REGULARIZED VSSNLMS-BASED ITERATIVE CHANNEL ESTIMATION FOR MC-IDMA SYSTEMS

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Introduction

- Multicarrier Interleave Division Multiple Access (MC-IDMA) has been seen as a better alternative to the other popular multiuser schemes.
- Just like all the other wireless communications systems, availability of accurate channel state information (CSI) at the receiver of the MC-IDMA system is paramount for optimum performance system.
- This paper proposes regularized version of Variable Step Size Normalized Least Mean Square algorithm (RVSSNLMS) for iterative channel estimation scheme MC-IDMA systems.

Technical Background

MC-IDMA SYSTEM MODEL

- The MC-IDMA system model considered in this article is shown in Fig. 1 (a) and Fig. 1 (b).

REGULARIZED VSSNLMS-BASED ESTIMATOR

- The RVSSNLMS-based channel estimation computes the estimates of the channel impulse response (CIR) as:

$$\widehat{\boldsymbol{h}}_u[n+1] = \widehat{\boldsymbol{h}}_u[n] + \mu[n]e[n]\,\widehat{\boldsymbol{x}}_u^*[n] \Big/ \|\widehat{\boldsymbol{x}}_{\boldsymbol{u}}[n]\|^2 - \kappa\,\mathrm{sgn}(\widehat{\boldsymbol{h}}_u[n],$$

$$e[n] = \boldsymbol{z}[n] - \widehat{\boldsymbol{h}}_u^H[n]\widehat{\boldsymbol{x}}_{\boldsymbol{u}}[n],$$

$$\mathrm{sgn}(y) = \begin{Bmatrix} \frac{y}{|y|}, & y \neq 0 \\ 0, & elsewhere \end{Bmatrix}.$$

$$\bar{\mu}[n] = \mu[n-1] + \rho Re\{e[n]e^*[n-1]\widehat{\boldsymbol{x}}_u^H[n]\widehat{\boldsymbol{x}}_u[n-1]\} \Big/ \|\widehat{\boldsymbol{x}}_{\boldsymbol{u}}[n-1]\|^2$$

