Matlab Project 3

Fourier Series Synthesizer

Exercise 1 Square Wave

%Square Wave

clc, clear all, close all;

K = 19; %as K goes higher, the sound becomes more distorted, the waveform seems to play clearest at K values between 17-20

fs = 8000;

f0 = 210; %When f0 is changed to 420 Hz, the waveform sound is exactly 1 octave higher, as the starting frequency has doubled which corresponds to one octave change

n = 0:2\*fs;

t = 0:1/fs:1;

xt = zeros(size(t));

xt(1:2000) = 1;

xt(2001:6000) = -1;

xt(6001:8001) = 1;

figure,plot(t,xt)

for k = -K:K

ak(k+K+1) = sum(xt.\*exp(-j\*k\*2\*pi\*t))\*1/fs;

end

figure,plot(real(ak))

xn = zeros(size(n));

for k= -K:K

xn = xn + ak(k+K+1).\*exp(j\*k\*2\*pi\*f0/fs\*n);

end

soundsc(real(xn),fs)

Exercise 1 Triangle Wave

%Triangle Wave

clc, clear all, close all;

K = 19; %as K goes higher, the sound becomes more distorted, the waveform seems to play clearest at K values between 17-20

fs = 8000;

f0 = 210; %When f0 is changed to 420 Hz, the waveform sound is exactly 1 octave higher, as the starting frequency has doubled which corresponds to one octave change

n = 0:2\*fs;

t = 0:1/fs:1;

xt = zeros(size(t));

xt(1:4000)= 1:-2/fs:0+2/fs;

xt(4001:8001) = 0:2/fs:1;

figure,plot(t,xt)

for k = -K:K

ak(k+K+1) = sum(xt.\*exp(-j\*k\*2\*pi\*t))\*1/fs;

end

figure,plot(real(ak))

xn = zeros(size(n));

for k= -K:K

xn = xn + ak(k+K+1).\*exp(j\*k\*2\*pi\*f0/fs\*n);

end

soundsc(real(xn),fs)

Exercise 2 Synthesizer Function

%This function takes values passed from "testsynth" and generates

%the signal that is passed back to "testsynth" and written to a .wav file

function y = synth(freq,dur)

K = 19;

fs = 8000;

f0 = 210;

n = 0:0.5\*fs;

t = 0:1/fs:1;

xt = zeros(size(t));

xt(1:2000) = 1;

xt(2001:6000) = -1;

xt(6001:8001) = 1;

for k = -K:K

ak(k+K+1) = sum(xt.\*exp(-j\*k\*2\*pi\*t))\*1/fs;

end

xn = zeros(size(n));

y = [];

for mi = 1:length(freq)

xn = 0;

n = 0:0.5\*fs\*dur(mi);

for k= -K:K

xn = xn + ak(k+K+1).\*exp(j\*k\*2\*pi\*freq(mi)/fs\*n);

end

y = [y,xn];

end

wav = y/max(abs(y));

wavwrite(real(wav),fs, 16,'Trevor.wav'); %writes the song to a .wav file

Exercise 2 Synthesizer Script

%This script calls the function "synth" which plays the song

%described by the notes in the vector "mllnotes"

clc,clear all,close all;

twelve = 440\*2.^((0:12)./12);

major = twelve([1,3,5,6,8,10,12,13]);

mllnotes = [3,2,1,2,3,3,3,2,2,2,3,5,5,3,2,1,2,3,3,3,3,2,2,3,2,1];

%dur controls the note lengths to each note in the song played

dur = [1,1,1,1,1,1,2,1,1,2,1,1,2,1,1,1,1,1,1,1,1,1,1,1,1,2];

freq = major(mllnotes);

z = synth(freq,dur);

soundsc(real(z),8000); %Plays song described in "mllnotes"