Contribution Title:	GEOMETRIC FOURIER ANALYSIS IN COGNITIVE VISION
Authors:	J. Turski
Presenting author:	Turski J.
Affilation:	University of Houston-Downtown
E-mail:	turskij@uhd.edu
Invited speaker:	
YRS seminar:	NO

The group SL(2,C) occupies a truly remarkable position in mathematics and sciences. It is inherently relevant to non-Euclidean geometries, modern complex analysis (Teichmüller spaces), and special theory of relativity. We demonstrate that SL(2,C) provides geometrical and numerical framework for computational vision, including visual neuroscience and machine vision. In the conformal camera, that models eye imaging functions, image projective transformations are given by SL(2,C) acting on the camera's image plane by linear-fractional mappings. The conformal camera has its own projective Fourier analysis constructed in the framework of representation theory of SL(2,C). Projective Fourier transform (PFT) provides image representation well adapted to both perspective transformations of retinal images and the retinotopy of the brain visual pathways. We use the conformal camera to process visual information when eyes execute three times per fast scanning movements called saccades. Despite these incisive eye movements, we perceive a stable world. This visual constancy is maintained by neuronal receptive field shifts prior to saccade onset in various retinotopically organized cortical areas. These shifts may integrate visual information across saccades and eliminate the need for starting image processing anew three times per second at each fixation. However this remapping is not perfect; around the time of saccades the perceptual space is compress, the phenomenon called perisaccadic mislocalization. In our modeling of perisaccadic perception, we utilize basic properties of PFT. First, the inverse PFT can be efficiently computed by a fast Fourier transform in logarithmic coordinates that approximate the retinotopic mapping. Second, a simple translation in retinotopic (logarithmic) coordinates, modeled by the standard shift property of Fourier transform, remaps the presaccadic scene into a postsaccadic reference frame. This shift accounts for the perisaccadic mislocalization.