%formants extraction

[x,fs]=audioread('C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin\work\data\1-11.wav');

% plot waveform

t=(0:length(x)-1)/Fs; % times of sampling instants

subplot(2,1,1);

plot(t,x);

legend('Waveform');

xlabel('Time (s)');

ylabel('Amplitude');

% get Linear prediction filter

ncoeff = round(Fs/1000) + 2; % rule of thumb for formant estimation

%lpc Linear Predictor Coefficients.

%A = lpc(X,N) finds the coefficients, A=[ 1 A(2) ... A(N+1) ], of an Nth

%order forward linear predictor.

a=lpc(x,ncoeff);

% plot frequency response

[h,f]=freqz(1,a,512,Fs);

subplot(2,1,2);

plot(f,20\*log10(abs(h)+eps));

legend('LP Filter');

xlabel('Frequency (Hz)');

ylabel('Gain (dB)');

%To find the formant frequencies from the filter, we need to find the locations of the resonances that make up the filter.

%This involves treating the filter coefficients as a polynomial and solving for the roots of the polynomial.

% find frequencies by root-solving

r=roots(a); % find roots of polynomial a

r=r(imag(r)>0.01); % only look for roots >0Hz up to fs/2

ffreq=sort(atan2(imag(r),real(r))\*Fs/(2\*pi));

% convert to Hz and sort

for i=1:length(ffreq)

fprintf('Formant %d Frequency %.1f\n',i,ffreq(i));

end