

# A neuro-mathematical model for geometrical optical illusions

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## 1 Abstract

Geometrical optical illusion (GOIs) have been of great interest due to the possibility to understand, through the effect they produce on neural connections, the behaviour of low-level visual processing. They have been defined in the XIX century by German psychologists (Oppel 1854 [4], Hering, 1878, [3]) in terms of phenomenology of vision, as situations in which there is an awareness of a mismatch of geometrical properties between an item in object space and its associated percept (Westheimer 2008, [5]). As pointed out by Eagleman (Nature, 2001 [2]) the study of these systematic misperceptions combined with recent techniques for brain's activity recording provides a brilliant insight to lead new experiments and hypothesis on receptive fields of V1 and feedback mechanisms.

In this framework, starting from the geometrical model introduced by Citti and Sarti in 2003 [1], we provide an efficient mathematical model which allows to interpret these phenomena and to measure the perceived misperception, involving image-processing techniques and expressing the displacement through PDEs. We expect this to be the starting point of new considerations about feedback mechanism between V1 and the retina and the study of lateral inhibition.

## 2 References

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- (2) D.M. Eagleman, *Visual Illusions and Neurobiology*, Nature Reviews Neuroscience. 2(12), 920-6, (2001).
- (3) E. Hering, *Beitrage zur Physiologie I. Zur Lehre vom Ortssinne der Netzhaut*, Leipzig: Engelmann, (1861).
- (4) J. J. Oppel , *Ueber geometrisch-optische Tauschungen*, Jahresbericht des physikalischen Vereins zu Frankfurt am Mains, 39-47, (1854-1855).
- (5) G. Westheimer, *Illusion in the spatial sense of the eye*, Vision Research 48, 2128-2142, (2008).