Speaker Recognition

INTEGRANTES: Meola Franco Román, Puente Julieta, Strubolini Diego Martín
ITBA Segundo Cuatrimestre 2014

PALABRAS CLAVE: transformada de fourier, mfcc

Resumen

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1. Introducción

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2. Metodología

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2.1. Implementación

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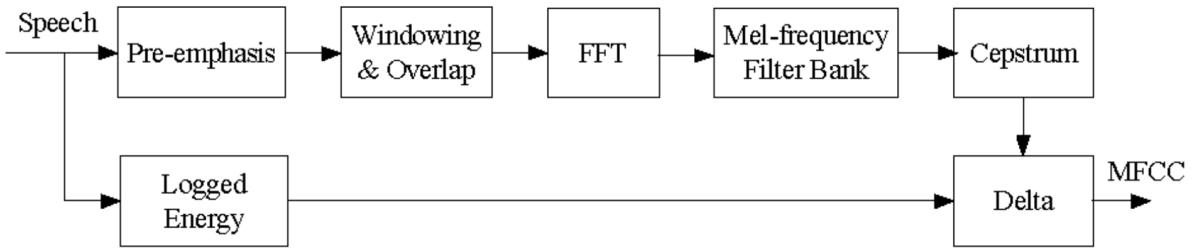

Figura 1: Diagrama de Trabajo

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2.2. Función Principal

```
\Llama a las demas funciones

function mfcc = mfcc(y,fv,fbanks)

overlap_percentage = 0.5;
frame = 0.02; \%20 ms

total_samples = rows(y);
frame_size = fv*frame;
overlap = overlap_percentage*frame_size;

yp = preemphasis(y,rows(y));

\figure(1);
\plot(y);
\title("original");

\figure(2);
\plot(yp);
\title("preemphasis");

\funcion de hamming
ham = hamming(frame_size);

total_frames = floor(total_samples/overlap)-1;

\Se iteran por los frames
\sacarle magic numbers
coef_amount = 13;
filter_amount = 33;

for f = 1: total_frames
    yw = windowing(yp,frame_size,f,overlap,ham);
    yf = fft(yw);
    yper = periodogram(yf,frame_size);
    \if f == 4
    \ figure(3)
    \ plot(yper);
    \end
    for fb = 1 : rows(fbanks)
        energy = 0;
        filterbank = fbanks(fb,:);
        for fftpoint = 1 : columns(filterbank)
            energy += filterbank(fftpoint)*yper(fftpoint);
        end
        filterenergies(fb)=energy;
    end
    for n = 1 : (coef_amount - 1)
        c=0;
        for k = 1 : filter_amount
            c+=log(filterenergies(k))*cos(n*(k-0.5)*pi/filter_amount);
        end
        coef(n)=c;
    end
    energycoef = loggedenergy(y,frame_size);
    n+=1;
    coef(n)=energycoef;
    for k = 1 : n
        mfcc(k,f) = coef(k);
    end
end
\Se calculan los deltas
delta(1,:) = (2*(mfcc(:,3)) + (mfcc(:,2)))/10;
delta(2,:) = (2*(mfcc(:,4)) + (mfcc(:,3)) - mfcc(:,1)))/10;
for f = 3 : (total_frames-2)
    delta(f,:) = (2*(mfcc(:,f+2) - mfcc(:,f-2)) + (mfcc(:,f+1) - mfcc(:,f-1)))/10;
end
delta(total_frames-1,:) = (2*(-1*mfcc(:,total_frames-3)) + (mfcc(:,total_frames) - mfcc
    (:,total_frames-2)))/10;
delta(total_frames,:) = (2*(-1*mfcc(:,total_frames-2)) + (-1*mfcc(:,total_frames-1)))
    /10;
```

```
70
71 \guardo los deltas
72 for f = 1 : total_frames
73     for k = 1 : coef_amount
74         mfcc(coef_amount + k,f) = delta(f,k);
75     end
76 end
77
78 mfcc;
```

