HIGH RESOLUTION WAVELET FILTERING

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For many geodetic and geophysical applications a measured time series has to be filtered, i.e., for the extraction of certain desired signal components. In general, the filtering procedure consists of three steps: (1) computation of the time-frequency-components, (2) extraction of the desired components, (3) computation of the filtered signal from the modified components. It turned out that wavelet analysis is an appropriate tool for the first step. Frequently two signal components, which have to be separated, are very close to each other in the frequency domain. Standard orthogonal filterbanks do not fulfill the required accuracy in analysis, whereas the Morlet wavelet with its minimal and adaptive time-frequency window does. With use of the a trous algorithm a filterbank based on the Morlet Wavelet can be constructed. Then the inverse wavelet transform, needed in the third step, can be calculated with the Neumann algorithm for inverting linear operators using an appropriate pseudo-inverse. It can be shown that the use of a suitable pseudo-inverse-filterbank provides a synthesis with least error. That means that the error due to the energy norm between the modified wavelet coefficients and the wavelet coefficients of the synthesized signal can be minimized. Due to the last fact and the replacement of the integral extension of the standard inversion by a well-controllable and fast calculable series-evaluation, the procedure presented is an appropriate tool for high resolution wavelet filtering.