Projective Geometry Seen in Renaissance Art

Word Count: 2655

Abstract: For the West, the Renaissance was a revival of long-forgotten knowledge from classical antiquity. The use of geometric techniques from Greek mathematics led to the development of linear perspective as an artistic technique, a method for projecting three dimensional figures onto a two dimensional plane, i.e. the painting itself. An "image plane" intersects the observer's line of sight to an object, projecting this point onto the intersection point in the image plane. This method is more mathematically interesting than it seems; we can formalize the notion of a vanishing point as a "point at infinity," from which the subject of projective geometry was born. This paper outlines the historical process of this development and discusses its mathematical implications, including a proof of Desargues' Theorem of projective geometry.

Outline:

I. Introduction

   A. Historical context; the Middle Ages and medieval art

   B. How linear perspective contributes to the realism of Renaissance art, incl. a comparison between similar pieces from each period.

C. Influence of Euclid

II. Geometry of Vision and Projection

A. Euclid's *Optics*

B. Cone of vision and the use of conic sections to model projection of an object onto a picture. Projection of a circle explained intuitively.

C. Brunelleschi's experiments and the invention of his technique for linear perspective

D. Notion of points at infinity as a vanishing point

III. Projective geometry and Desargues' Theorem

A. Definition of a projective plane and relation to earlier concepts discussed

B. History of early projective geometry and Desargues, Desargues Theorem; statement and proof of dim 3 case

IV. Conclusion

A. Perspective, and the study of mathematics and science as a whole, as a cultural shift toward an emphasis on the importance of the human experience by accuracy in portraying it.

Math Point: Desargues' Theorem and the basics of projective geometry.

- Books
  - *Perspectives on Projective Geometry: A Guided Tour Through Real and Complex Geometry* by Richter-Gebert
  - *The Geometrical Work of Girard Desargues* by Field and Gray
- Primary Sources
  - *Optics* by Euclid (translated by Burton)
  - *The Geometrical Work of Girard Desargues* by Field and Gray (contains both translations of Desargues and exposition written by Field and Gray)
- Secondary Sources
  - *Brunelleschi's mirror, Alberti's window, and Galileo's 'perspective tube'* by Edgerton (elaborates on Brunelleschi's experiments)
  - *The Geometrical Work of Girard Desargues* by Field and Gray (contains both translations of Desargues and exposition written by Field and Gray)