Mathematical Physics

The Fourier U(2) Group and Separation of Discrete Variables

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(Submitted on 1 Jun 2011)

The linear canonical transformations of geometric optics on two-dimensional screens form the group $Sp(4,R)$, whose maximal compact subgroup is the Fourier group $U(2)_F$; this includes isotropic and anisotropic Fourier transforms, screen rotations and gyrations in the phase space of ray positions and optical momenta. Deforming classical optics into a Hamiltonian system whose positions and momenta range over a finite set of values, leads us to the finite oscillator model, which is ruled by the Lie algebra $so(4)$. Two distinct subalgebra chains are used to model arrays of N^2 points placed along Cartesian or polar (radius and angle) coordinates, thus realizing one case of separation in two discrete coordinates. The N^2-vectors in this space are digital (pixellated) images on either of these two grids, related by a unitary transformation. Here we examine the unitary action of the analogue Fourier group on such images, whose rotations are particularly visible.

Subjects:	**Mathematical Physics (math-ph)**; Optics (physics.optics)
Journal reference:	SIGMA 7 (2011), 053, 18 pages
DOI:	10.3842/SIGMA.2011.053
Cite as:	**arXiv:1106.0093 [math-ph]**
	(or **arXiv:1106.0093v1 [math-ph]** for this version)

Submission history

From: Sigma [view email]
[v1] Wed, 1 Jun 2011 05:14:33 GMT (947kb,D)

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