produce a comparable misadjustent. The unknown system is assumed to be finite impulse response (FIR) system and the length of coefficient vector is 11.

*1) Uncorrelated signal*

Signal applied to the system is a pseudorandom bit sequence, with zero mean value and unit variance. Additive noise $noise(k)$ with the same mean value and variance is also applied to the simulation. Parameters of the ESD-VSS algorithm are $\alpha = 2.6$ $u = 0.034$. To obtain comparable misadjustment, for the modified algorithm we set parameters $\alpha = 0.997$, $\beta = 0.99$ and $\gamma = 0.025$. The step size of standard LMS algorithm is 0.01.

Fig 4 shows the behavior of the ESD-VSS algorithm, standard LMS algorithm and MVSS algorithm. Notice that the small misadjustment level is achieved by the algorithms, but the convergence rate of the standard LMS is not satisfying. The ESD-VSS and MVSS algorithm reduce the tradeoff between misadjustment and convergence rate. The ESD-VSS reaches steady state after about 200 iterations while the MVSS reaches steady state about 50 iterations later, which proves the efficiency of ESD-VSS algorithm.

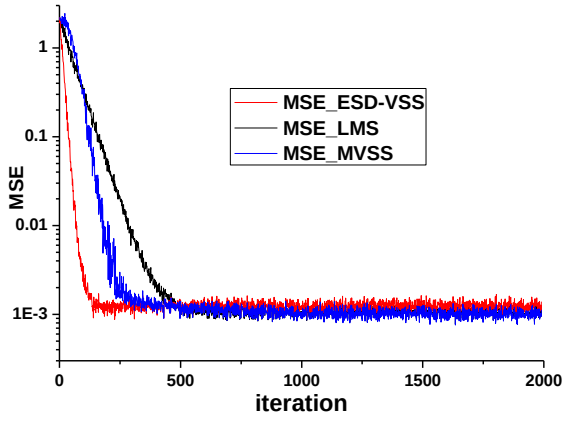


Fig.4 Comparison of MSE behavior for uncorrelated signal and low SNR

*2) Uncorrelated signal with abrupt change in system coefficients*

To check the robustness of the ESD-VSS algorithm, we set an abrupt coefficient change at the $1000^{th}$ iteration. All the other related parameters are kept the same as simulation shown in Fig.4. Fig.5 compares the behaviors of the algorithms, which shows that the ESD-VSS algorithm converge faster and reaches steady state first with smaller computational complexity compared with the MVSS algorithm. The simulation demonstrated the ESD-VSS algorithm has better tracking performance after the abrupt coefficients change.

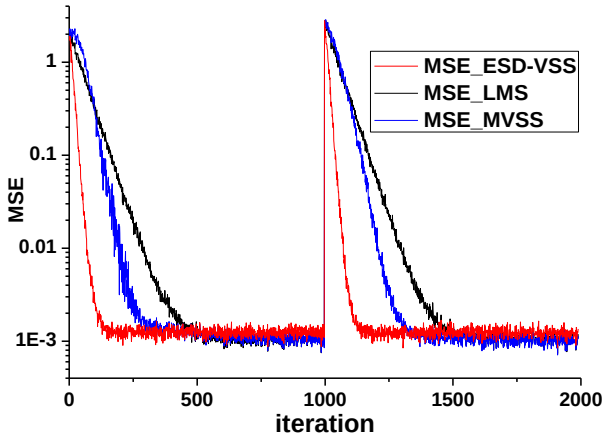


Fig. 5 MSE behavior for uncorrelated signal with abrupt change in system coefficients

## V. Conclusion

A new variable step size LMS algorithm (ESD-VSS) has been proposed, with a comprehensive consideration of both convergence speed and misadjustment. The variable step size is updated using the difference between the error signals. The simulation results show that the ESD-VSS.

ESD-VSS algorithm provides better performance over . MVSS algorithm and the modified LMS algorithm, as well as standard LMS algorithm in the environment of channel equalization and system identification.

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