# Reverspective, Hollow Faces, and the Dragon Illusion

Peter Vangorp, George Drettakis – REVES / INRIA Sophia Antipolis

*(a) Reverspective* *(b) Hollow Face illusion* *(c) Dragon illusion*

*Figure 1: Well-known demonstrations of (a) Reverspective, (b) the Hollow Face illusion, and (c) the Dragon illusion.*

## Research Goal

Human beings have evolved a very complex system to be able to perceive the 3D shape of objects. This system makes use of many cues, such as lighting, texture, shadows, silhouettes, edges, relative size, optic flow, stereo vision, prior knowledge, and reasonable assumptions. All these cues help to disambiguate the 2D image input from the eyes to recover the correct 3D shape of objects.

These cues are not all equally reliable, and sometimes they are contradictory. In such cases, more weight is given to the more reliable, less contradictory cues. This weighting scheme, called *cue combination* or *fusion* [Clark 90], has evolved to work almost flawlessly in our daily lives.

Artists and illusionists have perfected ambiguous configurations where the 3D shape of objects is perceived incorrectly. Well-known examples (Figure 1) include *Reverspective* [Hughes, Wade 99], the *Hollow Faces* illusion [Gregory, Yellott 79, Dultz 84, Hill 07], and the *Dragon* illusion [Andrus, Binary 98]. In these ambiguous configurations the assumption of convexity and the prior knowledge of familiar shapes are stronger than all the other cues.

## Our Approach

These illusions were traditionally created by making molds of existing objects or by manually constructing simple papercraft reversed perspectives. In computer graphics it is relatively easy to reverse the perspective of polygonal meshes.

The mesh processing can be done with existing libraries [CGAL, OpenMesh] by propagating the reversal from initial polygons to adjacent polygons. If only parts of objects need to be reversed, e.g., the head of the dragon, then a user should be given a simple graphical interface to select that region. Care has to be taken to preserve the connectivity of the mesh in the case of non-zero genus or unusual user-selected regions.

An interesting research direction would be to create several objects as stimuli for a perceptual study to explore the limits of these illusions. In addition we plan to explore the possibilities of 3D printing the resulting objects or simplifying them to automatically generate papercraft patterns.

## Bibliography


[Andrus] Jerry Andrus. *3-D Paper Dragon*. http://jerryandrus.org/

[Binary 98] Binary Arts, 1998. *Dragon Illusion*.

[CGAL] CGAL. *Computational Geometry Algorithms Library*. http://www.cgal.org/

[Clark 90] James Joseph Clark and Alan L. Yuille, 1990. *Data fusion for sensory information processing systems*. Kluwer.

[Dultz 84] Wolfgang Dultz, 1984. *The Bust of the Tyrant: an optical illusion*. Applied Optics 23(2), pp. 200–203.

[Gregory] Richard L. Gregory. *Charlie Chaplin Mask*. http://www.richardgregory.org/

[Hill 07] Harold Hill and Alan Johnston, 2007. *The hollow-face illusion: Object-specific knowledge, general assumptions or properties of the stimulus?* Perception 36(2), pp. 199–223.

[Hughes] Patrick Hughes. *Reverspective*. http://www.reverspective.com/

[OpenMesh] *OpenMesh*. http://www.openmesh.org/

[Wade 99] Nicholas J. Wade and Patrick Hughes, 1999. *Fooling the eyes: trompe l'oeil and reverse perspective*. Perception 28(9), pp. 1115–1119.

[Yellott 79] John I. Yellott Jr. and Jerry L. Kaiwi, 1979. *Depth inversion despite stereopsis: the appearance of random-dot stereograms on surfaces seen in reverse perspective*. Perception 8(2), pp. 135–142.