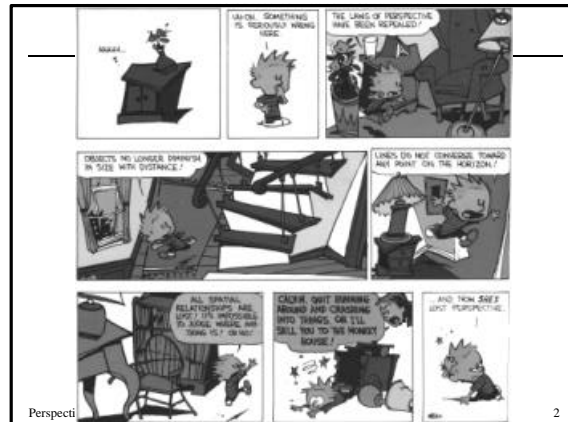


The Art and Science of Depiction
Linear Perspective

Fredo Durand
MIT-Lab for Computer Science



Assignments for Monday 30.

- Solso *Cognition and the Visual Arts*
 - Chapter 8 & 9
- Final project
 - Firm subject

Plan of the next sessions

- Drawing and projection
- Denotation
- Tone & color

Plan

- Intro to perspective
- History of Renaissance perspective
 - Early attempts
 - Bruneleschi
 - Alberti
 - De la Francesca
 - Leonardo
 - Dürer
- Gadgets
- Distortion issues

Perspective

- Does linear perspective “occur” in nature
 - E.g. we “experience” foreshortening
- Perspective or perspectives?

Pictorial depth cues

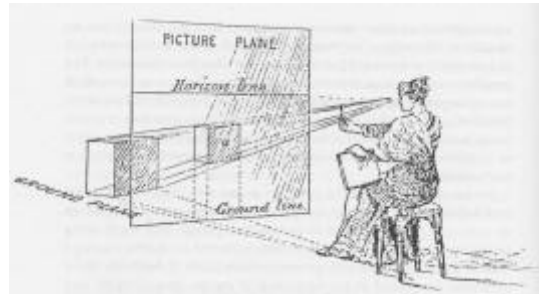
- Occlusion
- Size
- Position relative to the horizon
- Convergence of parallels, linear perspective
- Shading, shadow
- Texture gradient
- Aerial perspective

Perspective

7

Introduction to Perspective

- Importance of the single viewpoint



Perspective

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Linear Perspective

- Image as a window
- *St Jerome In His Study*
Antonello da
Messina 1475



Perspective

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Some accompanying concepts

- Viewpoint
- Foreshortening
- Vanishing point

- Very linked to architectural spaces

Perspective

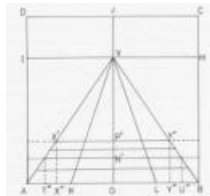
10

Primary/secondary geometry

- Primary geometry
 - Description in 3D object-space
- Secondary geometry
 - Description in 2D image-space



Perspective



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Plan

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Perspective

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Early attempts

- St John the Baptist Retiring to the Desert
Giovanni di Paolo 1454



Perspective

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Early attempts

- Giotto, 1297-1299



Perspective

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Early attempts

- Lorenzetti 1337-1340

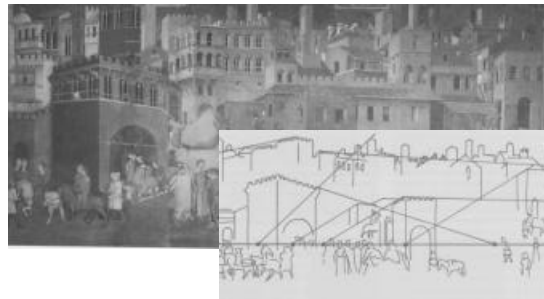


Perspective

15

Early attempts

- Lorenzetti 1337-1340



Perspective

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Giotto's rules

- Lines and planes above eye level incline downwards when they move away
- Below eye level upwards when they move away
- Lines to the left incline inwards to the right

Perspective

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Giotto

- Confirmation of the Rule of St Francis 1325

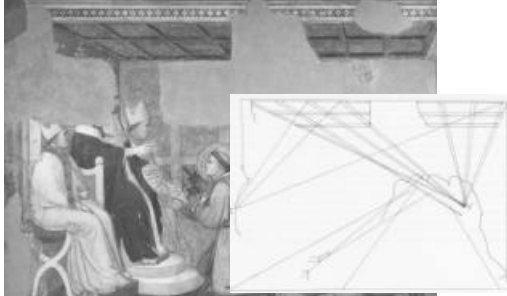


Perspective

18

Giotto

- Confirmation of the Rule of St Francis 1325



Perspective

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Early attempts

- Pietro Lorenzetti, *Birth of the Virgin* 1342



Perspective

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Perspective

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Brunelleschi's experiments, 1413

- Existing buildings
- Measurement, surveying
- Single viewpoint
- First scientific mimesis

Perspective

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Brunelleschi's experiment, 1413