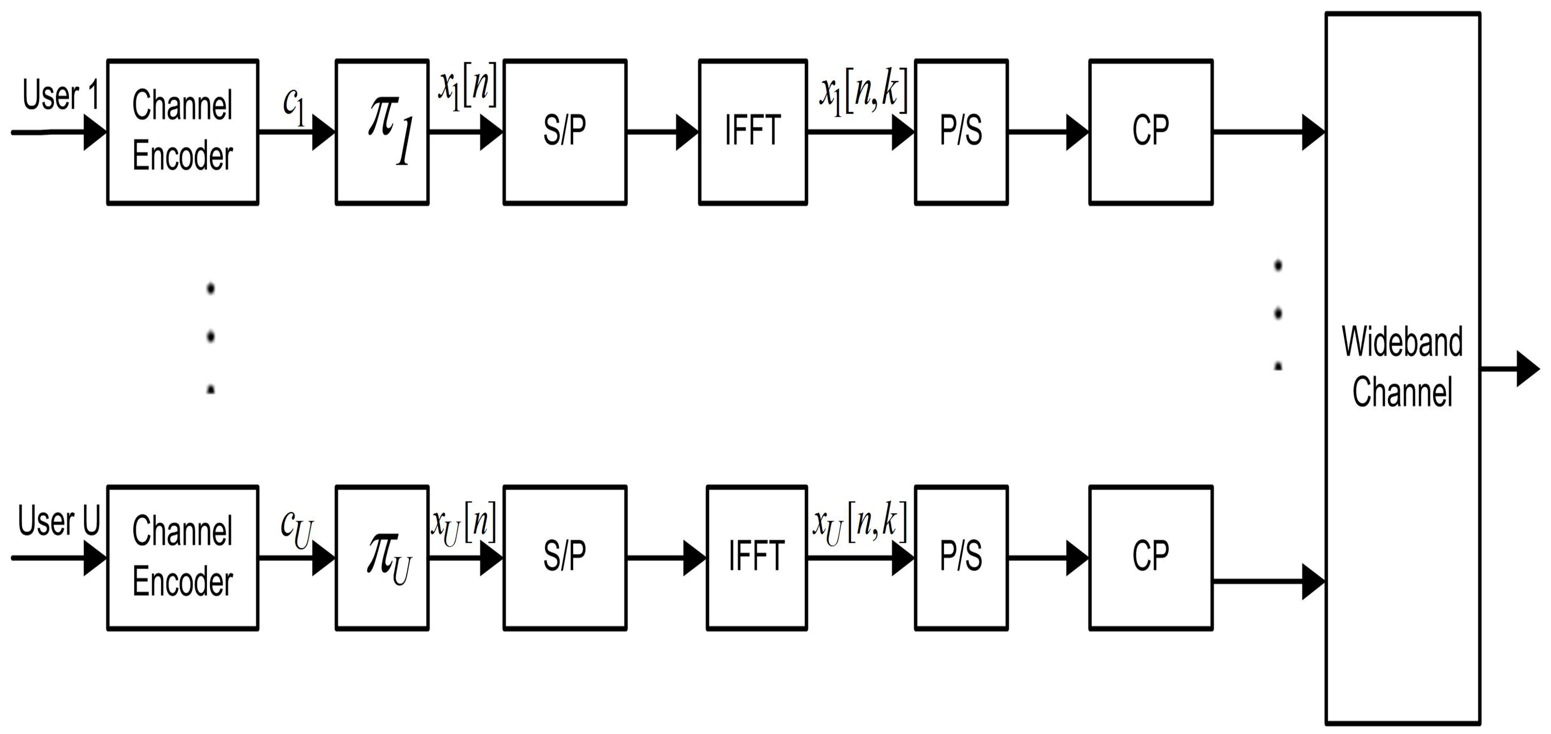

Figure 1a: MC-IDMA transmitter.

