Practical Assignment

August 12, 2013

1. (**Loopback test**) Obtain a audio cable with 3.5mm stereo jacks on either end. Connect one end to the audio output of your soundcard, and the other end to the audio input. Using the software available on the course website (see folder called "loopback"), or your own software, play a sinusoidal signal of frequency 100Hz for a finite duration of time (atleast 2 seconds). Assert that you can hear the tone when the cable is not plugged in and the audio is played through internal computer speakers, or a set of connected headphones. Obtain samples at rate $F_s = 44100$Hz,

$$x_1, \dots, x_L, \qquad y_1, \dots, y_L$$

   from the left and right channels of the soundcard input, where L is the number of samples obtained. Reconstruct the signals as

$$\tilde{x}(t) = \sum_{\ell=1}^{L} x_\ell \operatorname{sinc}(F_s t - \ell), \qquad \tilde{y}(t) = \sum_{\ell=1}^{L} y_\ell \operatorname{sinc}(F_s t - \ell)$$

   where

$$\operatorname{sinc}(t) = \frac{\sin(\pi t)}{\pi t}. \tag{1}$$

   Plot these reconstructed signals for a 20ms window from $t = 1$s to 1.02s.

2. (**Multiplier**) Consider the operational amplifier circuit in Figure 1. Analyse this circuit to obtain a relationship between the input voltage x and the output voltage y. Build the circuit on a breadboard and, using the soundcard, input the signal

$$x(t) = \tfrac{1}{3}\sin(2\pi f_1 t) + \tfrac{1}{3}\sin(2\pi f_2 t)$$

   with $f_1 = 100$ and $f_2 = 233$. Using the (stereo) soundcard simultaneously record the input signal x directly from the soundcard ouput and also the output voltage signal y. Build reconstructed approximate signals $\tilde{x}$ and $\tilde{y}$ from the samples obtained and hypothesise a relationship between $\tilde{x}$ and $\tilde{y}$. Plot $\tilde{x}$, $\tilde{y}$ and the hypothesised signal over a 20ms duration and comment on the validity of your hypothesis. List the components that you used in constructing the circuit.

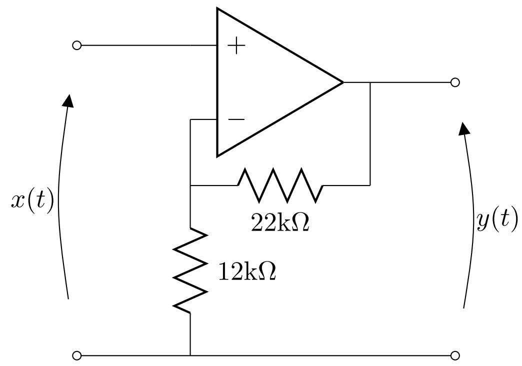

Figure 1: Operational amplifier circuit configured as a multiplier