

CIE 227 Signals and Systems

Project 1

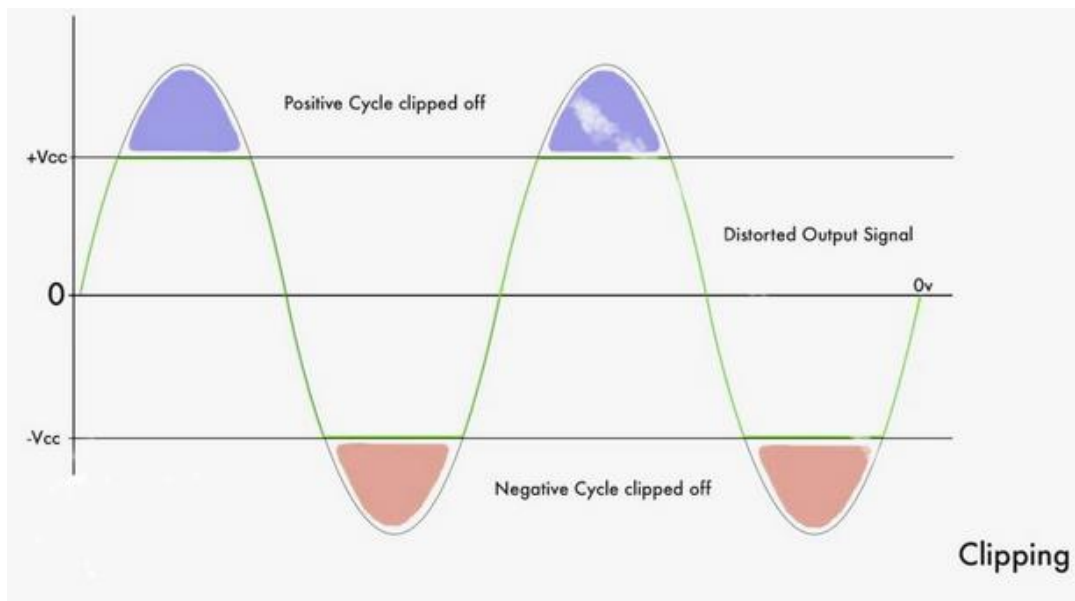
Audio Distortion Meter

An important device for testing the quality of audio amplifiers is the distortion meter. The Audio system to be tested is fed with a continuous sin wave of a selected audio frequency, for example 1000 Hz. The output signal from the amplifier is sampled at 16000 Sps, and analyzed by a Fourier series analysis, and the sum of the squares of all harmonics starting from the second harmonic is calculated.

The % distortion is

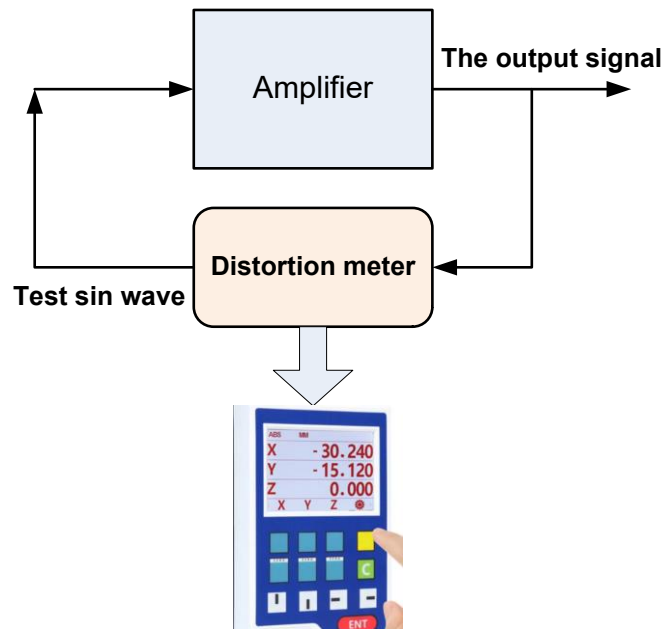
$\% \text{ Dist} = 100 * (\text{sum of the squares of all harmonics (up to the } 10^{\text{th}} \text{ harmonic)}) / (\text{square of the amplitude of the fundamental frequency of the output}).$

To test your method, assume the amplifier system is (nonlinear) given by



- 1) The test signal is a pure sinusoidal signal at 1000 Hz, generated by the testing device of amplitude 20 volts.
- 2) The output $Y[n]$ is clipped by the Amplifier. The amplifier clips the output signal $Y[n]$ to a max absolute value of 15
 $Y[n] = 15 \text{ if } x[n] \geq 15$