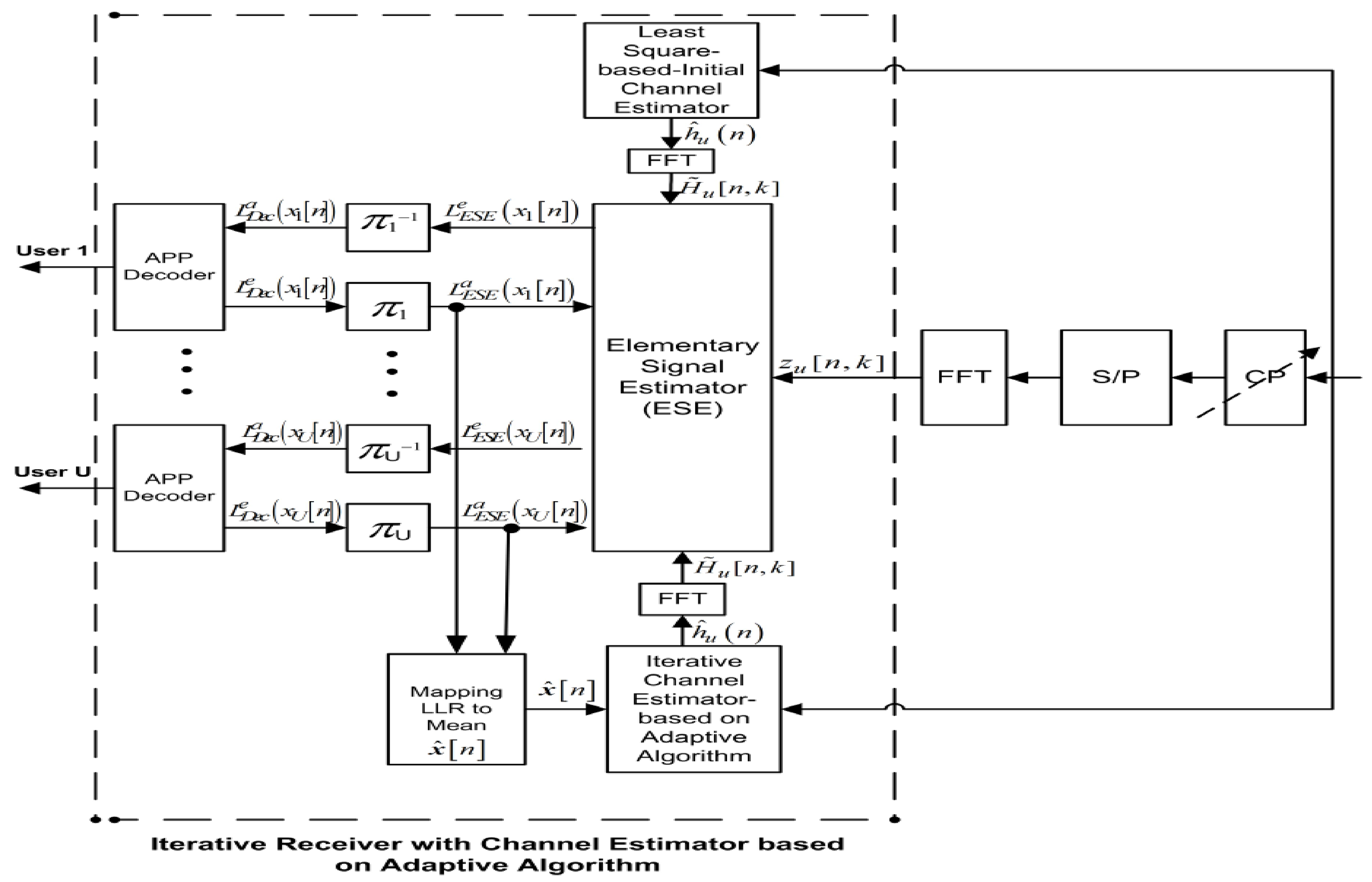

Figure 1b: Iterative Receiver with Adaptive Algorithm-based Channel Estimator .

Simulation Results

- QPSK-modulated having K = 64 subcarriers and a total bandwidth of 800 kHz considered. The wireless channel is a Rayleigh fading channel of M = 16 paths with normalized Doppler frequencies of fDn = 0.108 and fDn = 0.0045 corresponding to mobile speeds of v = 120km/h and v = 5km/h respectively are considered; the number of sparse CIR coefficients, D = 4; the spreading length S = 8; μ = μ[0] for both LMS-based iterative channel estimator and the NLMS-based iterative channel estimator and to initialize the VSSNLMS and RVSSNLMS-based iterative channel estimators; rho = 0.002; and β =2.0.

