M255 – From Photo to Deep Fakes

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Experimental Visualization Lab
Media Arts & Technology
University of California, Santa Barbara
Interdisciplinary Overview

- **Historical**: A sampling of the history and evolution of the photographic image (from 1826 to present)
- **Social**: What are the critical issues and impact of how we perceive the technological image
- **Computational**: A sampling of ideas and methods related to the digital image - from image processing, and Information Theory to present neural-network applications
- **Artistic**: Examples of artistic projects to highlight the role of aesthetics in image design
- **Short weekly reports**: Thoughts you may have about any of the materials covered in the weekly presentations.

- **A course project**: Student defined – it can be a project realized in computer code, or a project created not by code, or a research paper.
Analog-Optical Apparatus Fundamentals
From the Literature

Mozi, social philosopher, Tengzhou, China (470-390 BC)

Aristotle, Greek philosopher, pinhole to study eclipse (384-322 BC)

Ḥasan Ibn al-Haytham, mathematician, astronomer, physicist, “father of modern optics”, Basra, Iraq (965-1039AD)

Roger Bacon, philosopher, scientist, England, (1219-1292 AD)

Leonardo da Vinci, artist, scientist describes pinhole camera (1452-1519 AD)

Johannes Kepler, astronomer, uses term “Camera Obscura” in 1604 (1571-1630)

Dark chamber lets photons (lightbeams) thru pinhole/lens, then captured on receiving flat surface
Tracing the projection inside a Camera Obscura
The Hockney–Falco thesis advanced by artist David Hockney and optics physicist Charles M. Falco: Advances in realism based on use of optical instruments.

Johannes Vermeer, “The Geographer” (1668/1669), the “Astronomer” (1668)
Various Perspectives

Oblique: Entrance and yard of a yamen. Detail of scroll about Suzhou by Xu Yang, ordered by the Qianlong Emperor, 18th century

Brunelleschi 2 point perspective, 1415-1420 (video)

Albrecht Dürer, grid window (1525?) Right panels: Giotto (1310), Cimabue (1280-1285)
Staring Into the Soul of the Catskills Through a Pinhole

With his camera obscura, Shi Guorui reinterprets the landscapes of the Hudson River School painter Thomas Cole.

Mr. Shi was inspired by “Falls of the Kaaterskill,” an 1826 painting by Thomas Cole (1801-1848).
Niepce (1826), oldest chemically fixed image (outside his window)

https://www.hrc.utexas.edu/niepce-heliograph/
10 minute shutter exposure

Louis Daguerre, first photograph of a person on a busy street, (1839)
Etienne-Jules Marey, scientist, physiologist, 1880s
Camera Motion, *Grand Prix*, Jacques-Henri Lartigue (1913)
High-speed photography

Harold Edgerton, MIT, “Bullet through Three Balloons” (1959)
Visualizing Photons in Motion at a trillion frames per second (2013)

Femto-Photography: Capturing and Visualizing the Propagation of Light

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Chinmaya Joshi$^{1‡}$, Everett Lawson$^{1}$, Mouni Bawendi$^{3}$, Diego Gutierrez$^{2}$, Ramesh Raskar$^{1}$

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Figure 1: What does the world look like at the speed of light? Our new computational photography technique allows us to visualize light in ultra-slow motion, as it travels and interacts with objects in table-top scenes. We capture photons with an effective temporal resolution of less than 2 picoseconds per frame. Top row, left: a false color, single streak image from our sensor. Middle: time lapse visualization of the bottle scene, as directly reconstructed from sensor data. Right: time-unwarped visualization, taking into account the fact that the speed of light can no longer be considered infinite (see the main text for details). Bottom row: original scene through which a laser pulse propagates, followed by different frames of the complete reconstructed video. For this and other results in the paper, we refer the reader to the video included in the supplementary material.
Point of View

- **Field-of-View**: What is seen at a given moment
- **Angle of view**: Angular extent of a scene imaged by a camera
- **Vantage point**: The location where the photo is taken from
- **Frustum**: 3D region viewed on the screen
Basic optical-mechanical camera format

Focal Length and Angle of View

Longer focal length = NARROWER angle of view
Shorter focal length = WIDER angle of view
Focal lens – the distance between the lens and the image sensor
This dissertation examines the process of automation of real and virtual cameras, drawing on insights from artificial intelligence, robotics, narrative theory, virtual and interactive systems design, and presents two contributions: an analysis of automation in camera systems, and a prototype software tool for virtual camera control.
Depth of Field

László Moholy-Nagy, *Photograph (Self-Portrait with Hand)*, 1925/29, printed 1940/49
Lytro – variable depth-of-field

https://en.wikipedia.org/wiki/Lytro
Vexierbild – Erhard Schön, 1530
Anamorphic Projection: Analogical/Digital Algorithms

Francesco Di Paola · Pietro Pedone · Laura Inzerillo · Cettina Santagati

Abstract  The study presents the first results of a wider research project dealing with the theme of "anamorphosis", a specific technique of geometric projection of a shape on a surface. Here we investigate how new digital techniques make it possible to simplify the anamorphic applications even in cases of projections on complex surfaces. After a short excursion of the most famous historical and contemporary applications, we propose several possible approaches for managing the geometry of anamorphic curves both in the field of descriptive geometry (by using interactive tools such as Cabri and GeoGebra) and during the complex surfaces realization process, from concept design to manufacture, through CNC systems (by adopting generative procedural algorithms elaborated in Grasshopper).

