d(t, \phi) = A\ cos(2\pi f_c t) cos(2\pi f_c t + \phi) \tag{1}$$

The period of the carrier f_c is given by $T = \frac{1}{f_c}$.

If the demodulated signal $d(t, \phi)$ is integrated over a time period T that is many times the period of the carrier (i.e., $N\ T$, where $N >= 2$), the value of the integral without phase error ($\phi = 0$) is given by:

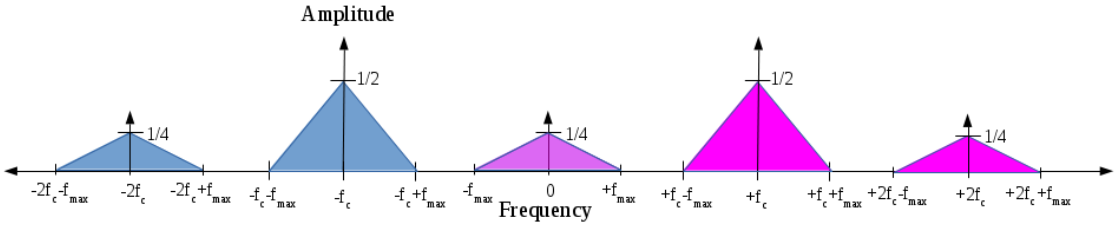

Figure 3: **Describe figure 1b... here**

$$\begin{aligned} M_0 &= \int_0^{\frac{2}{f}} A\ cos(2\pi f_c t) cos(2\pi f_c t) \\ &= \frac{1}{f} \end{aligned} \tag{2}$$

The value of the integral with phase error ($\phi \neq 0$) over the same period is given by:

$$\begin{aligned} M_1 &= \int_0^{\frac{2}{f}} A\ cos(2\pi f_c t) cos(2\pi f_c t + \phi) \\ &= \frac{cos(\phi)}{f} \end{aligned} \tag{3}$$

The maximum phase error ϕ that can be tolerated for the demodulated signal to ensure the amplitude is within ten percent of the amplitude without a phase error is given by:

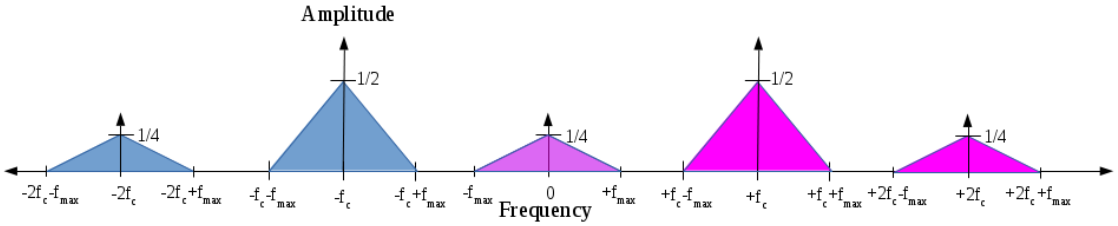

Figure 4: **Describe figure 2a... here**

$$\begin{aligned} \frac{M_0}{M_1} &\leq 10 \\ sec(\phi) &\leq 10 \\ |\phi| &\leq \ sec^{-1}(10) \\ |\phi| &\leq \ 0.4706 \end{aligned} \tag{4}$$

2 Matlab/Simulink Simulations

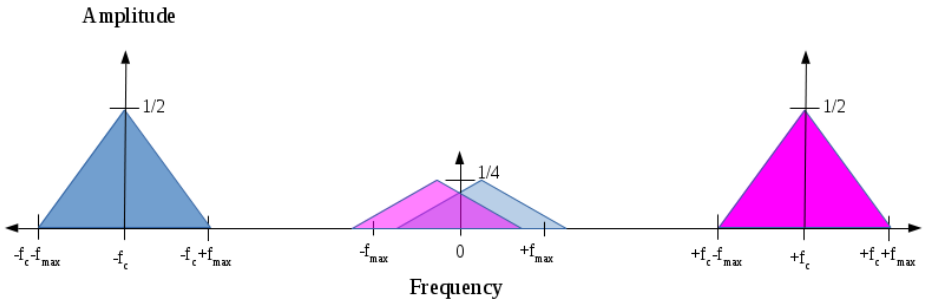

Figure 5: **Describe figure 2b... here**

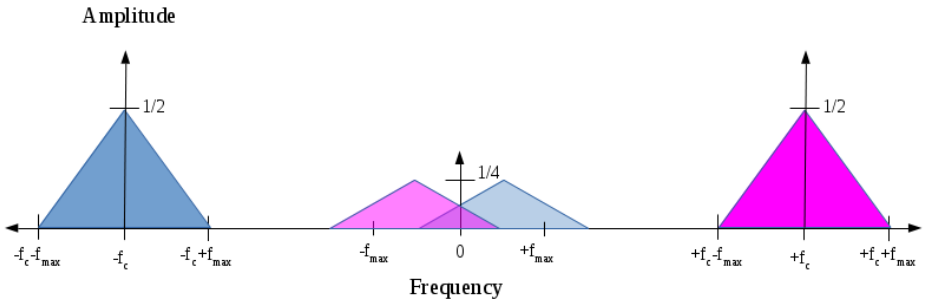

Figure 6: **Describe figure 2c... here**