Linear Prediction in MATLAB

Signal is from ELECTENG 733 Lab 2. “Carl leaps into a jeep” male, NZ English.

# MATLAB Code

clear;

% Audio file to be analysed

filename = 'vowel.wav';

% Linear prediction order

p = 3;

% Read file

[s,Fs] = audioread(filename);

n = 0:size(s)-1;

% Perform LPC analysis, determine estimated signal and error

a = lpc(s,p);

s\_est = filter([0,-a(2:end)],1,s);

e = s-s\_est;

% Zoom in on the signal and error

n1 = 501:800;

s1 = s(n1);

e1 = e(n1);

% Plot of signals

figure(1);

plot(n,s,n,s\_est);

legend('orginal','estimated');

xlabel('n')

ylabel('s[n]')

title('Original signal and Estimated signal');

% Plot of error signal

figure(2);

plot(n,e);

xlabel('n')

ylabel('e[n]')

title('Error');

% Plot of zoomed in signal

figure(3);

subplot(2,1,1)

stem(n1,s1);

xlabel('n')

ylabel('s[n]')

title('Original Signal')

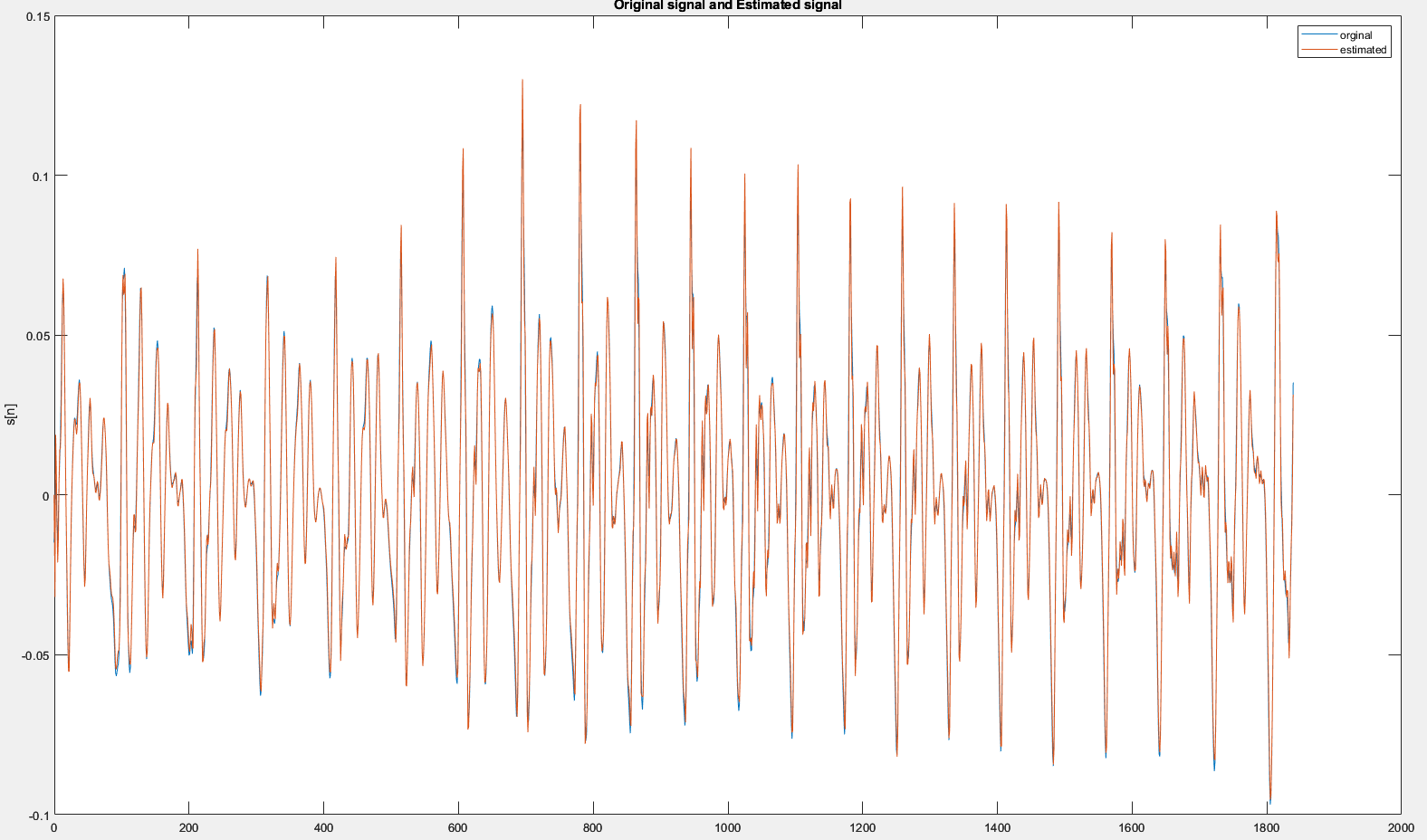
subplot(2,1,2)

stem(n1, e1.^2);

