Homework 3 Solutions, ECE 252A

Given \( r[0] = 1, r[1] = 0.8, r[2] = 0.6, r[3] = 0.4 \), we have \( J_0 = r[0] = 1 \).

First Order Predictor: \( \Delta_1 = r[1] = 0.8 \) and
\[
k_1 = \frac{\Delta_1}{J_0} = 0.8.
\]
Hence \( \alpha^{(1)}[1] = k_1 = 0.8 \), and \( J_1 = J_0(1 - k_1^2) = 0.36 \).

Second Order Predictor:
\[
\Delta_2 = r[2] - r[1]\alpha^{(1)}[1] = 0.6 - 0.80.8 = -0.04
\]
Then
\[
k_2 = \frac{\Delta_2}{J_1} = \frac{-0.04}{0.36} = -\frac{1}{9}.
\]
Hence \( \alpha^{(2)}[2] = k_2 = -\frac{1}{9} \), and \( J_2 = J_1(1 - k_2^2) = 0.36(1 - \frac{1}{81}) = \frac{16}{45} \). Also
\[
\alpha^{(2)}[1] = \alpha^{(1)}[1] - k_2\alpha^{(1)}[1] = \frac{8}{9}.
\]

Third Order Predictor:
\[
\Delta_3 = r[3] - r[2]\alpha^{(2)}[1] - r[1]\alpha^{(2)}[2] = 0.4 - 0.6\frac{8}{9} - 0.4(-\frac{1}{9}) = -\frac{2}{45}.
\]
Then
\[
k_2 = \frac{\Delta_3}{J_2} = -\frac{2}{45} \cdot \frac{45}{16} = -\frac{1}{8}.
\]
Hence \( \alpha^{(3)}[3] = k_3 = -\frac{1}{8} \), and \( J_3 = J_2(1 - k_3^2) = \frac{7}{20} \). Also
\[
\alpha^{(3)}[1] = \alpha^{(2)}[1] - k_3\alpha^{(2)}[1] = \frac{7}{8}.
\]
\[
\alpha^{(3)}[2] = \alpha^{(2)}[2] - k_3\alpha^{(2)}[1] = 0.
\]
ECE 252A - HW3 Problem 2:

For voiced frame:

Fig 1. The original voiced frame (20ms) and the DFT spectrum.

Fig 2. The Prediction error sequence for each order, and the error power (last subplot).

Fig 3. All-pole spectrum of each order, with comparison to DFT spectrum.
For unvoiced frame:

Fig 4. The original unvoiced frame (20ms) and the DFT spectrum.

Fig 5. The Prediction error sequence for each order, and the error power (last subplot).

Fig 6. All-pole spectrum of each order, with comparison to DFT spectrum.