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# On the design of multiband transmission functions synthesized by one wave digital lattice structure

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## Abstract:

In this contribution, the design of multiband transmission functions is considered. Independent and arbitrary number of bands can be designed. Moreover, the whole transmission function is synthesized by one wave digital lattice structure. The approximation process starts by extracting the scattering matrix properties of multiband reference lattice structures. Consequently, the approximation problem reduces to generating a polynomial  $Q$  of degree  $n$ , which is the degree of the filter. The degree  $n$  is depending on the number of the designed bands. Hence, if the number of bands is even,  $n$  will be odd, and if the number of bands is odd,  $n$  will be even. The polynomial  $Q$  will approximate the difference phase function of the two branch polynomials. It is composed of two subpolynomials, one of them is Hurwitz and the other is anti-Hurwitz. The degrees of these subpolynomials differ by odd number if the number of bands is even and differ by even number if the number of bands is odd.  $Q$  is generated according to iterative interpolation and using explicit recursive formulas. After obtaining  $Q$ , the two subpolynomials are calculated and the two branch all-pass functions are constructed. Consequently, the filter is synthesized in the digital frequency domain. The method is applied through an illustrative example. Copyright © 2011 John Wiley & Sons, Ltd.

## Keywords:

digital signal processing; digital filters; wave digital filters; multiband transmission functions; lattice structures

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( 2 )

# Robust and direct design for highpass ladder wave digital filters exhibiting equiripple characteristics

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## Abstract:

The paper presents a complete direct design method for highpass ladder wave digital filters. The approximation process starts by extracting the properties of the scattering matrix of the reference highpass ladder structures. Accordingly, the transmission function is formulated in the reference frequency domain. Then, it is designed through constructing its squared-absolute. The approximation problem is solved by applying iterative interpolation technique such that equiripple characteristics are obtained in the two bands. The synthesis of the resulting transmission function is carried out by successive partial extraction of the poles at zero, corresponding to transmission zero at dc frequency from the original impedance and successive remainder impedance functions, followed by full extraction of the non-zero poles corresponding to transmission zeros at finite non-zero frequencies from the successive remainder admittance functions. After obtaining the reference structure, the wave digital realization is reached by applying three-port parallel and series adaptors. The method is applied through illustrative examples.

## Keywords:

Digital signal processing Digital filters Wave digital filters Highpass ladder structures Straightforward approximation

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