



## **GENERALIZED FREQUENCY DOMAIN ADAPTIVE FILTER FOR ACOUSTIC ECHO CANCELLER**

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### **Abstract:**

The most significant problems of the acoustic echo canceller realizations are high computational complexity and insufficient convergence rate of the applied adaptive algorithms.

The use of the frequency domain block adaptive filter [1] essentially reduces computational complexity and increases convergence rate. Of course, in implementations of the frequency domain block adaptive filter, the size of the block must be set to twice the number of filter tap weights. The associated processing delay, equal to the block size, appeared to be prohibitive in acoustic echo cancellers.

The basic method of solving this problem is to segment the impulse response into small blocks. This idea has been employed in the subband acoustic echo cancellers.

The analysis of the realization of the frequency domain block adaptive filter and the subband acoustic echo canceller where DFT filter bank was employed to filter bank realization [2] has been performed. It has followed from this analysis that this subband acoustic echo cancellers do not take into account the effect of the multiplicative modifications in the DFT filter bank [3]. The effect of the multiplicative modification has been taken into account in the fast convolution methods used for the frequency domain block adaptive filter realization. This effect has brought the decrease of the convergence rate and increase of the steady-state mean square error by time domain aliasing in the subband acoustic echo cancellers.

On the basis of these facts the new adaptive filter for the acoustic echo canceller [4] has been derived. The new adaptive filter has been named the generalized frequency domain adaptive filter and this adaptive filter is a generalization of the subband adaptive filter and the frequency domain block adaptive filter.

The qualities of the design algorithm were evaluated by computer simulation with acoustic echo path impulse response model for white noise and real speech signal excitation. The result of simulation performance showed convergence behaviour improvement of new adaptive algorithm on the subband acoustic echo cancellers applied till the present time.

From the computational complexity analysis follow the realization possibility of new algorithm for acoustic echo path length 256 ms, 16 kHz sampling rate and 16 ms processing delay on modern signal processor in real time.

### **REFERENCE:**

- [1] LEE, J. C. – UN, C. K.: Performance Analysis of Frequency Domain Block LMS Adaptive Digital Filters. IEEE Trans. on CAS, Vol.36, No.2, February 1989.
- [2] CHEN, J. et al.: A New Structure for Subband Acoustic Echo Canceller. IEEE ICASSP 88, New York 1988.
- [3] CROCHIERE, R. E. – RABINER, L. R.: Multirate Digital Signal Processing. Prentice Hall, Inc., Englewood Cliffs, New Jersey 1983.
- [4] DOHNAL, F.: Adaptive Acoustic Echo Canceller. Doctoral Thesis, Military Academy Brno 1992, (in czech)