Keywords  Anamorphosis Anamorphic technique Descriptive geometry Architectural geometry Generative algorithms Free form surfaces

The painters used the concepts of anamorphosis in the creation of their works, with extreme skill and mastery, creating wonderful examples on the curved surfaces of apses and niches, over large areas of aristocratic salons or on the articulated vaults of churches.

We can cite, among the examples of anamorphosis on large scale, the apse of the church of Santa Maria in San Satiro in Milan created by Donato Bramante (1483), the corridors of Palazzo Spada in Rome by Francesco Borromini (1540), and the trompe-l’oeil scenography of Palladio’s Teatro Olimpico in Vicenza designed by Vincenzo Scamozzi (1584).

The architect and painter Andrea Pozzo was one of the greatest exponents of illusory architecture as well as a theorist of perspective. The frescos on the ceiling of
Anamorphic fresco of St. John in Patmos at Trinità dei Monti convent, Jean Francois Niceron, 1640
Anamorph Transformation

Fig. 3. Hans Holbein, 1533, The Ambassadors, oil on panel with an anamorphic image of a skull in the bottom of the image

Fig. 4. The Skull – visualisation of the flat surface anamorph from The Ambassadors

Fig. 5 – Anamorphic structure by J.F. Niceron, Thaumaturgos Opticus (Tab. 33, Fig. LXVI and LXVII), Paris, 1646.
Catoptric anamorphic images – Istvan Orosz, William Kentridge
(Catoptric – phenomena of reflected light as in mirrors)
Spatial Transfiguration: Anamorphic Mixed-Reality in the Virtual Reality Panorama

Abstract

Spatial illusion and immersion was achieved in Renaissance painting through the manipulation of linear perspective’s pictorial conventions and painterly technique. The perceptual success of a painted trompe l’œil, its ability to fool the observer into believing they were viewing a real three-dimensional scene, was constrained by the limited immersive capacity of the two-dimensional painted canvas. During the baroque period however, artists began to experiment with the amalgamation of the ‘real’ space occupied by the observer together with the pictorial space enveloped by the painting’s picture plane: real and pictorial space combined into one pictorial composition resulting in a hybridised ‘mixed-reality’. Today, the way architects, and designers generally, use the QuickTime Virtual Reality panorama to represent spaces of increasing visual density have much to learn from the way in which Renaissance and baroque artists manipulated the three-dimensional characteristics of the picture plane in order to offer more convincing spatial illusions. This paper outlines the conceptual development of the QuickTime VR panorama by Ken Turkowski and the Apple Advanced Technology Group during the late 1980s. Further, it charts the technical methods of the Virtual Reality panorama’s creation in order to reflect upon the VR panorama’s geometric construction and range and effectiveness of spatial illusion. Finally, through a brief analysis of Hans Holbein’s Ambassadors [1533] and Andrea Pozzo’s nave painting in Sant ‘Ignazio [1691-94] this paper proposes an alternative conceptual model for the pictorial construction of the VR panorama that is innovatively based upon an anamorphic ‘mixed-reality’.

Fig.01 [above]
Cylindrical VR panorama interactivity diagram illustrating the panning of the drum around the observer, and their tele-present location at the drum’s centre.

Fig.02 [right]
Diagram representing the translation of spatial information through anamorphism, from the cube-based typological state to the sphere-based VR panorama.

Fig.03 [right]
Diagram representing the anamorphic translation from the cylinder-based typology to the cube-based typology. This diagram also represent the change in displacement from the central viewing position in the drum & cube’s centre, to the outer surface to the panorama’s geometry.
Intae Hwang thesis to transfer Jeon Seon’s traditional paintings into virtual environments

St. Ottilien’s Six “True View Landscapes” by Chông Sôn (1676-1759) *3

Jeong Seon, *The Complete View of the Diamond Mountains*, deep color on silk, 33.3 x 54.8cm.
Andrea Pozzo, church of St. Ignazio, Rome, 1690. 3D illusion on flat surface.
Other Explorations - Beyond Human Vision

The Electromagnetic Spectrum

- **Penetrates Earth’s Atmosphere?**
  - Y  N  Y  N

- **Radiation Type**
  - **Radio**: $10^3$
  - **Microwave**: $10^{-2}$
  - **Infrared**: $10^{-5}$
  - **Visible**: $0.5 \times 10^{-6}$
  - **Ultraviolet**: $10^{-8}$
  - **X-ray**: $10^{-10}$
  - **Gamma ray**: $10^{-12}$

- **Approximate Scale of Wavelength**
  - Buildings
  - Humans
  - Butterflies
  - Needle Point
  - Protozoans
  - Molecules
  - Atoms
  - Atomic Nuclei

- **Frequency (Hz)**
  - $10^4$
  - $10^8$
  - $10^{12}$
  - $10^{15}$
  - $10^{16}$
  - $10^{18}$
  - $10^{20}$

- **Temperature of objects at which this radiation is the most intense wavelength emitted**
  - **1 K**: $-272 ^\circ C$
  - **100 K**: $-173 ^\circ C$
  - **10,000 K**: $9,727 ^\circ C$
  - **10,000,000 K**: $\sim 10,000,000 ^\circ C$
We Are Stardust, 2 screen installation in *InfoSphere* ZKM, Karlsruhe, 2015
Software Generated images using Neural Texture Synthesis (Snelgrove)
Software Generated Images – statistical derived
Some classical references (1970s-2000)
To be continued…