3) $Y[n] = -15$ if $x[n] \leq -15$



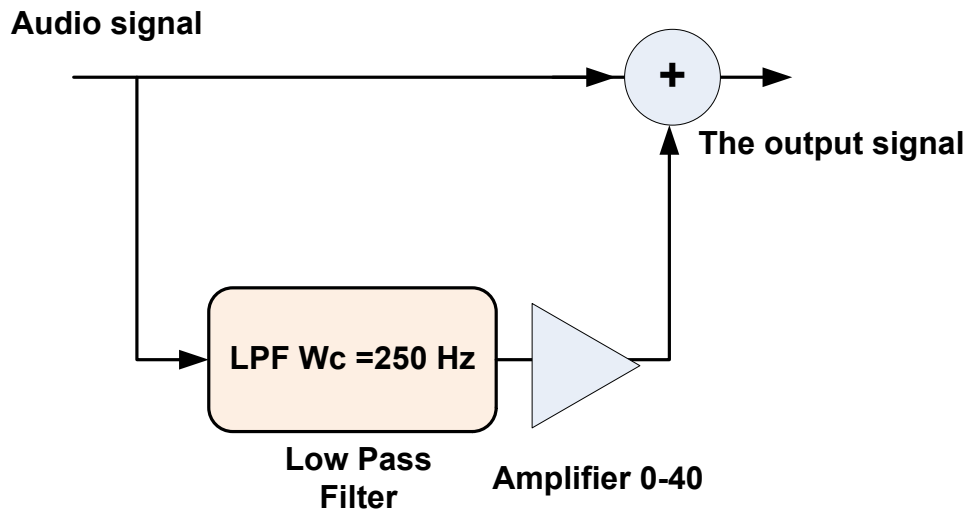
Use $F_s = 16000$ sps

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Project 2

Build a Bass Amplifier

A Bass booster amplifies the low frequency in the audio signal.



Use Matlab/Simulink. Use an input and output signals sampled at 44100 sps.

Convert the signal to a wav file (using matlab)

- 1) Build a FIR LPF of order 20. Use cutoff frequency of 250 Hz.
- 2) Add Amplifier (gain) after the LPF with variable gain 0-40
- 3) Use about 5-10 seconds Audio speech (or music) mp3 as an input
- 4) Process the sign by the LPF and the amplifier
- 5) Save the output signal and play it.
- 6) Change the gain and select a suitable value for demonstration
- 7) You need to submit the Matlab code and the input audio and the output audio, and the selected amplifier gain.

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Project 3

Echo generator

The echo generator adds a delayed version of the input signal to the input signal.

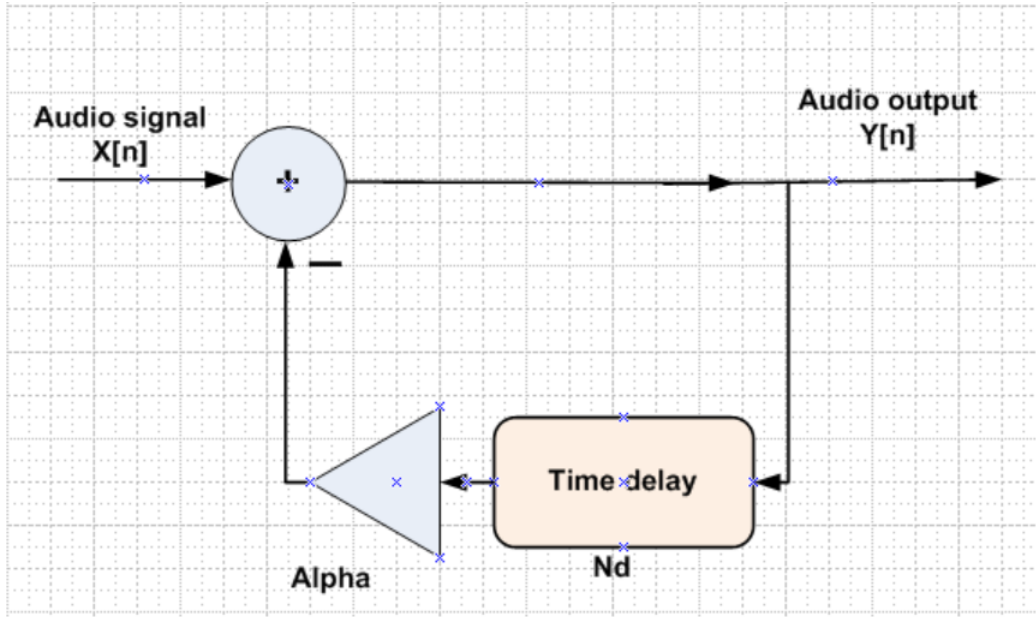
$$Y[n] = x[n] + \alpha * Y[n - N_d] \quad \alpha = 0.4 \text{ to } 0.8$$

N_d is equivalent to delay from 50 msec to 2 seconds

$N_d * T_s$ is the (Delay in seconds)

Try various values of α and delay and hear the input sound and the output sound. You need to submit the Matlab code and the input audio and the output audio as mp3 or wav, files 5-10 seconds.

Generate at least 3 seconds of output after $x[n]$ ends.



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