Discrete and finite fractional Fourier transforms

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Abstract

The fractional Fourier integral transform has been of interest for signal analysis in phase space, and it can be implemented by optical means for parallel processing. Discrete and finite versions of the fractional Fourier transform have been sought because such are data to be sensed and processed in shallow waveguides. We use Lie algebras and q-algebras to set up finite oscillator models, in one and two dimensions, in cartesian and polar coordinates, whose configuration space consists of a finite number of 'sensor' points, and whose unitary evolution defines corresponding finite fractional Fourier-Kravchuk, Fourier-q-Kravchuk and Hankel-Hahn transforms. Such models support coherent states, and have well-defined contraction limits to their continuous counterparts.