

**Homework #5 NLMS, GNLMS, and Transform Domain LMS Adaptive Filters
(due Wednesday, Oct. 23, 2002)**

Build the following tools: NLMS . M, GNLMS . M, SOAF . M, and DCT - LMS . M in the Adaptive Signal Processing toolkit.

Experiments

1) (Convergence rate experiments) Redo Experiment 1 Case 4 in Section 8.4 using the algorithms below to adjust the coefficient vector. Adjust μ so that $J_{ex} \approx 0.006$, where J_{ex} is measured at convergence. Perform at least 100 simulation runs in order to obtain an accurate MSE.

(a) LMS. Plot the MSE and specify μ , J_{ex} , and the misadjustment.

(b) NLMS. Plot the MSE and specify μ , J_{ex} , and the misadjustment.

(c) GNLMS (projection order, $P = 2$). Plot the MSE and specify μ , J_{ex} , and the misadjustment.

(d) Comment on the convergence rates. Also note the superior convergence properties of NLMS (proportional to $\chi^{1/2}$) over LMS (proportional to χ) (see Rupp for more details).

2) (Adaptive Equalization) Recreate the results from Experiment 2 p. 473 (only Fig. 10.9 in dB) to verify correct operation of your DCT-LMS. Note the values of α , β , g , d used in the text.

3) (NLMS/SOAF comparisons) Redo Experiment 1 Case 4 in Section 8.4 of your text using the NLMS and SOAF algorithms to update the coefficient vector. Note that the final values for the NLMS adaptive filter and SOAF adaptive filter will differ by \mathbf{Q} .

(a) On a single figure plot the MSEs for both algorithms in dB (calibrated to $\sim 10\%$ misadjustments). Comment on the convergence rates for each case.

(b) List the filter coefficients for the Wiener solution, NLMS, and SOAF with and without the inverse transform by \mathbf{Q} .

4) (NLMS/DCT-LMS comparisons) Same as 3) but with the more practical DCT-LMS instead of SOAF.