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Title:	Realization of general first-order optical systems using thin lenses of arbitrary focal length and fixed free propagation distance
Authors:	Ameen Yasir, P. A (/jspui/browse?type=author&value=Ameen+Yasir%2C+P.+A)
Keywords:	first-order thin lenses of arbitrary focal length optical systems
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Abstract:	Any general first-order optical system can be represented using S∈$Sp(4,\mathbb{R})$, where $Sp(4,\mathbb{R})$ is the symplectic group with real entries in four dimensions. We prove that any S∈$Sp(4,\mathbb{R})$ can be realized using not more than 18 thin lenses of arbitrary focal length and seven unit distance. New identities that realize S=$S1 \oplus S2$, where $S1, S2 \in Sp(2,\mathbb{R})$, are obtained. Also, it is proved any S of the form $S1 \oplus S2$ can be realized using a maximum of eight thin lenses of arbitrary focal length and three unit distance. Moreover, decompositions for examples such as differential magnifier, partial Fourier transform, and inverse partial Fourier transform are also provided. A “gadget” is proposed that can realize any S∈$Sp(4,\mathbb{R})$ using thin lens transformations—which can be realized through the use of eight spatial light modulators (SLMs) and seven unit distance. Experimental limitation imposed by SLMs while realizing thin lens transformations is also outlined. The justification for the choice of unit distance according to the availability of thin lenses in a lab is given too.
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