

Applications of Image-Based Modeling and Rendering in Art and Cinema

Paul Debevec

Overview



- **Image-based techniques are used in many ways;**
for each we can ask:

What is the model?

How are images used?

What is the rendering method?


How are images made?

What is the effect?

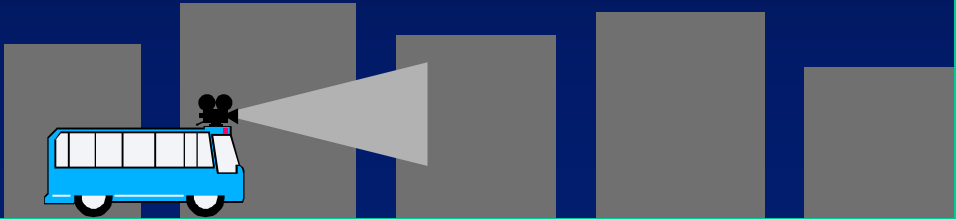
Is what we see what is really there?

Aspen Moviemap

(MIT, 1978-1980)




- Vehicle-mounted camera filmed driving down all streets of downtown Aspen
- Video transferred to random-access videodisc
- User interface allows real-time photorealistic exploration of the space

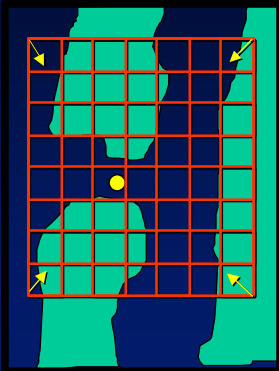


Golden Gate Moviemap


Michael Naimark, Exploratorium 1987



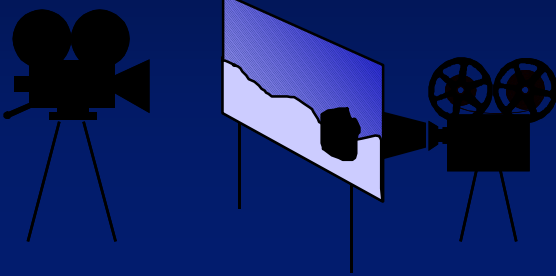
- Helicopter flown in 2D grid pattern over Bay Area
- Camera kept pointed toward Golden Gate Bridge
- Film transferred to videodisc
- Trackball interface allows real-time fly-over of San Francisco



Matte Painting





- **Instead of building a set, just create an image!**
- **Used since the early days of the film industry**
 - *Gone With the Wind* (1939)
- **Matting allows actors, etc. to be added**
- **Can pan and zoom to simulate motion**
- **Now done digitally**

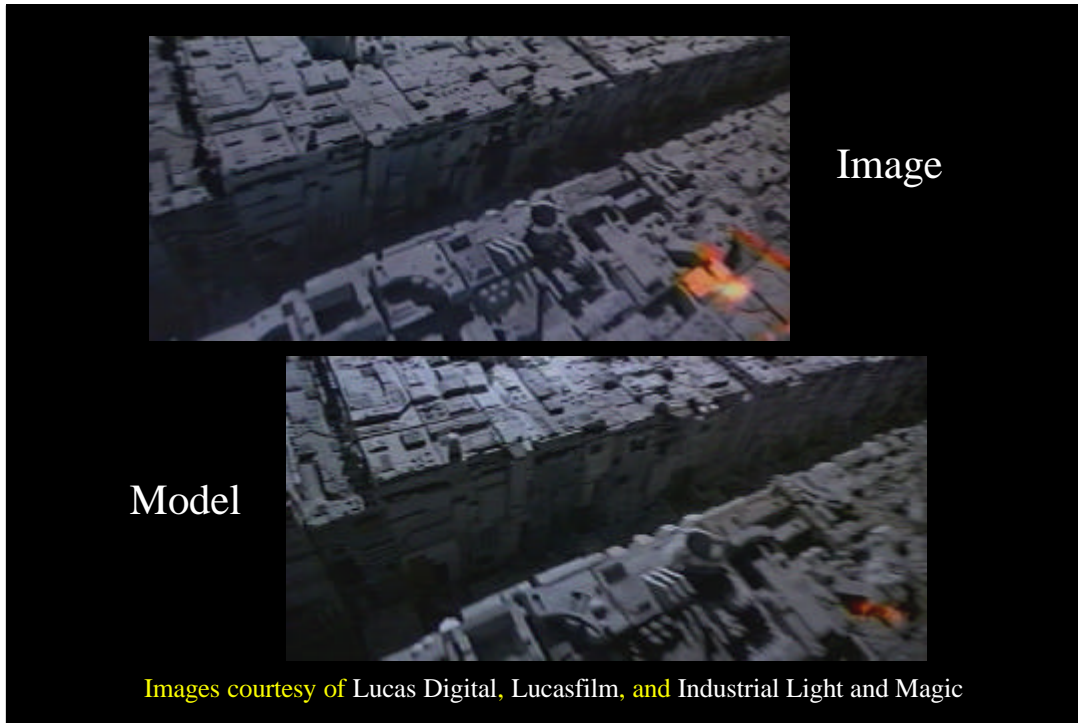


Star Wars Trench Sequence

Industrial Light and Magic, 1977



Images courtesy of Lucas Digital, Lucasfilm, and Industrial Light and Magic



Tour into the Picture

(Horry, Anjyo, Arai, Hitachi SIGGRAPH 97)



- **An approximate 3D model is constructed interactively with easy-to-use tools**
- **Foreground objects modeled as flat cut-outs**
- **User fills in the occluded areas**
- **Animations from the single photograph reveal depth as well as visual detail**
- **Software at:**
http://koigakubo.hitachi.co.jp/little/DL_TipE.html