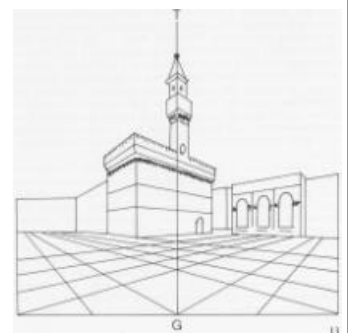


Perspective

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Brunelleschi's second experiment

- Cut out
- Note that this is 2-point perspective



Perspective

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Limitations

- Existing buildings
- Requires measurement

Perspective

25

Masaccio, *The Trinity*, 1427

- The oldest perspective painting
- Probably measurement
- Maybe helped by Brunelleschi



Perspective

Masaccio, *The Trinity*, 1427

- The oldest perspective painting
- Santa Maria Novella (Florence)

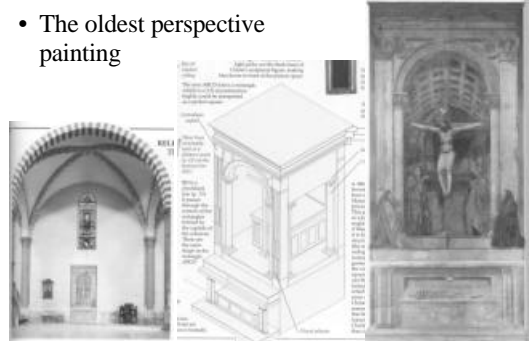


Perspective

27

Masaccio, *The Trinity*, 1427

- The oldest perspective painting



Perspective

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Plan

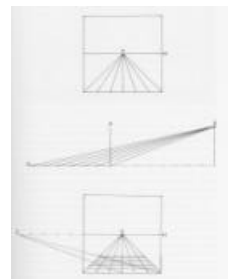
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Perspective

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Leon Battista Alberti, *On Painting*

- 1435
- Intersections of pyramids with image surface
- Proportional triangles
- Use side view for foreshortening
- Check with diagonal
- Use pavement as reference
- Center = prince of rays



Perspective

30

Leon Battista Alberti, On Painting

- Paolo Uccello, *The Selling of the Host*, 1468



Perspective

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Legitimate construction

- Carlo Crivelli, *Annunciation* 1486



Perspective

Plan

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Perspective

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Piero de la Francesca

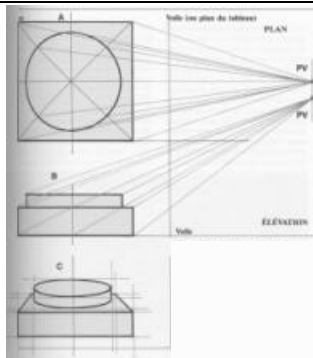
- *De Prospectiva Pingendi*, 1474
(On the perspective of painting)
- Ratios of distance and size
- Use plan and elevation view

Perspective

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Piero de la Francesca

- Use plan and elevation view

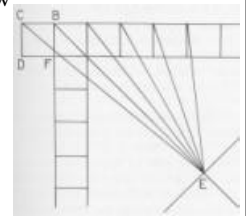
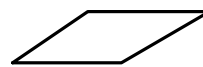


Perspective

35

Piero de la Francesca

- *De Prospectiva Pingendi*, 1474
(On the perspective of painting)
- Ratios of distance and size
- Use plan and elevation view
- Deformation of square
 - Angle of view less than 90°



Perspective

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Piero de la Francesca

- *Flagellation of Christ*, 1460



Perspective

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Piero de la Francesca

- Invention of the true cross 1452-59
- “wrong perspective on the left



Perspective

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Piero de la Francesca

- Invention of the true cross 1452-59
- “wrong perspective on the left



Perspective

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Plan

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Perspective

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Leonardo & perspective

- Techniques of artists' perspective in theory and practice
- Geometry of visual rays
- Devices and instruments
- Optics and the eye
- Curiosities of vision (e.g. anamorphosis)
- Apparent contradictions

Perspective

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Leonardo

- *Last Supper*, 1497



Perspective

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Leonardo

- *Last Supper*, 1497

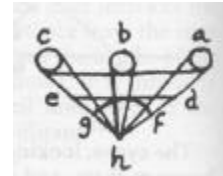
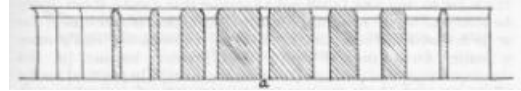


Perspective

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Leonardo & contradictions

- Wide angle vision

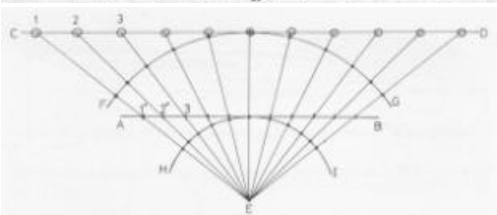
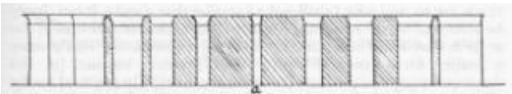


