Multiple Perspectives in Computer Graphics: Arguments from Perceptual Grouping and Renaissance Art

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Research in computer graphics noticed deviations from strict geometrical perspective in Renaissance painting, which it treated as exceptional cases, related to specific human perceptions. Based on research in perceptual grouping and art history, this work argues that the deviations are not exceptional but systematic. A new graphics architecture supporting multiple perspectives is also sketched.

1 Perceptual Grouping

‘Perceptual grouping refers to the processes by which the various elements in an image are perceived as “going together” in the same perceptual unit of experience’ [Palmer 1999]. Initially, perceptual grouping was considered an early visual process operating on the two-dimensional retinal image. Recent evidence, however, seems to show that grouping occurs late in vision, influenced by phenomena related to perceptual constancy, like depth perception.

Currently, psychologists believe [Palmer et al. 2003] that grouping occurs both early and late. Most important, retinal grouping occurs before depth perception based on pictorial cues, Figure 1. Thus, viewers of paintings see organization in the image plane as well as in depth.

![Figure 1: Grouping by proximity, shape and colour affects shape constancy. (A) Central element either ellipse in frontal plane or circle slanted in depth. (B) Ellipse in the frontal plane. (C) Circle slanted in depth. Reproduced from [Palmer et al. 2003] with permission from Elsevier.](image1.png)

2 Renaissance Art

Renaissance artists, in their quest for realism discovered and developed linear perspective, while retaining the Medieval practice of symbolizing relationships using picture plane geometry, a practice long known to art historians. Picture plane patterns affecting depth perception, as described above, allow symbolism to coexist with realism. The cost is over-constraint, which artists solved by adopting a pluralist approach, having many perspectives within a single picture. They used a ‘collage of different constructions’ [Elkins 1994], for practical reasons to be sure, but mostly to produce planar groupings that enhance symbolism and narrative while managing depth with linear perspective, Figure 2. Renaissance realism was ‘object oriented’, in contrast with photography or computer graphics, which are ‘space oriented’. Renaissance artists seem intuitively to have understood perceptual grouping as a multi-level process occurring both early on the image plane and later in the depth-interpreted image.

![Figure 2: To the left is Piero’s Baptism of Christ. Despite the carefully rendered perspective art historians agree that the main compositional element is an equilateral triangle (Trinity symbol) in the picture plane. To the right is Holbein’s The Ambassadors, a later painting. The anamorphic skull in the foreground indicates a view position from which the illustrated picture plane relationships tell a story. To create the narrative relationships Holbein pictured individual objects using different perspectives [North 2002]. Reproductions courtesy of The Yorck Project.](image2.png)

3 Computer Graphics

Image composition encompasses both three and two dimensions when artists employ the multi-stage, multi-domain perceptual grouping process. Renaissance artists, applying perceptual intuition to grouping, used multiple perspectives for realistic depth and creative freedom. Thus, it would be useful to artists and designers using a computer to have the capability of using multiple perspectives to compose in both plane and depth.

We propose adequately flexible perspective with a novel imaging architecture, based on recursive billboards. Each billboard, which is an object, depicts one or more objects in its own perspective. Placement and orientation of billboards provide the pictorial realism and creative freedom exploited by Renaissance realism.

References


