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VARIATION OF INITIAL PARAMETERS IN DESIGN OF MULTIPLIERLESS PERFECT RECONSTRUCTION LATTICE FIR FILTER BANKS

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A filter bank or otherwise an analysis /synthesis system refer to the perfect reconstruction (PR) filer bank when its the output signal is a delayed version of the input signal [1], i.e. the output signal is free from magnitude, phase and aliasing distortions. The PR filer banks can be designed on the base of lattice FIR filters [1]. The PR property of these filters is structurally ensured, i.e. the perfect reconstruction of the input signal is guaranteed by the lattice structure. In this case coefficient quantization will affect on the magnitude responses of analysis and synthesis filters only and will not on all analyses/synthesis system.

For two-channel PR lattice filter banks it is necessary to design the only asymmetric impulse response low-pass filter. Usually the filter magnitude response is interested. The PR lattice filters satisfies the power complementary property, which structurally ensured. Therefore it is enough to obtain the required stopband attenuation.

For VLSI implementation multiplierless lattice filter banks are very economic. In such banks all multipliers are replaced by adders and shift elements. Thus in order to reduce the complexity and to increase of speed of filter bank it is important to minimize the total number of adders including adders of the filter structure and adders, replacing multipliers.

For this purpose in [2] it was used an incomplete enumeration of discrete filter coefficients. Spaces of feasible change of the coefficients are defined preliminary using a nonlinear optimization procedure. Depending on the requirements to filter banks the method can demand hundred millions evaluations of solutions with discrete coefficients. Nevertheless, an example from [2] results in solutions with a performance comparable with those ones achieved in [3] but for shorter time.

In this work for design of the multiplierless PR lattice filter banks the algorithm of a variation of initial parameters (VIP), similar described in [4], is proposed. In the algorithm only two parameters are variable. Nevertheless, for examined example of design it results to the solution comparable with this one obtained in [2], and demands a lot of smaller number (789 instead of 285 531 616) of evaluations of a cost function with discrete coefficients. For the analysis bank (Fig.1b in [2]) the obtained filter coefficients by the VIP algorithm are

$\alpha_0 = -2^{2} + 2^{-1} + 2^{-5}$, $\alpha_1 = 2^{0} + 2^{-3} - 2^{-9}$, $\alpha_2 = -2^{-1} - 2^{-3} - 2^{-7}$, $\alpha_3 = 2^{-2} + 2^{-3} + 2^{-5}$, $\alpha_4 = -2^{-2} - 2^{-5} + 2^{-7}$, $\alpha_5 = 2^{-2} - 2^{-4} - 2^{-8}$, $\alpha_6 = -2^{-3} + 2^{-7}$, $\alpha_7 = 2^{-4} + 2^{-7}$, $\alpha_8 = -2^{-5} - 2^{-7}$, $\alpha_9 = 2^{-6} + 2^{-9}$, $\alpha_{10} = -2^{-7} + 2^{-9}$.

The stopband attenuation is 45.01 dB, the passband and stopband edges are 0.18 and 0.32 respectively and the sampling frequency is 1.

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