Perspective

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Leonardo & contradictions

- Wide angle vision

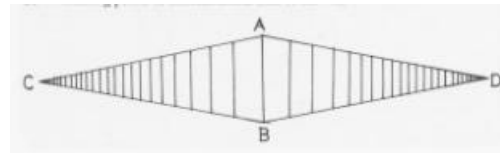


Perspective

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Leonardo & contradictions

- Wide angle vision
- Lateral recession



Perspective

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Plan

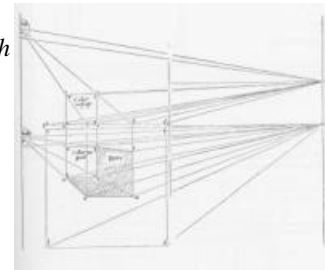
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Perspective

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Dürer

- Traveled to Italy
- Mainly influenced by de la Francesca
- *Instruction in Measurement with Compass and Ruler in Lines, Planes and Solid Bodies*, 1525



Perspective

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Dürer

- *St Jerome in his Study* 1514
- Very off-center
- Note the verticals



Perspective

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Dürer

- The artist's glass



Perspective

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Dürer

- The draftsman's net



Perspective

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Dürer

- Jacob de Keyser's invention



Perspective

52

Dürer

- Dürer's device



Perspective

53

Conclusions about Renaissance

- Different techniques, refinement
- Measurement
- Mainly central perspective
- No notion of infinity, no vanishing point
- Spiritual notion of mathematical harmony

Perspective

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After Renaissance

- 17th
 - Vanishing point
 - Abstraction
 - Desargues, Descartes
- Flourished until 19th
- 20th century
 - Come-back for computer graphics and computer vision

Perspective

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After Renaissance

- Thomas Malton
A Complete Treatise on Perspective, 1779



Perspective

Plan

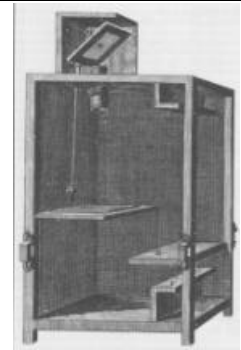
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Perspective

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Gadgets

- Camera obscura



Perspective

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Vermeer 1660

- Camera obscura



Perspective

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Gadgets

- Baldassare Lanci's universal instrument for surveying and perspective 1557

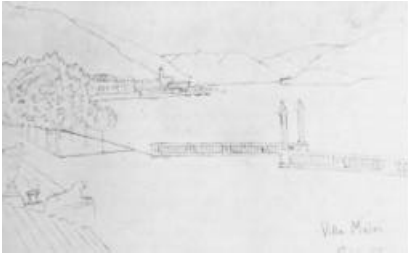


Perspective

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Gadgets

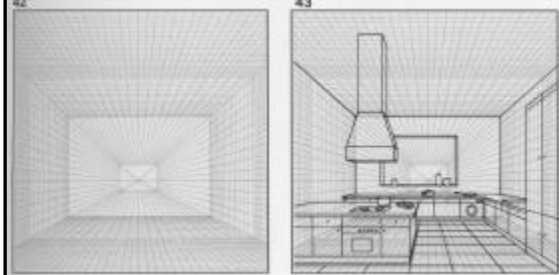
- Camera Lucida
- E.g. Talbot



Perspective



Perspective grids



Perspective

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Plan

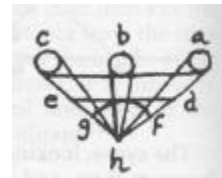
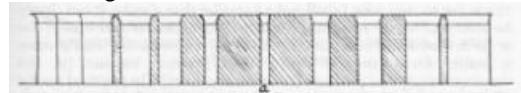
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Perspective

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Leonardo & contradictions

- Wide angle vision

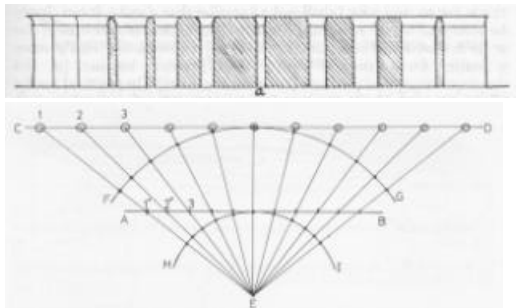


Perspective

64

Leonardo & contradictions

- Wide angle vision

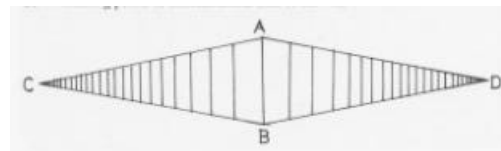


Perspective

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Leonardo & contradictions

- Wide angle vision
- Lateral recession



Perspective

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Perspective distortion

- The sphere is projected as an ellipse



Perspective

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Perspective distortion

- The sphere is projected as an ellipse



Perspective

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