Wavelet Filter Bank Based on QMF

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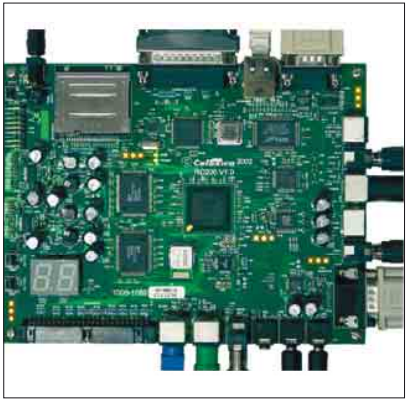
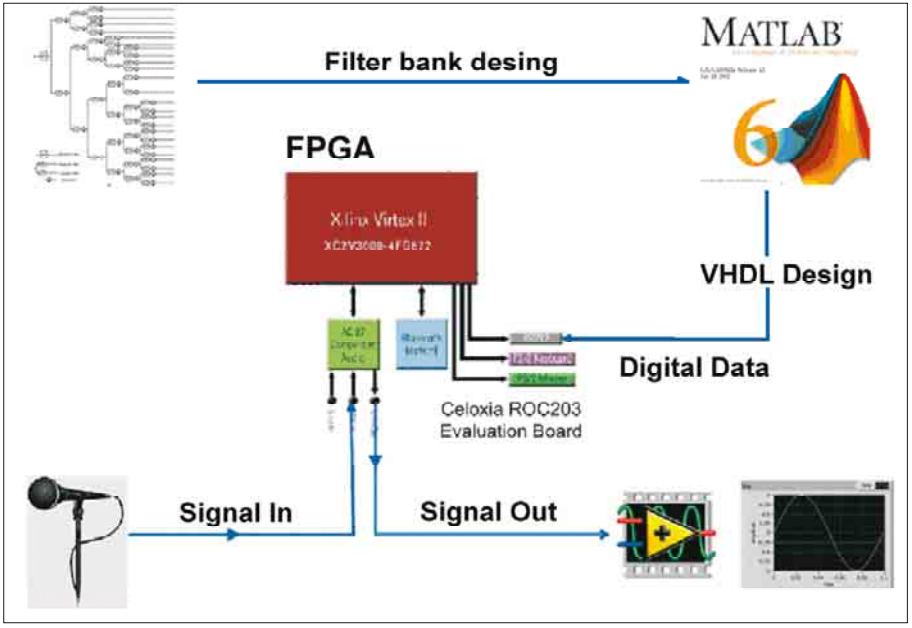


FPGA evaluation board

Problem: In many audio applications that are implemented with digital signal processing, it is useful to design the frequency analysis process similarly to the one used in the human auditory system. For the purpose of implementing frequency analysis as in human hearing, filter banks have to match the so called critical bands. The common approach to this problem is the M-Channel filter bank, but to achieve a better psychoacoustic analysis and more hardware efficiency a wavelet filter bank needs to be designed. For perfect reconstruction of the analysed audio signals the wavelet filter bank should be devised as a quadrature mirror filter, known as QMF.

Project Target: Research should determine if it is possible to implement a wavelet filter bank based on QMF that matches the first 24 critical bands as well as possible. An M-Channel filter bank as benchmark should also be implemented, for comparison with the wavelet filter bank. Therefore two sets of filter coefficients need to be calculated in Matlab, one for the M-Channel and one for the wavelet filter banks. Based on these filter coefficients, the filter structure for the FPGA will be implemented on the Celoxica



Development overview

RC203 board in VHDL. The performance of the filter banks will be tested and measured.

Conclusion: If the desired concept of the wavelet filter bank based on QMF is feasible, analysis will be able to determine how well the critical bands can be matched and how efficiently – from the point of view of hardware – this filter bank can be implemented in comparison to the M-Channel filter bank. Several figures of merit, such as peak signal-to-noise ratio (PSNR), hardware cost in number of logical cells used, throughput and latency will need to be verified in order to make the wavelet filter bank comparable to other filter banks. Once all these figures of merit have been determined, it will be possible to decide how competitive this filter bank is in comparison to other ones and how useful it will be for various audio applications, such as hearing aids.