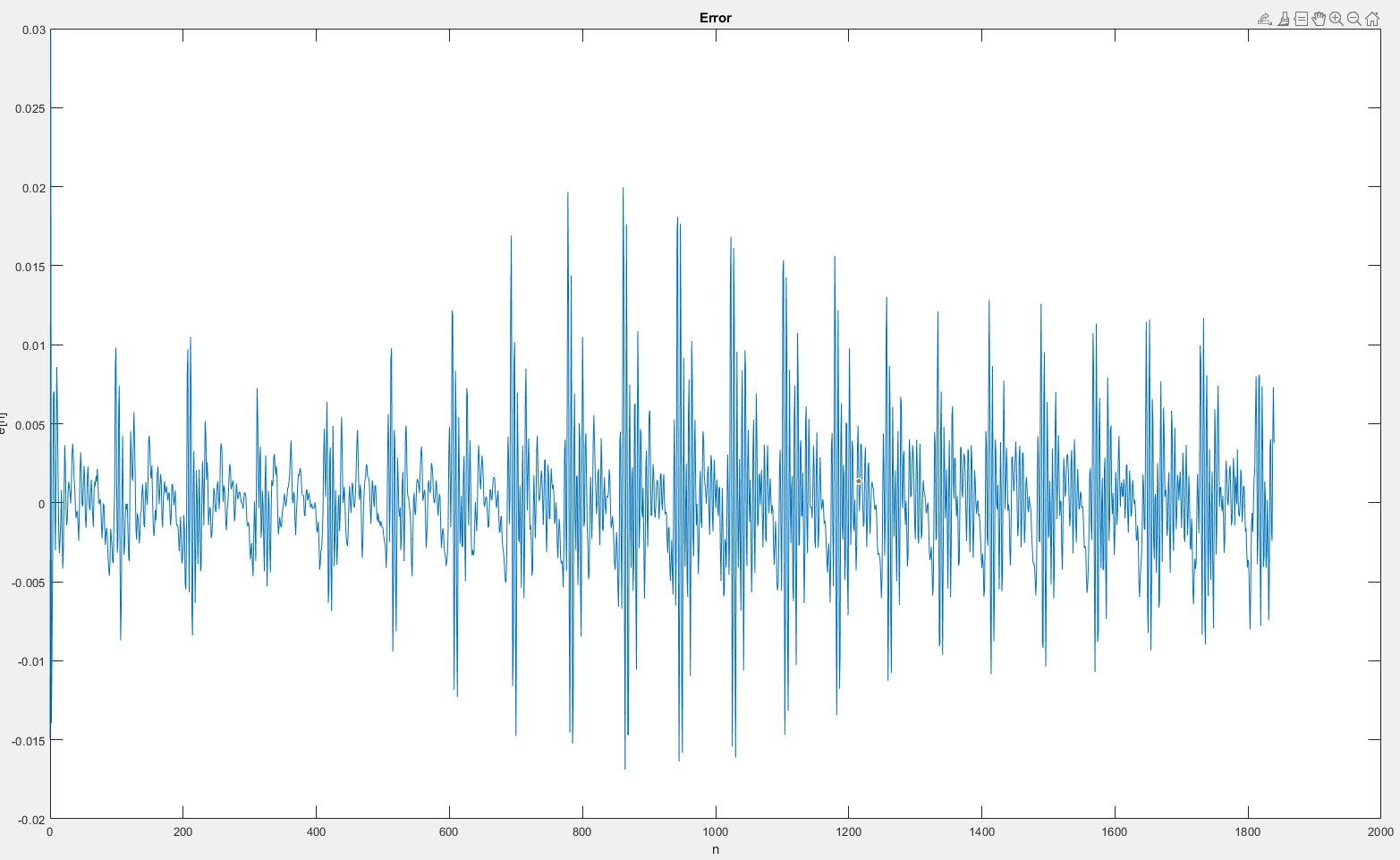
xlabel('n')

ylabel('e[n]^2')