Código 1: mfcc.m

```
1  function res = main()
2  sample_frequency = 8000;
3  filter_amount = 33;
4
5  fbanks = filterbanks(300,sample_frequency/2, filter_amount, 256);
6  [y,fv,bps] = wavread('media/JuanDaniela.wav');
7  coeforiginal = mfcc(y,fv,fbanks);
8  coefvqoriginal = vq(coeforiginal,16);
9
10 (...)
11
12 disp("Daniela");
13
14 [y,fv,bps] = wavread('media/HolaFranco.wav');
15 coefprueba1 = mfcc(y,fv,fbanks);
16 md1 = meandist(coefprueba1,coefvqoriginal);
17 disp(md1);
18
19 [y,fv,bps] = wavread('media/HolaSandra.wav');
20 coefprueba2 = mfcc(y,fv,fbanks);
21 md2 = meandist(coefprueba2,coefvqoriginal);
22 disp(md2);
23
24 (...)
```

Código 2: main.m

2.2.1. Pre-emphasis

```
1  function yp = preemphasis(y, rows)
2
3  a = 0.97;
4  yp(1) = y(1);
5
6  for n = 2:rows
7      yp(n) = y(n) - a * y(n-1);
8  end
9
10 yp;
```

Código 3: Pre-emphasis

2.2.2. Windowing and Overlap

```
1  function yw = windowing(y,frameSize,frameNmb,overlap, hamming)
2
3  i=1;
4  for k=1 + overlap*(frameNmb -1) : frameSize + overlap*(frameNmb-1)
5      yw(i)=y(k)*hamming(i);
6      i=i+1;
7  end
8
9  yw;
```

Código 4: Windowing

2.2.3. FFT

Para el cálculo de la transformada de Fourier utilizamos el método `fft` provisto por Octave.

2.2.4. Mel-frequency Filter Bank

```
function fb = filterbanks(min,max,amount,fftsize)

mmax = mel(max);
mmin = mel(min);
step = (mmax-mmin)/(amount+1);

for k=1:amount+2
    num = (k-1)*step + mmin;
    f(k) = num;
    fm(k) = melinv(num);
    fb(k) = floor((fftsize+1)*fm(k)/(max*2));
end

fbank = zeros(amount,fftsize/2+1);

for j=1:amount
    for i=fb(j):fb(j+1)
        fbank(j,i) = (i - fb(j))/(fb(j+1)-fb(j));
    end
    for i=fb(j+1):fb(j+2)
        fbank(j,i) = (fb(j+2)-i)/(fb(j+2)-fb(j+1));
    end
end

fb = fbank;
fb;
```

Código 5: filterbanks

2.2.5. Cepstrum

2.2.6. Logged Energy

```
function energy = loggedenergy(y,framesize)

energy = 0;
for n = 1 : framesize
    energy += y(n)**2;
end;

energy = log(energy);
energy;
```

Código 6: Logged Energy

3. Resultados

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Persona	Coincidencia	Falsa Concidencia
Franco	No	Enzo
Sandra	Si	-
Enzo	Si	-
Paula	Si	-
Diego	Si	-
Monica	No	Julieta
Julieta	No	Sandra
Daniela	No	Juli
Agustina	No	Sandra
Patricio	No	?
Sebastián	Si	-

Cuadro 1: Susana

Persona	Coincidencia	Falsa Concidencia
Franco	No	Sandra
Sandra	No	Enzo
Enzo	Si	-
Paula	Si	-
Diego	Si	-
Monica	No	Julieta
Julieta	Si	-
Daniela	Si	-
Agustina	No	Julieta
Patricio	No	Sebastián
Sebastián	Si	-

Cuadro 2: Juan

4. Conclusiones

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- Manual de Funciones de Octave `https://www.gnu.org/software/octave/doc/interpreter/`

6. Funciones Auxiliares

```
1 function m = mel(f)
2
3 m = 1125*log(1+f/700);
4
5 m;
```

Código 7: Mel

```
1 function m = melinv(f)
2
3 m = 700*(exp(f/1125)-1);
4
5 m;
```

Código 8: Mel Inversa

```
1 function yp = periodogram(y,frameSize)
2
3 for k=1 : frameSize
4   yp(k)= (abs(y(k))**2)/frameSize;
5 end
6
7 yp;
```

Código 9: Periodogram