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I. Introduction

Proportionate Normalized Least Mean Square (PNLMS) algorithm [1], designed to utilize the a priori knowledge about the sparsity of the system impulse response, is a popular technique in the applications such as Adaptive Feedback Cancellation (AFC), Network Echo Cancellation (NEC) and Acoustic Echo Cancellation (AEC) among many others. In the Fig. 1, an adaptive feedback cancellation setup has been shown to demonstrate the functionality of an adaptive filter for this application which is an integral part of Hearing Aids and the Public Address systems [2]. A sparse impulse response has a characteristic that there are significantly more zero or 'almost zero' coefficients than large magnitude coefficients. PNLMS redistributes the adaptation gain among the filter coefficients on basis of the instantaneous magnitude of the coefficients. It shows that the proposed algorithm achieves higher effective gains to the large coefficients of the adaptive filter. It shows convergence rate is four times faster than the traditional algorithms like the Normalized Least Mean Squares (NLMS) [3] which face performance issues like slow convergence. The improved PNLMS (IPNLMS) [4], [5] uses a different gain calculation mechanism which further enhances the convergence rate in comparison with the basic PNLMS. Another advantage of the IPNLMS is the robustness against the variation in the sparseness of the unknown system. An unrelated family of sparse adaptive filters is that of the zero-attracting type adaptive filters [6]–[10] which predominantly employs different variety of sparsity

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