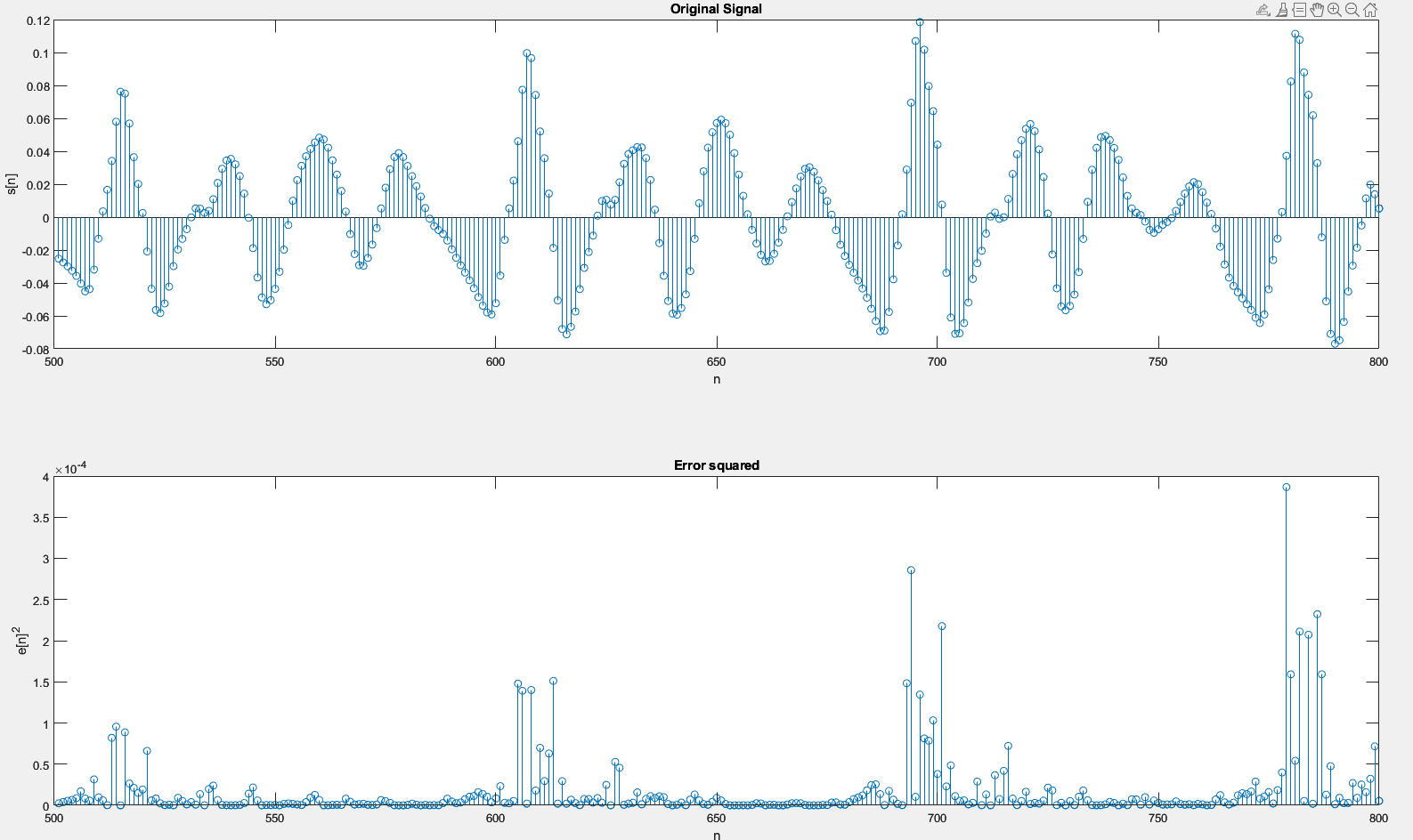
title('Error squared')



*A zoomed in vowel sound /a/ in “Carl” and the prediction . Prediction order is 3.*

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*Error signal .*

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*Stem plot of a few periods and the corresponding error. Peaks of the error line up with peaks in the signal.*

# Long Term Prediction

The following MATLAB code implements the long term prediction,

% Long term prediction order

Q = 2;

% Pitch estimation

f0 = pitch(e, Fs, Method='LHS');