Displacements

Michael Naimark, San Francisco Museum of Modern Art, 1984



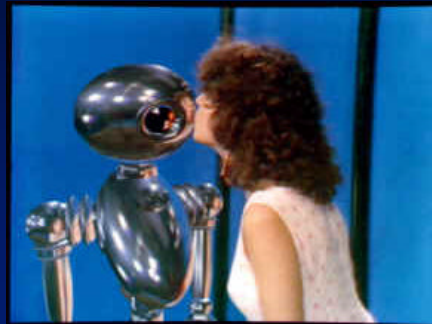
- **Image-based modeling and rendering with real geometry and real light**
- **Living room filmed with rotating movie camera**
- **Room painted white**
- **Film reprojected with rotating movie projector**

“Interface”

Lance Williams, Carter Burwell, Ned Greene
SIGGRAPH 85 Film Show





- **First use of Image-Based Reflection Mapping in an Animation**




<http://www.CS.Berkeley.EDU/~debevec/ReflectionMapping/>

Reflection Mapping in Films





Flight of the Navigator
Randal Kleiser
1986



Terminator II
James Cameron
1991

<http://www.CS.Berkeley.EDU/~debevec/ReflectionMapping/>

Rouen Revisited

(Golan Levin and Paul Debevec, SIGGRAPH 96 Art Show)





Synthetic View:
1996



Synthetic View:
1896




Synthetic View:
Monet Painting




Like a Rolling Stone

Buf Compagnie, SIGGRAPH 96 Electronic Theatre





- **View interpolation** based on **stereo reconstruction** between two views of the same scene (Software by Arnaud Lamorlette)
- Free-style **morphing** between sparsely sampled frames
 - Artifacts serve artistic effect



3D computer effects: Buf Compagnie
Producer: Partizan-midi-minuit
Director: Michel Gondry
See Also: *City of Lost Children*, commercials for Reebok, Chanel, Gap

Mona Lisa View Morph

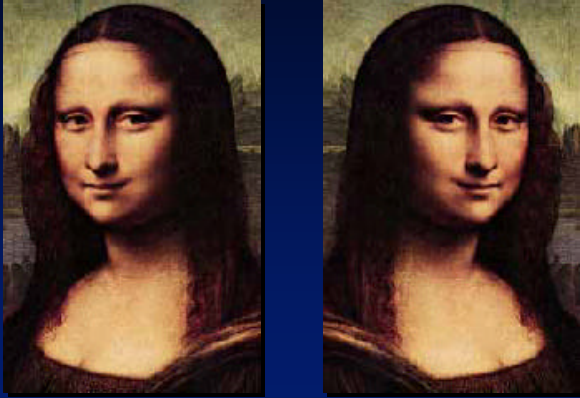

Steve Seitz, SIGGRAPH 96



Seitz, S. and C. Dyer. *View Morphing*. SIGGRAPH 96.

Mona Lisa View Morph

Steve Seitz, SIGGRAPH 96



Seitz, S. and C. Dyer. *View Morphing*. SIGGRAPH 96.

The Prince of Egypt

IBR for NPR!



“Exposure”

- Geometry constructed in 3D
- Shaded renderings given to artists to paint
- Digital paintings used as 3D textures

Video courtesy of Dreamworks, LLC

More use of IBR for NPR in Films




- *Tarzan* – “Deep Canvas”
- *What Dreams May Come*
Pierre Jasmin and Pete Litwinowicz, RE:Vision

Related Sketch Session: Dimensional Painting
Wednesday 11 August, 5:25pm - 6:00pm, Room 151 / 152

Deep Canvas in Disney’s “Tarzan”
The Making of the Painted World: “What Dreams May Come”
The Making of “Fiat Lux”


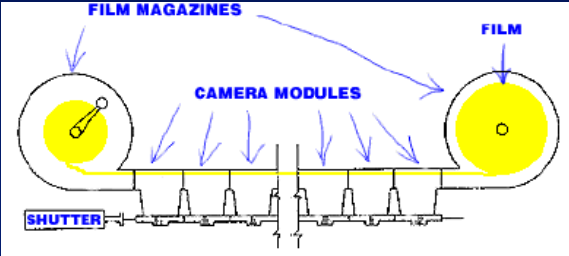
Image-Based Modeling, Rendering, and Lighting in “Fiat Lux”
Friday 13 August, 11:40am - 12:15pm, Room 408AB

Dayton Taylor’s Virtual Camera



<http://www.virtualcamera.com/>

- Array of pictures taken onto same roll of film
- Playback achieves “frozen time” effect



The Campanile Movie

(SIGGRAPH 97 Electronic Theatre)



Tower Photographs



Environment Photographs

- Model of Campus Built from 20 images
- Real-time virtual animation created w/ projective texture-mapping

The Matrix



www.mvfx.com

Courtesy of
George Borshukov
and John Gaeta,
MANEX
Entertainment



Conclusion

IBMR in Art and Cinema



- Image-based techniques have a long lineage
- Allow reinterpretation of existing imagery
- Enable many new effects
- Artifacts can be interesting
- IBMR techniques ~~will likely~~ **have** become standard tools in filmmaking

Thanks

Ken Anjyo, George Borshukov, Michael Naimark, H.B. Seigel, Ellen Pasternack, Jeanne Cole, Arnaud Lamorlette, Steve Seitz, Linda Branagan, Dayton Taylor, Craig Barron, Lance Williams, Golan Levin, Industrial Light and Magic, Lucas Digital, Ltd., Lucasfilm, Ltd., Dreamworks LLC, Buf Compagnie, Virtual Camera, MANEX Entertainment