RTDSP Week 12 Homework

CYEE 10828241 Chen Da-Chuan

May 22, 2023

1 Computational cost of LMS algorithm in terms of additions and multiplications

To compute the adaptive filter output with $y(n) = \sum_{l=0}^{L-1} w_l(n)x(n-l)$, this needs L times of multiplications and $L-1$ times of additions. To compute the error signal $e(n) = d(n) - y(n)$, this needs 1 time of additions. To update the weight vector using the scalar form $w_l(n+1) = w_l(n) + \mu x(n-L)e(n)$, this needs $2L$ times of multiplications and L times of additions.

Therefore, the total number of multiplications is $L+2L = 3L$ and the total number of additions is $L-1+1+L = 2L$.

2 In practical case of ANC we use $e(n) = d(n) + y(n)$, how can we modify the LMS algorithm to adapt to this case?

We can add an signal inverter to the output side of $w(n)$. This way, we can get $e = d + (-y)$. This will need one more multiplication computation for each signal.

3 What should we choose for $w(0)$, either $R^{-1}p$ or 0?

With option a, this option needs more time to startup, but may be closer to optimal solution. With option b, this relatively needs no time to startup, but may be far away to optimal solution. Therefore we need to know roughly what is the optimal solution and calculate whether it takes more time to calculate option a or just iterate with option b.