N0=Fs./f0;

N0\_avg = round(mean(N0));

% Shift error to the right by N0, e(1)=e\_shift(N0+1)

e\_shift = zeros(size(e,1)+N0\_avg,1);

e\_shift(N0\_avg+1:end) = e(1:end);

n2 = 0:size(e\_shift)-1;

% Perform a long term LPC prediction. LPC on e is predicting e\_shift. what

% about b0 coefficeint?

b1 = lpc(e, Q);

e\_shift\_est = filter([0,-b1(2:end)],1,e\_shift);

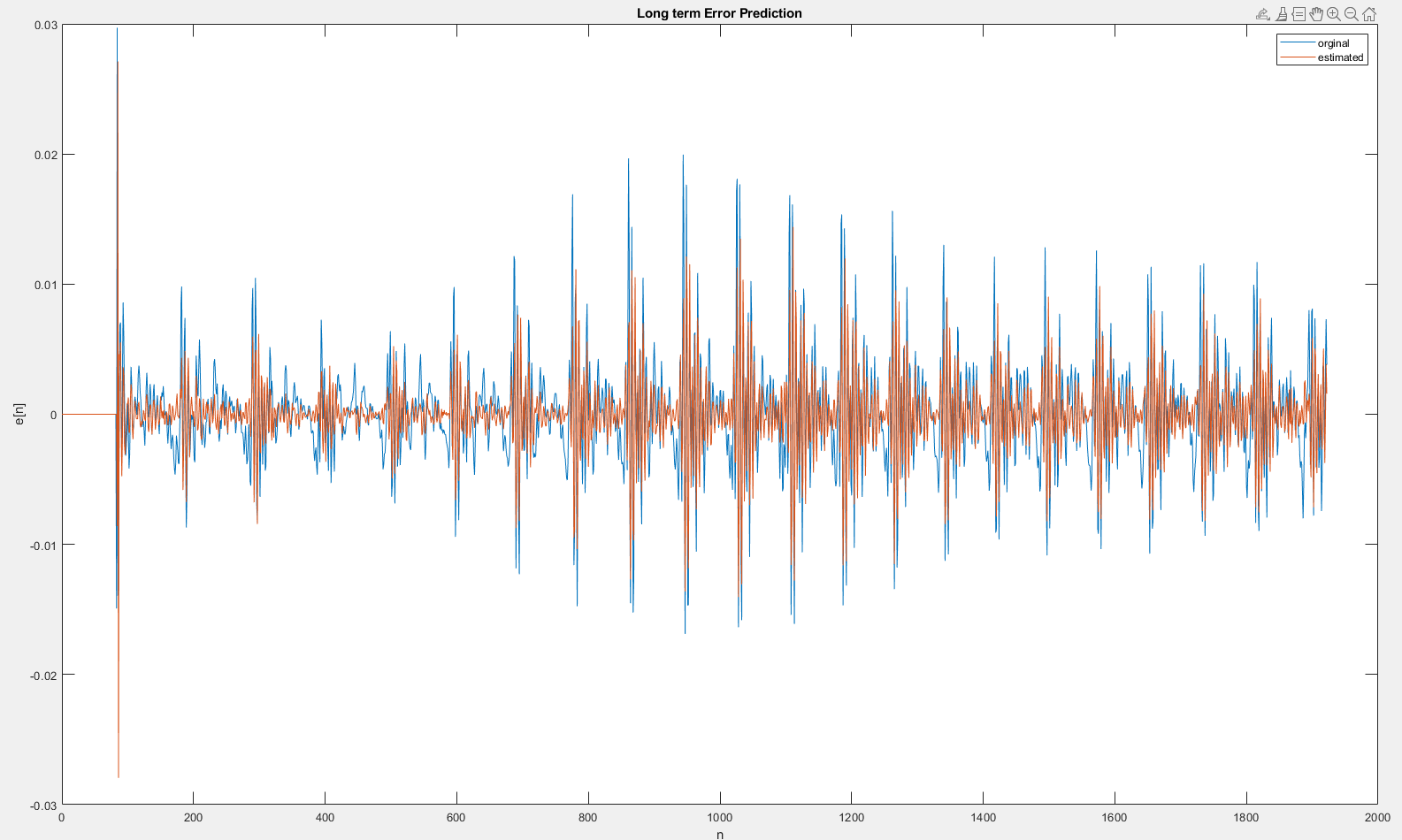
q = e\_shift-e\_shift\_est;

e\_shift is the error signal, shifted to the right by one fundamental pitch period N0\_avg (zeros from index 1 – N0\_avg. Linear prediction is performed on the error signal e which is used to predict e\_shift. This is equivalent to obtaining using the samples to , i.e.

