DESC9115 2012 LAB REPORT 2

DIGITAL AUDIO SYSTEMS

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Date: Tuesday 8 May, 2012

Wahwah.m

The aim of this code is to demonstrate the understanding of the processes within the function of wah-wah effect. The wah-wah effect was firstly used to describe a guitar effect pedal that mimics human voice by changing the tone of signal to create a unique 'wah' sound. The band-pass filter inside the wah-wah pedal is the core item that brings out the wah-wah sound effect. The method to implement the wah-wah effect in Matlab code has the similar concept as the wah-wah pedal.

Syntax

```
dataout = mywahwahfunction_2(x, fs, damp, minf, maxf, fw)
```

Description

Each input signal should first be imported as data for processing. The user inputs the variables `x` and `fs` in the function call. The acoustic.wav wave file is loaded.

Input

`x` = signal to be processed

`fs` = sample rate in Hertz

`dampmax` = maximum damping factor

`dampmin` = minimum damping factor

`qf` = Q factor

`minf` = minimum centre cutoff frequency of variable bandpass filter

`maxf` = maximum centre cutoff frequency of variable bandpass filter

`fw` = wah frequency, how many Hz per second are cycled through

Output

`dataout` = wah output signal

`'Out_wah.wav'` = Written wave file output

Process

The wah-wah code function is mainly doing the three parts:

1. Create a triangle wave to modulate the centre frequency of the bandpass filter.

```
% create triangle wave of centre frequency values
```

```
fc = minf:delta:maxf;

while(length(fc) < length(x) )
   fc = [ fc (maxf:-delta:minf) ];
   fc = [ fc (minf:delta:maxf) ];
end
```

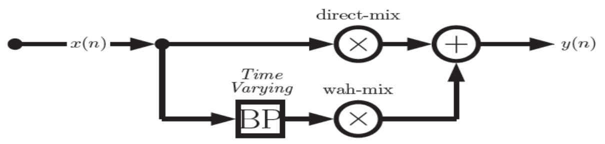
2. Implementation of the state variable filter

```
% trim tri wave to size of input
fc = fc(1:length(x));
% difference equation coefficients
% must be recalculated each time Fc changes
F1 = 2*sin((pi*fc(1))/fs);

% the Q value changes
deltaQ = qf/fs;

% create triangle wave of centre frequency values
Qc = dampmin:deltaQ:dampmax;

while(length(Qc) < length(x) )
  Qc = [ Qc (dampmax:-deltaQ:dampmin) ];
  Qc = [ Qc (dampmin:deltaQ:dampmax) ];
 end

 % trim tri wave to size of input
 Qc = Qc(1:length(x));
 Qc = 2*Qc;

% create emptly out vectors
yh=zeros(size(x));
yb=zeros(size(x));
yl=zeros(size(x));
% first sample, to avoid referencing of negative signals
yh(1) = x(1);
yb(1) = F1*yh(1);
yl(1) = F1*yb(1);
```

3. Repeated recalculation if centre frequency within the state variable filter loop

```
% apply difference equation to the sample
for n=2:length(x),
    yh(n) = x(n) - yl(n-1) - Q1(n)*yb(n-1);
    yb(n) = F1*yh(n) + yb(n-1);
    yl(n) = F1*yb(n) + yl(n-1);
    F1 = 2*sin((pi*fc(n))/fs);
end
```

The signal flow for a wah-wah is as follows:



where **BP** is a time varying frequency bandpass filter.

Figure 1 – Diagram of function (signal flow)

Output

The **Wah_wah.m** outputs the affected wave file filtered by wah-wah filter. Here is the filtered plot.

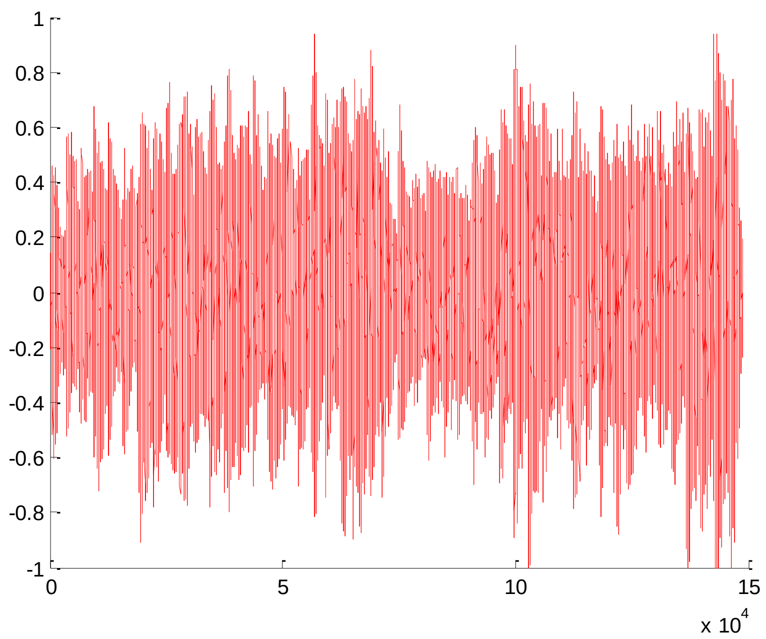


Figure 2 – wah-wah filtered plot

References

Code and diagram of function: CM0340 Tutorial 6: MATLAB Digital Audio Effects

Mathematical equations: Digital Audio Signal processing chapter 5 pg. 119