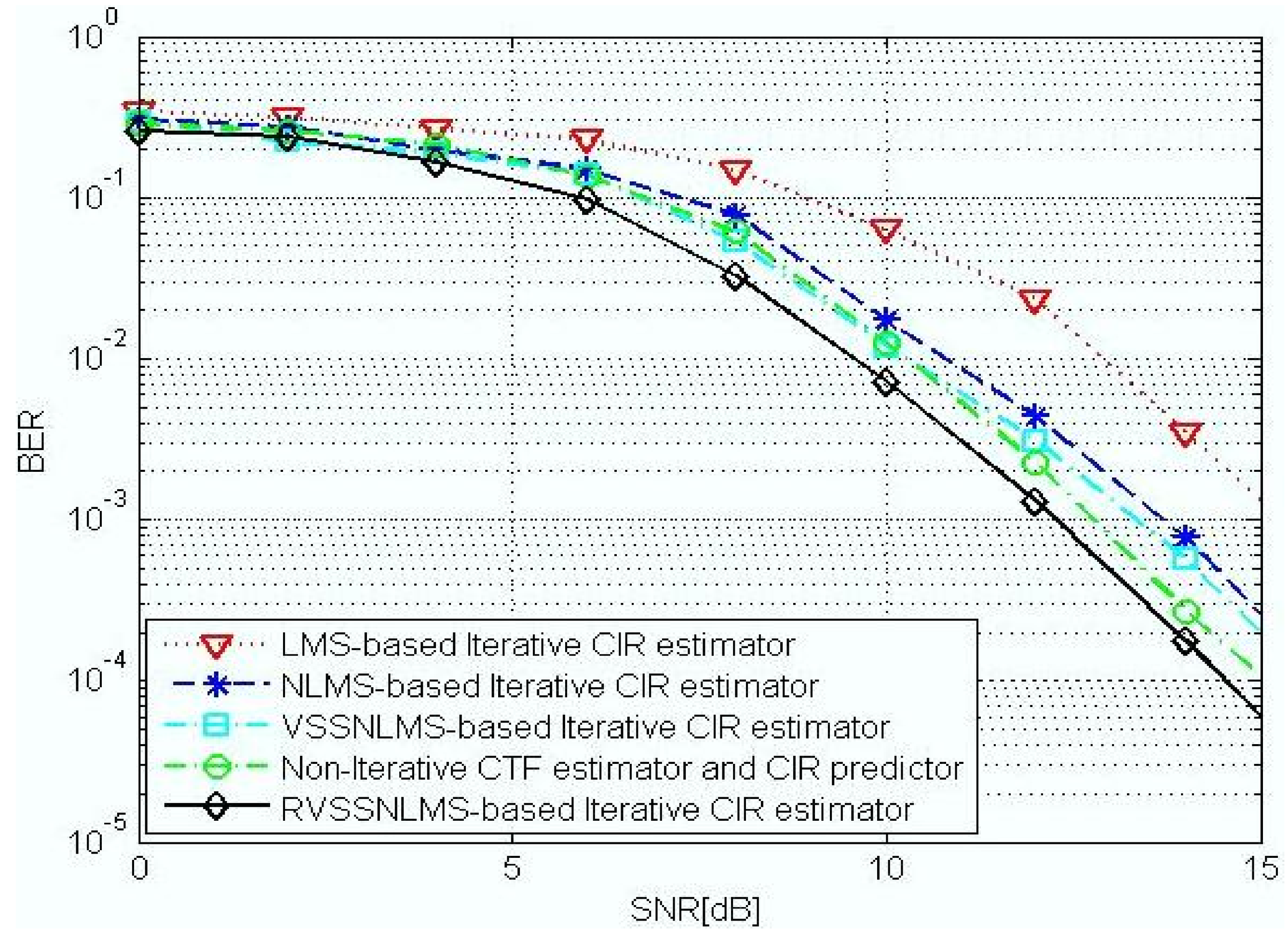

Figure 2: Average BER versus SNR exhibited by estimators, fDn=0.108, v=120Km/h, U= 4.

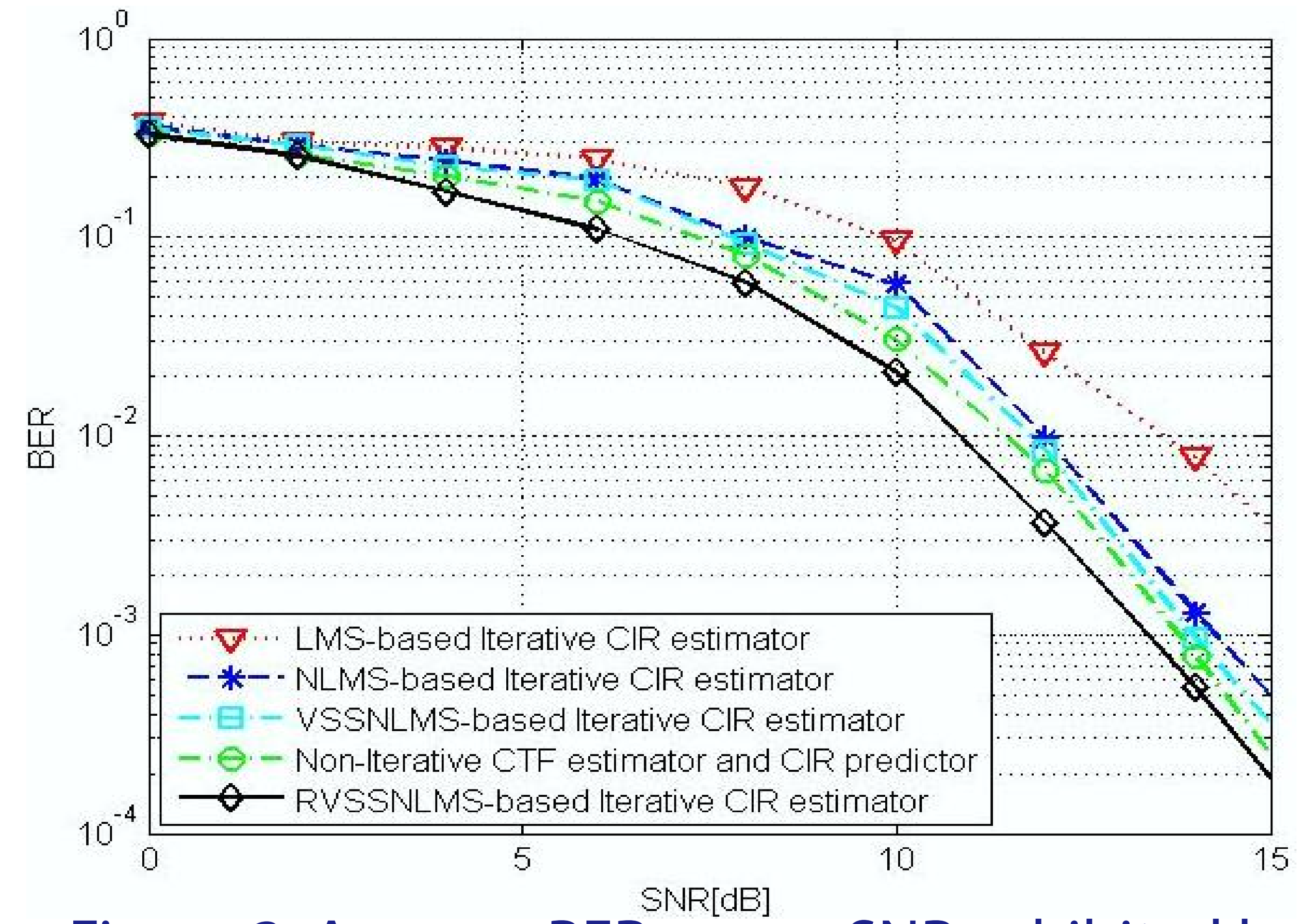

Figure 3: Average BER versus SNR exhibited by estimators, fDn=0.004 , v=5Km/h, and U= 4.

