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Difference Operators and Generalized Discrete Fractional Transforms in Signal and Image Processing

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Highlights

- The paper introduces two categories of discrete fractional transforms in unitary and non-unitary settings.
- The relationship between the discrete fractional Fourier transform and second order, self adjoint difference operators is extensively investigated.
- The unitary extension of the discrete fractional Fourier transform is established in terms of the eigenvalues of the discrete fractional Fourier transform, and the eigenvectors extracted from difference operators, with many key parameters.
- The non-unitary discrete fractional transform is defined in terms of arbitrary systems of eigenvalues and eigenvectors.
- Several numerical experiments are carried out, demonstrating the efficiency of the proposed transforms.
- The unitary extension of the discrete fractional Fourier transform is embedded in an image encryption scheme efficiently, while the non-unitary discrete fractional Fourier transform is applied to a blind watermarking scheme.
- Several security, statistical and sensitivity analyses are exhibited.

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