

Exercise 1: Autolpc function:

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1. function [A, G, r, a] = autolpc(x, p)
2. %AUTOLPC Autocorrelation Method for LPC
3. % Usage: [A, G, r, a] = autolpc(x, p)
4. % x : input samples
5. % p : order of LPC
6. % A : prediction error filter, (A = [1; -a])
7. % G : rms prediction error
8. % r : autocorrelation coefficients
9. % a : predictor coefficients
10.
11. x = x(:);
12. L = length(x);
13. r = zeros(p+1,1);
14. for i=0:p
15.     r(i+1) = x(1:L-i)' * x(1+i:L);
16. end
17. R = toeplitz(r(1:p));
18. a = R\r(2:p+1);
19. A = [1; -a];
20. G = sqrt(sum(A.*r));
21. end
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Exercise 2~6:

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1. % Exercise 2
2. load('s5.mat');
3. L=320; % Hamming window of 320 samples
4. win= hamming(L);
5. SH=s5(15800:15800+319); % select the suit length array for window
6. AA=s5(17000:17000+319);
7. SH_win=SH.*win;
8. AA_win=AA.*win;
9. [A1,G1,r1,a1]=autolpc(SH_win,12);
10. [A2,G2,r2,a2]=autolpc(AA_win,12);
11.
12. SH_freq=freqz(A1,1,10000,'whole'); % use the function freqz to get the frequency
    responses
13. SH_vtm_filter=freqz(G1,A1,10000,'whole'); % A is prediction error filter, G/A is the vo
    cal
14. figure(1);
15. plot(20*log10(abs(SH_vtm_filter))); % get the log magnitude
16. hold on;
17. plot(20*log10(abs(SH_freq)));
18. title('The prsdiction error filter and The vocal tract model filter for"SH"');
19. xlabel('Frequency');
20. ylabel('magnitudue(dB)');
21. legend('The vocal tract model filter for "SH"', 'The prsdiction error filter for "SH"')
22.
23. AA_freq=freqz(A2,1,10000,'whole');
24. AA_vtm_filter=freqz(G2,A2,10000,'whole');
25. figure(2);
26. plot(20*log10(abs(AA_vtm_filter)));
27. hold on;
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28. plot(20*log10(abs(AA_freq)));
29. title('The prsdiction error filter and The vocal tract model filter for "AA"');
30. xlabel('Frequency');
31. ylabel('magnitudue(dB)');
32. legend('The vocal tract model filter for "AA"', 'The prsdiction error filter for "AA"')
33.
34. figure(3)          % find the zeros of the prediction error filter for both cases
35. zplane(A1');
36. title(' zeros of the prediction error filter for "SH"');
37. figure(4)
38. zplane(A2')
39. title(' zeros of the prediction error filter for "AA"');
40.
41. % Exercise 3
42. figure(5)          % get DFT for SH
43. SH_DFT=fft(SH_win,10000);
44. plot(20*log10(abs(SH_DFT)));
45. hold on;
46. plot(20*log10(abs(SH_vtm_filter)));
47. title('The DFT of the windowed segment and vocal tract model for "SH"');
48. xlabel('Frequency');
49. ylabel('magnitudue(dB)');
50. legend('DFT for "SH"', 'vocal tract model for "SH"');
51.
52. figure(6)          % get DFT for AA
53. AA_DFT=fft(AA_win,10000);
54. plot(20*log10(abs(AA_DFT)));
55. hold on;
56. plot(20*log10(abs(AA_vtm_filter)));
57. title('The DFT of the windowed segment and vocal tract model for "AA"');
58. xlabel('Frequency');
59. ylabel('magnitudue(dB)');
60. legend('DFT for "AA"', 'vocal tract model for "AA"');
61.
62.
63. % Exercise 4
64. OO=s5(7200:7200+319);
65. OO_win=OO.*win;
66. OO_DFT=fft(OO_win,10000);
67. [A3,G3,r3,a3]=autolpc(OO_win,12);
68. OO_vtm_filter=freqz(G3,A3,10000,'whole');
69. figure(7)
70. plot(20*log10(abs(OO_DFT)));
71. hold on;
72. plot(20*log10(abs(OO_vtm_filter)));
73. title('The DFT of the windowed segment and vocal tract model for "O"');
74. xlabel('Frequency');
75. ylabel('magnitudue(dB)');
76. legend('DFT for "O"', 'vocal tract model for "O"');
77.
78. II=s5(14500:14500+319);
79. II_win=II.*win;
80. II_DFT=fft(II_win,10000);
81. [A4,G4,r4,a4]=autolpc(II_win,12);
82. II_vtm_filter=freqz(G4,A4,10000,'whole');
83. figure(8)
84. plot(20*log10(abs(II_DFT)));
85. hold on;
86. plot(20*log10(abs(II_vtm_filter)));
87. title('The DFT of the windowed segment and vocal tract model for "I"');

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88. xlabel('Frequency');
89. ylabel('magnitudue(dB)');
90. legend('DFT for "I"', 'vocal tract model for "I"');
91.
92. % Exercise 5
93. % We choose SH in this part, [A1,G1,r1,a1]=autolpc(SH_win,12);
94. [A_p8,G_p8,r_p8,a_p8]=autolpc(SH_win,8);
95. SH_vtm_filter_p8=freqz(G_p8,A_p8,10000, 'whole');
96. [A_p10,G_p10,r_p10,a_p10]=autolpc(SH_win,10);
97. SH_vtm_filter_p10=freqz(G_p10,A_p10,10000, 'whole');
98. [A_p20,G_p20,r_p20,a_p20]=autolpc(SH_win,20);
99. SH_vtm_filter_p20=freqz(G_p20,A_p20,10000, 'whole');
100. figure(9)
101. plot(20*log10(abs(SH_DFT)));
102. hold on;
103. plot(20*log10(abs(SH_vtm_filter_p8)));
104. hold on;
105. plot(20*log10(abs(SH_vtm_filter_p10)));
106. hold on;
107. plot(20*log10(abs(SH_vtm_filter)));
108. hold on;
109. plot(20*log10(abs(SH_vtm_filter_p20)));
110. xlabel('Frequency');
111. ylabel('magnitudue(dB)');
112. legend('DFT for "SH"', 'vocal tract model for "SH" in p=8', ...
113.        'vocal tract model for "SH" in p=10', ...
114.        'vocal tract model for "SH" in p=12', ...
115.        'vocal tract model for "SH" in p=20');
116.
117. % Exercise 6
118. y = filter([1, -0.98], 1, s5);
119. SH_y=y(15800:15800+319);
120. SH_y_win=SH_y.*win;
121. [A_y,G_y,r_y,a_y]=autolpc(SH_y_win,12);
122. SH_y_freq=freqz(A_y,1,10000, 'whole');
123. figure(10)
124. plot(20*log10(abs(SH_freq)));
125. hold on;
126. plot(20*log10(abs(SH_y_freq)));
127. title('Comparison for whether apply a preemphasis filter');
128. xlabel('Frequency');
129. ylabel('magnitudue(dB)');
130. legend('Without new filter', 'With new filter');

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