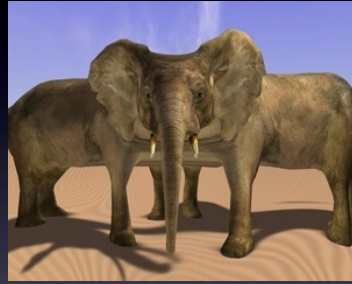# Multi-Perspective Images

M. C. Escher, 1956

Rademacher and Bishop, 1998

Images that depict **more** than can be seen from any **single** viewpoint, yet remain interpretable
-- J. Yu

Multi-Perspective Images

Motivation

- Artists often deviate from perspective projection
  - Alter projection for each object
  - Curvilinear, nonlinear, inverted

- Express mood, feeling, idea

- Improve comprehensibility

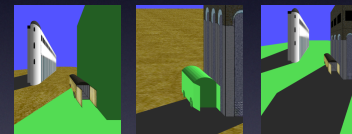- Visualize spatial relationships

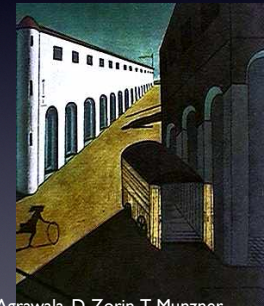Giorgio de Chirico's *Mystery and Melancholy of a Street*

Slide by M. Agrawala, D. Zorin, T. Munzner

Motivation

- Artists often deviate from perspective projection
  - Different projection for each object
  - Curvilinear, nonlinear, inverted
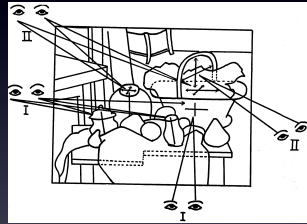
- Express mood, feeling, idea

Five different projections

Slide by M. Agrawala, D. Zorin, T. Munzner

Artistic Expression

- Viewing Anomalies
  Cezanne's *Still Life with Fruit Basket*

Schematic from Loran (1943)

Slide by M. Agrawala, D. Zorin, T. Munzner
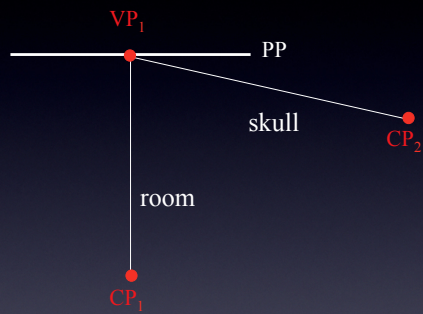
van Eyck's "Ghent Alterpiece" (1432)

Hans Holbein (1533) *The ambassadors*. National Gallery, London

Hans Holbein the Younger, *The Ambassadors*, 1533

ANAMORPHIC PROJECTION

VP_1

PP

skull

CP_2

room

CP_1

2 Centers of Projection:
• Orthogonal PP
• Slanted PP

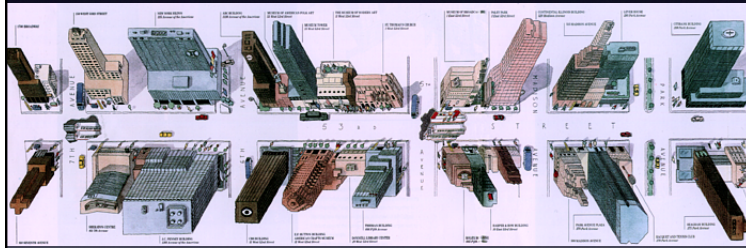## Hockney's "Pearblossum Highway" (1986)

