

The invention relates to a filter in accordance with the first part of claim 1.

Filters of the type mentioned above are used to build up filter banks for so-called sub-band decoders for audio and video signals. Such filters comprise a split filter arrangement consisting of a low pass filter and a mirror image high pass filter having respectively a sampling rate halver as well as a merge filter arrangement consisting of two sampling rate doublers having a low pass filter and a mirror image high pass filter for the interpolation. The filters are built up such that errors due to the reduction in the sampling rate do not appear if the low pass and the high pass propagation is error free. Such filters are for example, quadrature mirror filters, conjugate quadrature filters, non-recursive wave digital filters or lattice quadrature mirror filters as well as bridged wave digital filters.

If, for the generation of sub-bands, these filters are built up from a plurality of stages, then disturbances on the transmission path, such as are brought about by e.g. quantisation noise or data reduction, can lead to errors in the directly bordering or more distantly located bands i.e. the next but one bands, which then manifest themselves as audible or visible distortions that cannot be masked during the use in a sub-band coder.

The object of the invention is to dimension a filter of the type mentioned hereinabove such that disturbances, in bands which are more distantly located than those in which the disturbance occurs, are suppressed.

This object is achieved in a filter in accordance with the first part of claim 1 by the features specified in the characterising part. The invention will be explained with the help of the drawing.

The drawing shows in

Fig. 1 a basic illustration of a two band filter,

Fig. 2 a sub-filter in a two stage filter structure,

Fig. 3 the amplitude/frequency response of a low pass filter having pass band, cross-over and stop band regions,

Fig. 4 the amplitude/frequency response of the two stages $N1'$ and $N2'$ from Fig. 2 in a first filter layout with an illustration of disturbance signals and

Fig. 5 the amplitude/frequency response of the two stages $N1'$ and $N2'$ from Fig. 2 in a layout of the filter arrangement in accordance with the invention with an illustration of disturbance signals.

Fig. 1 shows a basic illustration of a two band filter. This comprises an input, to which digital signals $x(n)$ that reach a low pass filter TP and a high pass filter HP are applied. The low pass filter TP and the high pass filter HP form a complementary filter arrangement. Respective sampling rate halvers are connected to the low pass filter TP and the high pass filter HP of the filter arrangement. Low pass and high pass filtered signals appear at the output of the sampling rate halvers.

A coder, with which a quantisation or a data reduction can be carried out, could be connected to these points of the circuit. A decoder whose output signals deviate from the input signals of the coder would then follow the coder. Alternatively, one can also envisage that signals from a source of disturbance are superimposed.

The output signals of the decoder are applied to sampling rate doublers. The output signals of the latter are supplied to a second filter arrangement consisting of a low pass filter TP' and a high pass filter HP'. The output signal $x'(n)$ derivable from the output terminal results from the addition of the output signals from the filter.

Fig. 2 shows as an example, a two stage filter structure which forms the basis for the illustration of the amplitude/frequency response in the further Figures 4 and 5. It comprises a first stage $N1$, a second stage $N2$ at the splitting side of the filter as well as a second stage $N2'$ and a first stage $N1'$ at the merging side of the filter. A time delay member T serves for compensating the transit time. The branches in which the signals appear are referenced by 1, 2, 3 and 4 at the splitting side of the filter and by 1', 2', 3' and 4' at the merging side of the filter. A disturbance signal S which may for example be quantisation noise is fed-in in the filter branch 4.

The amplitude/frequency response of a low pass filter having pass band, cross-over and stop band regions is illustrated in Fig. 3. In this illustration, As signifies the stop band

attenuation, F_0 the cut-off frequency and F_S the edge frequency of the stop band. The stop band extends from F_S to $F_1/2$, the cross-over region from F_0 to F_S and the pass band from 0 to $F_1/4$.

Fig. 4 shows a two stage merge filter structure whose input signals 1' and 3' are error free and whose input signal 4' has a superimposed disturbance signal S . The amplitude/frequency responses of the filter are depicted on the left adjacent to the illustrated filter structures. Therebelow, the frequency distribution of the disturbance signal S , S_2 , S_1 in the individual stages is depicted, but only the components that are greater than the components A_s which have been reflected because of the stop band attenuation. As can be seen from the drawing, the edge frequencies F_{1s} and F_{2s} of the stop bands of the first and second filter stages overlap. This also leads to a disturbance component materialising as is indicated in the drawing by X . This disturbance component X lies outside the sub-band filtered by the filter concerned.

In the illustration in Fig. 5, the filters are so dimensioned that the edge frequency F_{1s} of the stop band of the one stage coincides with that F_{2s} of the other stage. As can be seen from the frequency distribution of the disturbance signals, disturbance signals are also present in the sub-band here, but in contrast, disturbances do not occur in more distantly located bands.



Claims

1. Filter consisting of at least one first filter arrangement (N) comprising a complementary low pass, high pass filter (TP, HP) for dividing the signal into two frequency bands and at least one further filter arrangement (N') for combining the two frequency bands wherein the first filter arrangement (N) comprises a coder having half the sampling rate and the second filter arrangement (N') comprises a decoder having double the sampling rate and wherein the first (N) and the second (N') filter arrangement complement each other in such a way that the output signal $(x'(n))$ corresponds to the input signal $(x(n))$ and the filter arrangements (N, N') are built up from a plurality of stages, characterised in that, the filter stages are dimensioned such that their cross-over regions ($F_0 - F_s$) do not overlap at any point in the frequency range.

2. Filter in accordance with Claim 1, characterised in that, stop band edge frequencies (F_s) of the individual filter stages are the same.