

Regarding acoustic echo cancellation using frequency domain LMS algorithm and subband LMS algorithm

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Dear all,

I am working on the acoustic echo cancellation. I have implemented the time domain LMS algorithm for acoustic echo cancellation and it is working fine only for some audio files and not working for some other audio files which has the large eigen value spread. So to avoid this eigen value spread now I am working on the subband LMS algorithm in frequency domain for acoustic echo cancellation. So now I am searching for the documents of subband LMS algorithm and frequency domain LMS algorithm in which it is mentioned clearly which samples are to be considered and why. But I didn't find those details. But I understood the overall view of frequency domain LMS algorithm from the documents that I collected and its steps are as follows:

Step1: For every sample of a frame (ie., 10 m sec data), that sample and its previous samples, a total of samples equal to number of weights of the filter are taken (as a full band) and they are converted to frequency domain using DFT.

Step2: Initially all the weights of the filter are taken as zeros in frequency domain.

Step3: Then to get the echo sample of kth subsequent sample position its corresponding input sample in frequency domain (farend in frequency domain) are multiplied with its corresponding weight in frequency domain (its corresponding weight).

$$N(k) = X(k) * W(k)$$

Step4: Then the corresponding error sample is obtained by subtracting this echo sample from the desired sample in frequency domain.

$$E_k = Y_k - N_k$$

where Y_k is the desired signal sample in frequency domain.

Step5: Using this error sample in frequency domain all the weights of the filter are updated using the following formula:

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$$W_{k+1}(i) = W_k(i) + 2 * \mu_k * E_k * X_k$$

where X_k is column vector containing the current sample and its previous samples.

W_k is the column vector of all the weights of the filter.

Step6: All the above steps are repeated for each and every sample of the frame until the end of the frame and is repeated for all the frames of the audio file.

My doubt is in the calculation of desired samples in frequency domain i.e., Y_k . According to logic, I think these frequency components are calculated using all the samples of desired signal of a frame. But it is nowhere mentioned in the documents that which samples I need to consider for this frequency band desired samples. Okay if we generate frequency domain desired samples equal to number of desired samples in time domain using all these time domain samples. If I integrate this idea with the subband LMS algorithm then again I am getting the doubt that for each subband of far-end signal (i.e., obtained by dividing a full band of far-end signal consisting of current sample of the frame and its previous samples to a particular number of subbands) whether we need to have the same desired signal frequency component for all the subbands or different frequency component for each subband and how it is calculated. I have these type of doubts and if we think of that there may be several possibilities.

So I am searching for that, but I am not getting the required points.

I think one solution for this is converting the code of time domain LMS algorithm to frequency domain and checking the code for all the possibilities by trial and error method and seeing that for which combination we will get the perfect output. But I am not getting the output.

Here I have converted the far-end signal, desired signal and weights of the filter are converted to frequency domain and after performing the operation the error signal is reconverted to time domain. And the convergence weight factor is given in different ways in different documents. I am in total confusion to proceed further.

I am very grateful to you if any one give me suggestions and guidance regarding this.

Thanking in advance.

Regards,
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