Hockney-style Collages

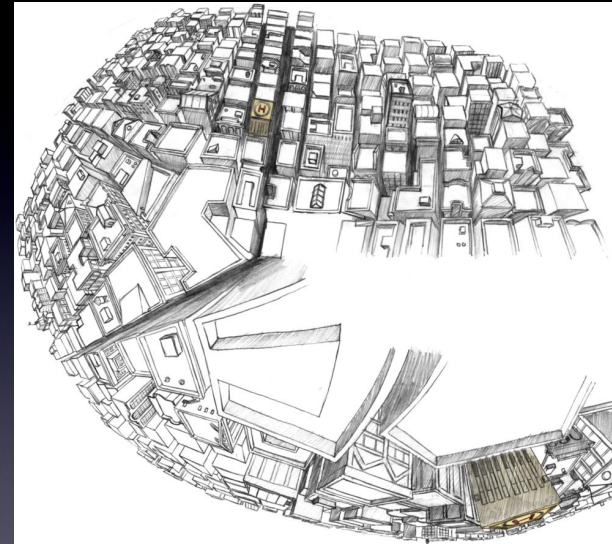Panography Group at Flickr.com

Visualization

- Artificial Perspective
  - Multiple parallel projections
  - Orient receding parallel towards vanishing point
  - Some area comparisons possible

53rd Street Map (Guarnaccia 93)

Slide by M. Agrawala, D. Zorin, T. Munzner

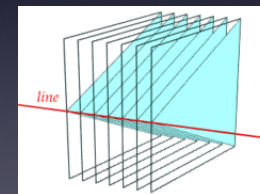# Multi-Perspective Cameras: Fisheye Lens Image

© http://www.bottin.com

Not a single optical center

Pushbroom Camera

http://grail.cs.washington.edu/projects/stereo/

Slit Panoramas

- Strip panoramas created by horizontally translating a 1D vertical strip camera past a scene

- Orthographic projection along horizontal axis; Perspective projection along vertical axis
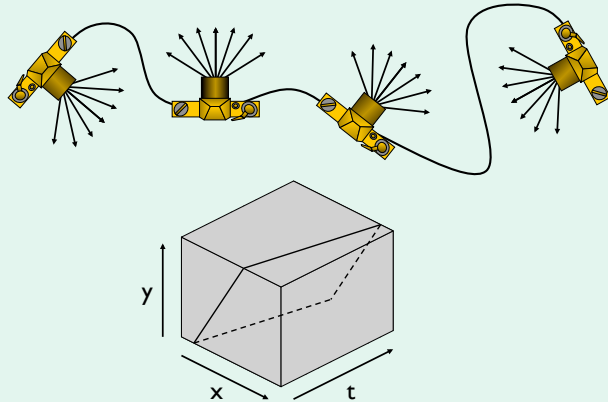

- Main Problem:
  closer squashed; further stretched

Slit Panoramas

[Roman 04, Ph.D. thesis 2006]

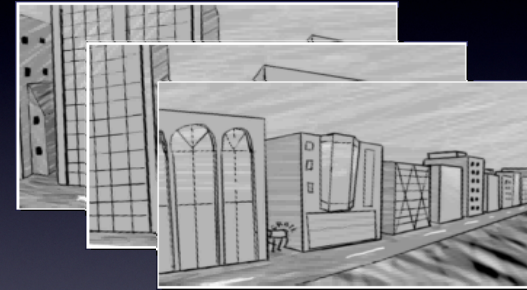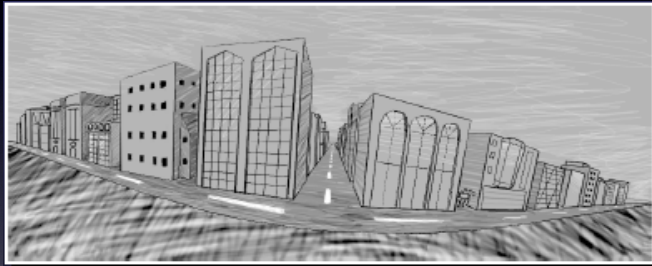---

Multi-Perspective Images

Multi-Perspective Panoramas

A *multi-perspective image* incorporates many perspectives into a single, locally-coherent image