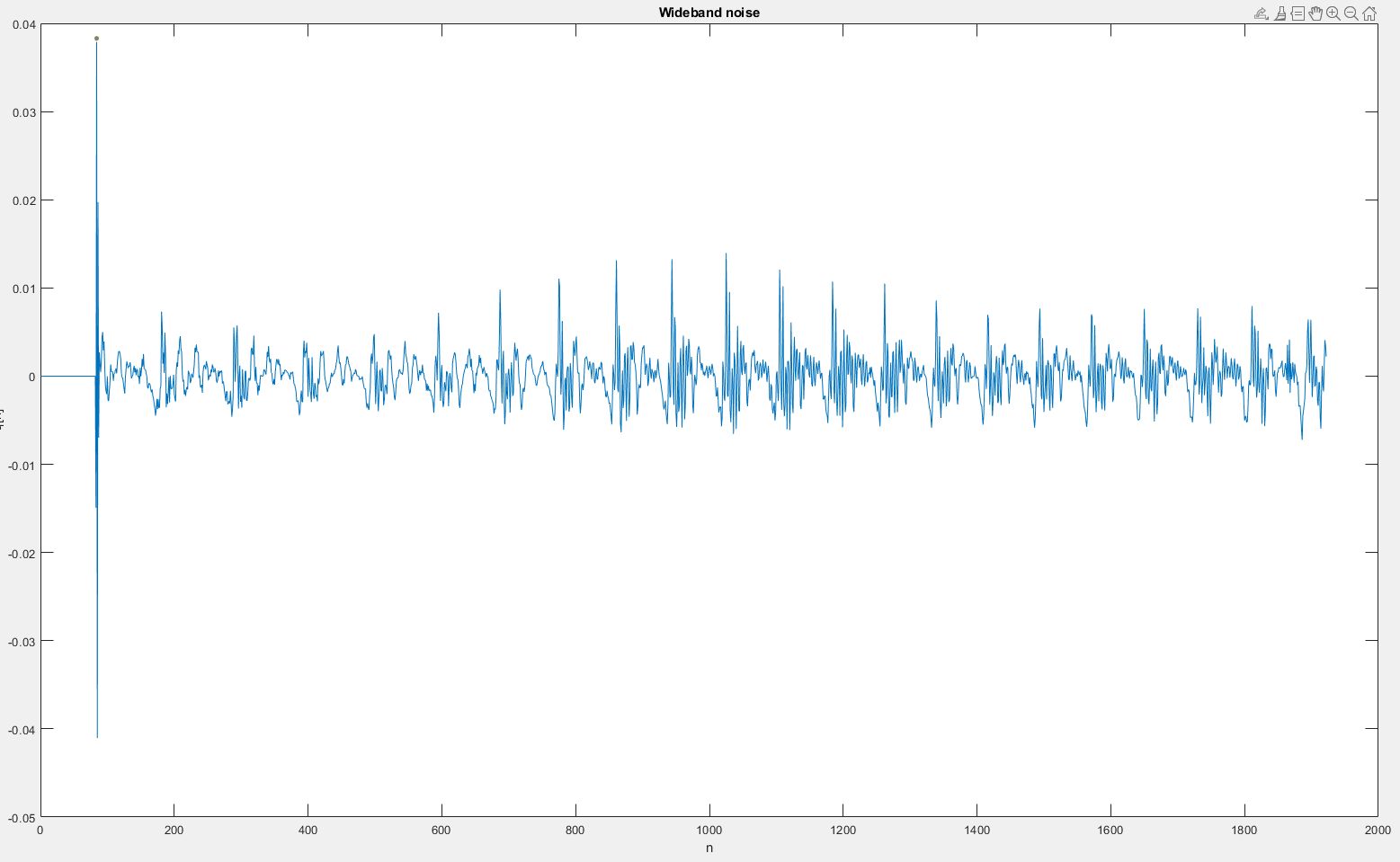
In the text, the prediction uses samples to ,

Not sure how to implement this. The wideband noise component is calculated as

There is some phase delay, which is expected since I just used the average pitch period.

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*Error and Predicted Error*

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*Wideband noise component*