New Approaches to Documenting Cultural Heritage

Experimentation and Collaboration at the Minneapolis Institute of Art

Dan Dennehy, Head of Visual Resources
Featured Research
Curators Nicole Labouff and Jan-Lodewijk Grootaers welcomed Malian artist Aoubakar Fofana to examine Mia’s West African textiles. Here, they explain the indigo dyeing process.

Digital and Print Publications
Browse our easy-to-search archive of books, articles, and other publications written by museum staff. From essays on artists, to the secret history of women plant collectors, to the role of museums in...

Library and Study Rooms
Explore the Art Research and Reference Library's 60,000 volumes in our reading room. Make an appointment to view prints and photographs in our study rooms.

Case Studies
Mia is committed to conducting and supporting research that expands the world’s knowledge, on topics from advancements in digital-imaging tools to new approaches to visitor behaviors.

Conservation
Conservation often leads to new discoveries about artworks, artists’ techniques, and materials. ART CHAMPIONS

Center for Empathy & the Visual Arts
CEVA supports research on fostering empathy and global awareness through art. How can museums promote these skills to help enable a more equal, happy, and creative
Alcohol’s Empire
Distilled Spirits in the 1700s Atlantic World

A collaboration of the Minneapolis Institute of Art, the Wangenstein Historical Library at the University of Minnesota, and Tattersall Distilling Company

Nicole LaBouff, Associate Curator of Textiles
Minneapolis Institute of Art

Emily Beck, Assistant Curator
Wangensteen Historical Library of Biology and Medicine, University of Minnesota

Start reading
Users / Museum

- The British Museum
- AD&D 40
- The Discovery Programme
- Malopolska’s Virtual Museum
- Santa Cruz Museum of Art
- Alienor.org, Conseil des musées de l'Europe
- Rmn-Grand Palais
- Kunsthistorisches Museum
- The Mel Fisher Maritime Museum

Minneapolis Institute of Art
SketchFab
https://sketchfab.com/artsmia

- Powerful 3D Viewer
- Tools for enhancing models
- Frequent platform development
- World-wide user base
- Free for Cultural Heritage
- Can embed viewer in other platforms
Photogrammetry

A method of obtaining a virtual 3D model of a physical object by measuring and interpreting photographic images and patterns of recorded light.
Why Photogrammetry?

- Photography tools and image workflows already in place
- Better color and surface appearance than other 3D scanning
- Data can be preserved and reprocessed as algorithms improve
- Methods and training available via Cultural Heritage Imaging.org
Photogrammetry
Process Steps
Camera Positions

The various look angles are analyzed along with data from the camera’s optical system and light passing thru the lens.
Polygon Mesh

A dense point cloud is triangulated to form millions of surface facets describing the geometry of the object.
Solid Geometric Form

The mesh is filled to create a solid object in virtual 3D space
Texture Map

Software maps RGB values from original photos and wraps a simulated texture onto the surface of the model.
Using Flash Photography and Image-Based Rendering to Document Cultural Heritage Artifacts

M. Tetzlaff¹ and G. Meyer¹
¹University of Minnesota

Abstract
A novel image-based rendering system is proposed for documenting cultural heritage artifacts. The system utilizes backscattering photography to acquire the initial pictures and derives estimates for the object’s diffuse albedo, surface normals, and the specular reflectivity from the images. A projective texture mapping technique is used to create a novel view of the artifact by blending the original photographs and projecting them onto a mesh that is also derived from the photos. By weighting the images according to how they best depict the manner in which a virtual light source illuminates the artifact’s surface, object relighting is also achieved.

IBRelight

Image-based rendering and relighting has been extensively studied by computer graphics researchers, but until now has not been made accessible to the cultural heritage community. IBRelight is a new 3D rendering tool that addresses this disparity. It leverages existing photogrammetry techniques, applied to camera-mounted flash photographs, to estimate the camera poses and the geometry of the object. IBRelight then captures and blends the photographs in a way that emulates the desired new lighting configuration, which may consist of point lights, an environment map, or both. The interface for specifying the camera and lighting is designed to be user-friendly and is based on other modern 3D applications.

Minneapolis Institute of Art

Berrier et al., 2019

IBRelight

Charles Walbridge
Don Dennehy
Minneapolis Institute of Art
Visual Resources

Flash photogrammetry

Light field rendering (no relighting)

Relighting for flash photogrammetry with virtual spot lights

Relighting for flash photogrammetry with virtual environment lighting

Image-Based Rendering with Relighting for Camera-Mounted Flash Photogrammetry
https://sites.google.com/view/ibrelight

Tetzlaff and Meyer, 2016

Tetzlaff and Meyer, 2017
The known position of the camera and flash enables accurate estimate of reflection and post relighting of the object.
Challenges Ahead in 3D Imaging

- Color Accuracy
- Reflectivity and Surface Appearance
- Verification of Geometric Data
- Standardized Viewers
- Interoperability across platform
- Digital Rights Management
- Long-Term Preservation
Thank you!