A *moving window* slides across the panorama, selecting frames for creating an animation

from Disney's film *Pinocchio*, 1940

Extracted frames

Multi-Perspective Panoramas

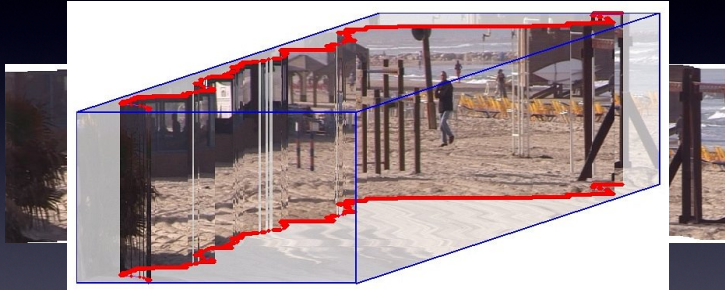
Fisherman's Evening Song, Xu Daoning, 11th century

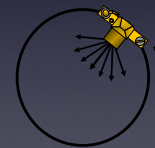## Multi-Perspective Panoramas

Input Video

Space-time scene manifolds, Y. Wexler and D. Simakov, Proc. ICCV, 2005

Multi-Perspective Panoramas

Space-time Scene Manifolds. Y. Wexler, D. Simakov
in ICCV 2005

Cyclographs

http://grail.cs.washington.edu/projects/stereo/
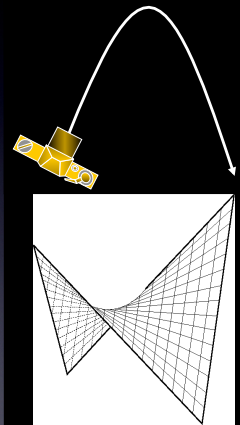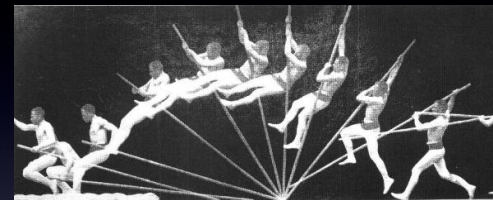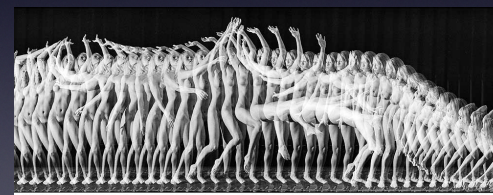

Parabolic Panoramas

perspective image

parabolic panorama
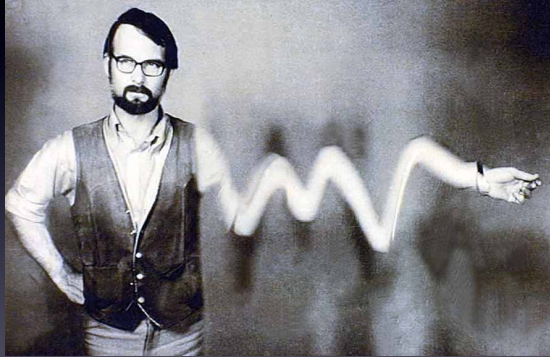

Space-Time Images

Etienne-Jules
Marey's
Chronophotographs
, 1888

Andrew Davidhazy

Slit Cameras with Dynamic Scene: Space-Time Images

Slit Cameras with Dynamic Scene: Space-Time Images

Hyperlapse Videos

- **Hyperlapse** is an exposure technique in time-lapse photography, in which the position of the camera is being changed between each exposure in order to create a tracking shot in timelapse sequences

- The camera is typically moved through very long distances

- Apps available from Microsoft and Instagram, for example

First-person Hyperlapse Videos

Johannes Kopf   Michel F. Cohen   Richard Szeliski
Microsoft Research

research.microsoft.com/hyperlapse

Multi-Camera Systems

Dayton Taylor's
Digital Air

Digital Air

- http://www.digitalair.com/equipment.html
- http://www.digitalair.com/techniques/