

# 521324S SSP II — Matlab Simulation Exercise

## Task 5

Lucas Ribeiro, lucas.ribeiro@oulu.fi  
Centre for Wireless Communications, University of Oulu

RLS ALGORITHM (7 PTS)

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In addition to the LMS algorithm in Lab 4, an alternative approach for the adaptive filtering is the RLS algorithm. In this lab, you will implement the RLS algorithm and compare its performance to that of the LMS algorithm. The purpose is to understand differences between these two adaptive methods, in terms of implementation and performance.

Consider the channel equalization problem in Lab 4. QPSK signals are transmitted over a 5-tap delay line channel. The signal-to-noise ratio (SNR) is 25dB. The received noisy signal is equalized before demodulation as illustrated in Fig. 1. Let the length of the smoothing-type equalizer be  $L = 20$ .

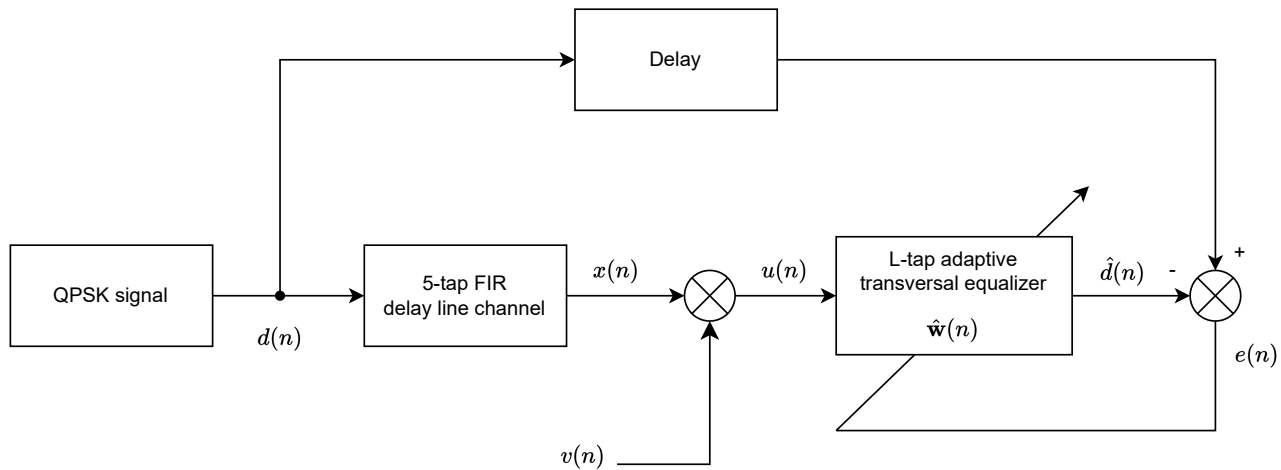


Fig. 1: Block diagram of an adaptive channel equalization.

- 1) Write the Matlab code for an RLS adaptive filter to equalize the received signals. The forgetting-parameter is set to  $\lambda = 1$ . Compare the performance, in terms of convergence and symbol error rate (SER), between the RLS and LMS algorithms.
- 2) Set  $\lambda = 0.98$  and repeat Task 1.

### Hint:

- Initialize equalizer vector  $\hat{\mathbf{w}}$  with zeros, and the matrix  $\mathbf{P}$  as  $\mathbf{P} = \frac{1}{\delta} \mathbf{I}$ , where  $\delta$  is a small positive constant and  $\mathbf{I}$  is the identity matrix.