Design of Quadrature Mirror Filter Banks Using Complex Half-Band Filters

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Abstract

This paper presents the theory and design examples for a new class of quadrature mirror filter banks. Two-channel filter banks are considered as a single filter with complex coefficients. The alias-free condition for the conventional two-channel quadrature mirror filter bank is analyzed and expressed in complex arithmetic. For any real coefficient digital filter, a phase shift in frequency domain produces a complex coefficient digital filter. In particular, a 90 degree phase shift for half-band digital filters results in a complex coefficient version. Such filters generate analytic output signals, and may be decomposed into the sum of an identity operation and a Hilbert transformer. Quadrature mirror filter banks based on complex half-band filters are investigated using the above complex arithmetic technique. Design examples and their associated polyphase realizations are included for the cases of linear phase FIR and elliptic IIR filter banks.

Keyword：Quadrature mirror filter bank, complex half-band filter, analytic signal, Hilbert transformer.