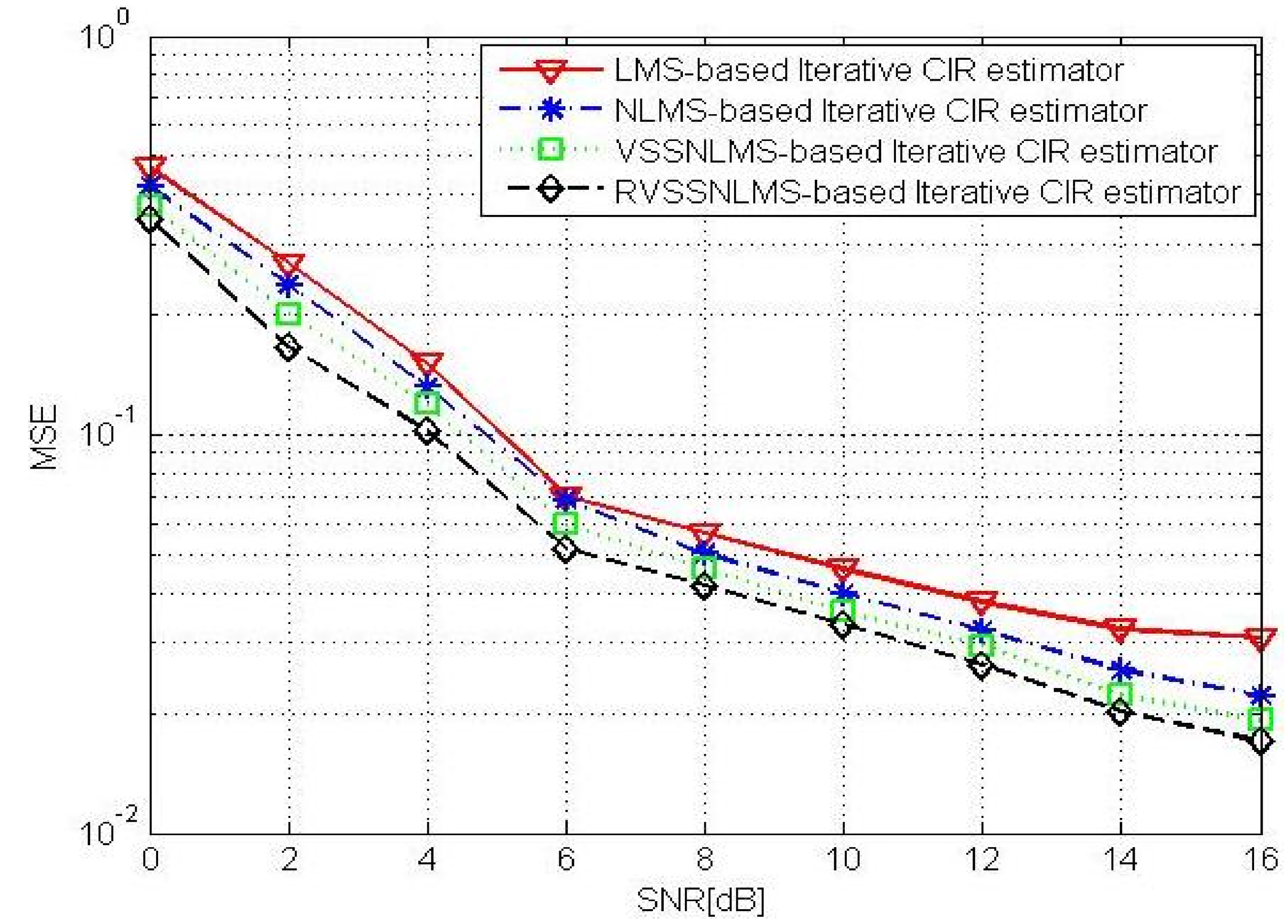

Figure 4: Average MSE exhibited by the estimators with fDn=0.004 , v=5Km/h, U= 4, and v= 5Km/h.

Conclusion

- From the presented results, RVSSNLMS-based iterative estimator performs better that the rest of the estimator and also shows the lowest computational complexities in comparison with the non-iterative CTF estimator and CIR predictor proposed earlier in literature.
- However, the computational complexity of the RVSSNLMS-based iterative estimator is higher than the complexity of each of the other adaptive algorithms-based iterative CIR estimators, but lower than that of the non-iterative combined CTF estimator and CIR predictor.