โปรแกรม MATLAB วิเคราะห์สัญญาณคลื่นเสียงภายในท่อ

(ก) โปรแกรมหลัก

%Read File Sound

clear,close all

```
[y,fs,Nbits]=wavread('D:\Thesis\sound\B1 48000\200');


            fprintf('\n\t Sampling of Sound Record = %d Samples/second\n',fs);
            fprintf('\n\t Number of Data Bits per Sample Record = %d Bit\n',Nbits);


figure,...
        plot(y,'k'),grid,...
                title('Sound Recording'),xlabel('Samples'),ylabel('Amplitude')


                    n=0:1:length(y)-1;
                    T=1/fs;


figure,...
        plot(n*T,y,'k'),grid,...
                    xlabel('Time(second)'),ylabel('Amplitude')
                title('Original Sound Signal')
```

% Selected Sound Signal

```
[xin,yin]=ginput(2);
n1=fix(xin(1)/T)+1;
n2=fix(xin(2)/T)+1;
y=y(n1:n2);


 n=0:1:length(y)-1;
 T=1/fs;
P=((n*T)+((n1-1)*T));


figure,...
        plot(P,y,'k'),grid,...
                xlabel('Time(second)'),ylabel('Amplitude')
                title('Selected Sound Signal')


                fprintf('\n\t Data of Selected Sound Signal : %d Samples\n', length(y))
```

% Lowpass Filtered Sound Signal

```
fc=20000;
 N=24;


        f = butterlpf(N,fc,fs,y);
```

% Fast Fourier Transform

```
Y1=fft(f);

L=length(Y1);

A=(0:L-1)/L*fs;


figure,...

    plot(A,abs(Y1),'k'),grid,...

                xlabel('Frequency'),ylabel('Amplitude Spectrum')

                title('Spectrum')

                axis([0 2500 0 2500])


                [xin,yin]=ginput(2);

                n1=fix(xin(1));

                n2=fix(xin(2));

                F=(n2-n1);


                fprintf('\n\t Frequency of Pipe = %d Hz\n',F);
```

% Analysis Liquid Level

```
Tc=25;

Lpipe = 220;


                v=331+0.6*Tc;

                Lair = (v*100)/(2*F);


                fprintf('\n\t Air Level = %.0f cm\n',Lair);


                Lwater = Lpipe-Lair;


                fprintf('\n\t Liquid Level = %.0f cm\n',Lwater);
```

(ข) โปรแกรมย่อย

    ข.1 ฟังก์ชั่นวงจรกรองความถี่สัญญาณคลื่นเสียง

```
function f=butterlpf(N,fc,fs,y)


        wn=fc/(fs/2);
        [b,a]=BUTTER(N,wn);
        [H,w]=freqz(b,a,48000);


figure,...
        plot(w*fs/(2*pi),abs(H),'k'),grid,...
                xlabel('Frequency'),ylabel('Magnitude')
                title('Frequency Response of Lowpass Filter')
                %  close


        f=filter(b,a,y);
                n=0:1:length(y)-1;
                T=1/fs;


figure,...
        plot(n*T,f,'k'),grid,...
                xlabel('Time(second)'),ylabel('Amplitude')
                title('Lowpass Filtered Sound Signal')


        f=f/(max((abs(f))));


figure,...
        plot(n*T,f,'k'),grid,...
                 xlabel('Time(second)'),ylabel('Amplitude')
                title('Normalize')
```