The Art and Science of Depiction

Drawing systems

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MIT- Lab for Computer Science
Assignments for Monday 30.

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

Plan

- Drawing and projection
  - Linear perspective & the Renaissance
  - Drawing systems
    - Catalogue of “all” drawing systems
    - Advantage/disadvantages
  - Distortion and constraints
- Denotation
- Tone & color
**Issues**

- Place of the spectator
- Intrinsic/extrinsic (essential/accidental)
- Unified space
- Shape representation
- Error/distortion/choice

- Child development
- No cultural judgment!

**Context**

- Importance of the notion of front/top/side
- Presence of lines and planes or not
- Orthogonals
  - Lines orthogonal to the picture plane
  - I.e. lines that converge in the center of the image in central perspective
- Picture plane/curved picture
Efficient shape representation

- True shape
- 3D layout
- Canonical view
- General/accidental view

Generic vs. accidental viewpoint

The angles are seen as right-angles because the brain reads them as rectangular corners shown in perspective.

THE IMPOSSIBLE TRIANGLE
This perspective triangle shows that what people expect to see can conflict with the evidence of their eyes. The top structure is logical, but, when reconstructed as an unbroken tribar, the brain interprets it as a three-dimensional triangle made up of three right angles - a geometric impossibility. Escher (right) was inspired by this structure to create his own "impossible" perspectives.
Generic vs. accidental viewpoint

- Accidental alignment of trash and sea

Photo
Peter Turner

Drawing systems

Generic vs. accidental viewpoint

Drawing systems
**Canonical view**

- Rate views
- Features must be salient
- General view
- Front view
- \( \frac{3}{4} \) up view

Drawing systems
**Invariants**

- Invariants
  - Alignments
  - Angles
  - Shape
  - Symmetry

- Property mapping

- Each system here assumes a unified space. Can be mixed up though

**3D and 2D attributes**

- Show a dice to children (~6-7)
- They usually draw a rectangle
- The rectangle can stand for one face
**3D and 2D attributes**

- Show colored or numbered dice to children (6-7)
- The still draw a rectangle
- But different colors or many points

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**3D and 2D attributes**

- Show colored or numbered dice to children (6-7)
- The still draw a rectangle
- But different colors or many points
- The rectangle stands for the whole dice
- The notion of 3D object with corners is translated as a 2D object with corners
Evolution of children’s drawings

- Asked to draw a table

<table>
<thead>
<tr>
<th>Class of drawing &amp; average age</th>
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<tbody>
<tr>
<td>7.4</td>
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Child’s view

Primary/secondary geometry

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

- Primary geometry
  - Description in 3D object-space
- Secondary geometry
  - Description in 2D image-space
  - Permits the description of more drawing systems
  - Often better corresponds to the drawing approach

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**British standard classification**

- Primary geometry
  - Orthogonal
    - Isometric
    - Dimetric
    - Trimetric
  - Oblique, axonometric
    - Two-point
    - Three-point
  - Perspective

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Fig. 2.1 Classification scheme for projection systems, based on primary geometry. Adapted from Berth Snedeker 1967-1969.
**Willats’s classification**

- **Secondary geometry**
  - Linear
    - Parallel
    - Linear perspective
    - Divergent perspective
  - Non Linear
    - Quasi linear
    - Curved projections
    - Topological
    - Split views, fold-out
    - Multiple viewpoints

**Classification of drawing systems**
Classification of drawing systems

• Linear
  – Parallel
  – Orthogonal
  – Fold-out oblique
    – Horizontal oblique
    – Vertical oblique
  – Orthographic
    – Isometric
    – Others
  – Non orthogonal
    – Oblique
    – Axonometric
  – Linear perspective
    – One point
    – Two points
    – Three points
  – Divergent perspective

• Non Linear
  – Quasi linear
  – Naïve perspective
  – Expressionist perspective
  – Importance-driven
  – Cell panorama
  – Curved projections
    – Panorama
    – Fish-eye
  – Topological
  – Split views, fold-out
  – Multiple viewpoints

Linear projections

• Straight lines and alignments are preserved
• Can be expressed in primary geometry
  – Ray-image intersections
  – A matrix

• Parallel

• Linear perspective

• Divergent perspective
Parallel projections

- No foreshortening
- Can represent true shape
- Some are poor shape representations

Projection direction
- Orthogonal to image plane or not
- Along one principal direction or not
- “Stretching” or not

Parallel projections

- Orthogonal
- Fold-out oblique
  - Horizontal oblique
  - Vertical oblique
- Non orthogonal
  - Oblique
  - Axonometric
- Orthographic
  - Isometric
  - Others
**Orthogonal**

- **Direction**
  - Perpendicular to image plane
  - Along one principal direction

- True shape for objects parallel to image plane

Drawing systems
Orthogonal

• Amphora, 6th century BC

Orthogonal

• Bayeux Tapestry 1080
Orthogonal

• Telephoto

As the hijack bargaining goes on under the sweltering sun...

