1. MagdyTawfik Hanna, Nabila Philip Attalla Seif and Waleed Abd El Maguid Ahmed, "Discrete Fractional Fourier Transform Based on the Eigenvectors of Tridiagonal and Nearly Tridiagonal Matrices," Digital Signal Processing, 18, pp. 709-727, May 2008.

Abstract:

The recent emergence of the discrete fractional Fourier transform (**DFRFT**) has caused a revived interest in the eigenanalysis of the discrete Fourier transform (**DFT**) matrix **F** with the objective of generating orthonormal Hermite–Gaussian-like eigenvectors. The Grunbaum tridiagonal matrix **T**—which commutes with matrix **F**—has only one repeated eigenvalue with multiplicity two and simple remaining eigenvalues. A detailed eigendecomposition of matrix **T** is performed with the objective of deriving two orthonormal eigenvectors—common to both the **F** and **T** matrices—pertaining to the repeated eigenvalue of **T**. The nearly tridiagonal matrix S first introduced by Dickinson and Steiglitz and later studied by Candan et al.—which commutes with matrix **F**—is rigorously proved to reduce to a 2 × 2 block diagonal form by means of a similarity transformation defined in terms of an involutary matrix **P**. Moreover explicit expressions are derived for the elements of the two tridiagonal submatrices forming the two diagonal blocks in order to circumvent the need for performing two matrix multiplications. Although matrix **T** has the merit of being tridiagonal and does not need the tridiagonalization step as matrix **S**, the simulation results show that the eigenvectors of matrix S better approximate samples of the Hermite–Gaussian functions than those of matrix **T** and moreover they have a shorter computation time due to the block diagonalization result. Consequently they can serve as a better basis for developing the DFRFT.