Orthogonal

• Child drawing
**Parallel projections**

- Orthogonal
- Fold-out oblique
  - Horizontal oblique
  - Vertical oblique
- Non orthogonal
  - Oblique
  - Axonometric
- Orthographic
  - Isometric
  - Others

**Fold-out oblique**

- Horizontal oblique
- Vertical oblique
- Direction
  - 45°, parallel to one principal face (top or side)
**Fold-out oblique**

- Horizontal oblique
- Vertical oblique
- Direction
  - 45°, parallel to one principal face (top or side)
- Can be stretched for fold-out
  - True shape for 2 directions
- Mainly interesting for secondary geometry

**Horizontal oblique**

- Folk art

*Fig. 2.8. Paul A. Seifert, Residence of Mr. E. R. James, 1881. Watercolor, 54.6 x 69.9 cm. New York State Historical Association, Cooperstown, New York.*
Horizontal oblique

- Icons

- Child drawing
**Horizontal oblique**

- Cézanne: Still life with a commode, 1887

**Pushing the envelope**
**Vertical oblique**

- Soriguerola, 13\textsuperscript{th}

*Image of a drawing depicting Soriguerola from the 13\textsuperscript{th} century.*
Vertical oblique

- Juan Gris, *Breakfast*, 1914
**Vertical oblique**

- Indian art, 1660

![Image of Indian art, 1660](drawing-systems.png)

**Vertical oblique**

- Claude Rogers, *The Hornby Train*, 1951-53

![Image of Claude Rogers' The Hornby Train, 1951-53](drawing-systems.png)
**Vertical oblique**

- Andre Kerstesz, Tulipe Melancolique

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**Pushing the envelope**

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**Pushing the envelope**

- Non-linear
- Locally linear

**Parallel projections**

- Orthogonal
- Fold-out oblique
  - Horizontal oblique
  - Vertical oblique
- Non orthogonal
  - Oblique
  - Axonometric
- Orthographic
  - Isometric
  - Others
Non orthogonal

- **Direction**
  - non orthogonal to picture plane

- **Oblique**
  - Picture plane parallel to front
  - True shape for front face

- **Axonometric**
  - True shape for top face
  - True distance for up direction
  - Direction 45° of the picture plane

Oblique

- Picture plane parallel to front
- True shape for front face
- Can use true distance for 3rd direction
**Oblique**

- Henry Lapp, 19th century

- Lady Wenji’s Return to China, 12th century
Oblique

Phoenix and Achilles, 350-340 BC
Axonometric

• Axonometric
  – True shape for top face
  – True distance for up direction
  – Direction 45° of the picture plane

Axonometric

• Le Corbusier was a big fan
Axonometric

• James Stirling, 1953

Axonometric

• Juan Gris, *Breakfast*, 1914
**Parallel projections**

- Orthogonal
- Fold-out oblique
  - Horizontal oblique
  - Vertical oblique
- Non orthogonal
  - Oblique
  - Axonometric
- Orthographic
  - Isometric
  - Others

**Orthographic**

- Direction
  - Orthogonal to picture plane
  - Along no principal direction
- Isometric
  - Direction along the average of the principal directions
  - True distances along 3 directions
- Others
  - Generic orthographic
Isometric

- Brooks-Greaves
  *St Paul's Cathedral*
  1928
**Isometric vs. Axonometric**

- **Isometric**
  - No true shape
  - True distances in 3 directions
  - Little distortion
  - Direction average 2 principal directions

- **Axonometric**
  - True shape for top face
  - True distance for up direction
  - Direction 45° from picture plane

**General Orthographic**

- Seldom used!
**Mixed parallel system**

- Persian miniature, 1494
- Oblique+vertical oblique

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**Classification of drawing systems**

- Linear
  - Parallel
  - Linear perspective
  - Divergent perspective
- Non Linear
  - Quasi linear
  - Curved projections
  - Topological
  - Split views, fold-out
  - Multiple viewpoints
**Linear perspective**

- Foreshortening
- The spectator is “immersed”
- Potential distortions

- One point
- Two points
- Three points

**1-point perspective**

- Central focus
- Preserves horizontals and verticals
1-point perspective

- Central focus
- Preserves horizontals and verticals
- Can mean that the optical center is not the center of the image
  - View-camera

1-point perspective

- Jean Vredeman de Vries, 1604
1-point perspective

• Unknown artist Ideal city, 15th

1-point

• Interior of St Bavo's church at Haarlem, Pieter Jansz Saenredam, 1648
1-point perspective

The Avenue Middelharnis, Meindert Obbema 1689

1-point perspective

Western perspective in a Japanese picture
2-point perspective

• Objects stand out of the picture
• Preserves verticals
• Can mean that the optical center is not the center of the image
  – Architecture lens
Old assignment

• Before: 3-point perspective

Old assignment

• After: 2-point perspective
3-point perspective

- Dramatic 3D effect
- The generic case, nothing preserved
- seldom used through art history
Perspective anomaly and expression

• Giorgio de Chirico, *Mystery and Melancholy of a Street*, 1914

Perspective anomaly and expression

• Giorgio de Chirico, *Les Muses Inquietantes*, 1925
**Perspective distortion**

- Wide angle projection
- Does not preserve subjective size

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**Perspective distortion**

- Wide angle projection
- Does not preserve subjective size
Perspective distortion

- Wide angle projection
- Distorts shape

Perspective distortion

- Portrait: distortion with wide angle
Perspective distortion

- The sphere is projected as an ellipse
- Symmetry is not preserved
- Some perspective manuals claim that the projection of a sphere is a circle

Perspective distortion

- The sphere should be projected as an ellipse
- But a circle is used
Classification of drawing systems

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Divergent perspective

- A.k.a. inverted perspective
- Subject of quarrel, hard to include in a theory

- Icons
- Asian
- Cubism
- Children
**Divergent perspective: explanations**

- Does not exist!
- Lack of skill
- Represents more faces
- Fear of idolatry
- Perceptual over-compensation
- Perceptual effect of field of view and size constancy

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**Divergent perspective**

- *The Four Gospels, Luke, 1380, Byzantine*
Divergent perspective

- Mark, 15th century, Byzantine

- Andrei Rublev, The Holy Trinity, 1408~1425
Divergent perspective

• Hasadera Enji (Japanese)

Divergent perspective

• Georges Braque, *Still Life: The Table*, 1928
Divergent perspective

- David Hockney, *Chair*

- Child drawing (Kenyan here)
Evolution of children’s drawings

- Asked to draw a table

Child’s view

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