

3D Reconstruction and Photoreal Digital Face Animation using Camera

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Image Sensor

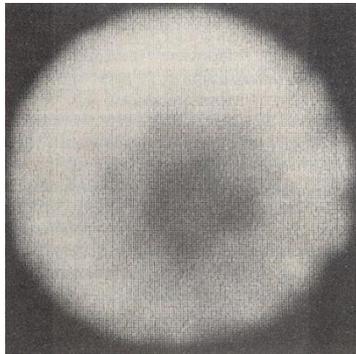
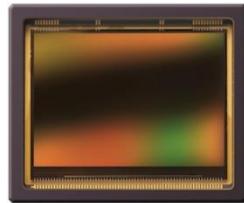
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Camera



Image Sensor

- ▶ A device that converts an optical image to an electric signal
- ▶ Charge-Coupled Device (CCD) 1970 bell lab
- ▶ Complementary Metal–Oxide–Semiconductor (CMOS) 1969

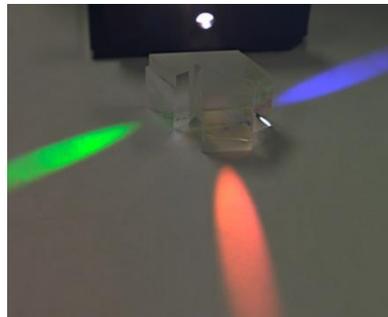
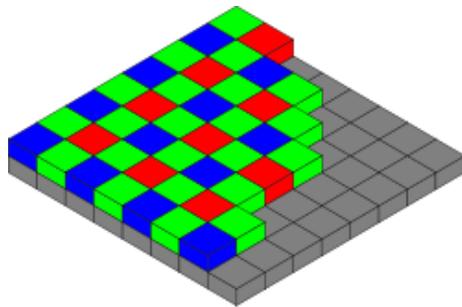
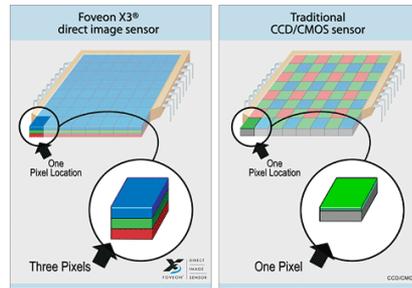


<http://astro.kias.re.kr/~hshwang/ccd.htm>



Color Sensor

- ▶ Bayer sensor 1976 – Demosaicking
- ▶ Foveon X3 sensor
- ▶ 3CCD



The Bayer arrangement of color filters on the pixel array of an image sensor. Each two-by-two cell contains two green, one blue, and one red filter

Sigma Corporation Acquires Foveon. Click [here](#) for the press release.



Sigma Corporation announces two new cameras using the Foveon 14.1 Megapixel X3 sensor

SIGMA



Sigma SD15 Sigma DP2

Check out the Sigma press releases for the [SD15](#) and for the [DP2](#)!





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Adjunct/Research Professor

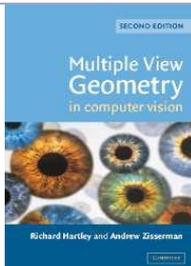
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Multiple View Geometry in Computer Vision

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Figure 1.1: An image of a scene

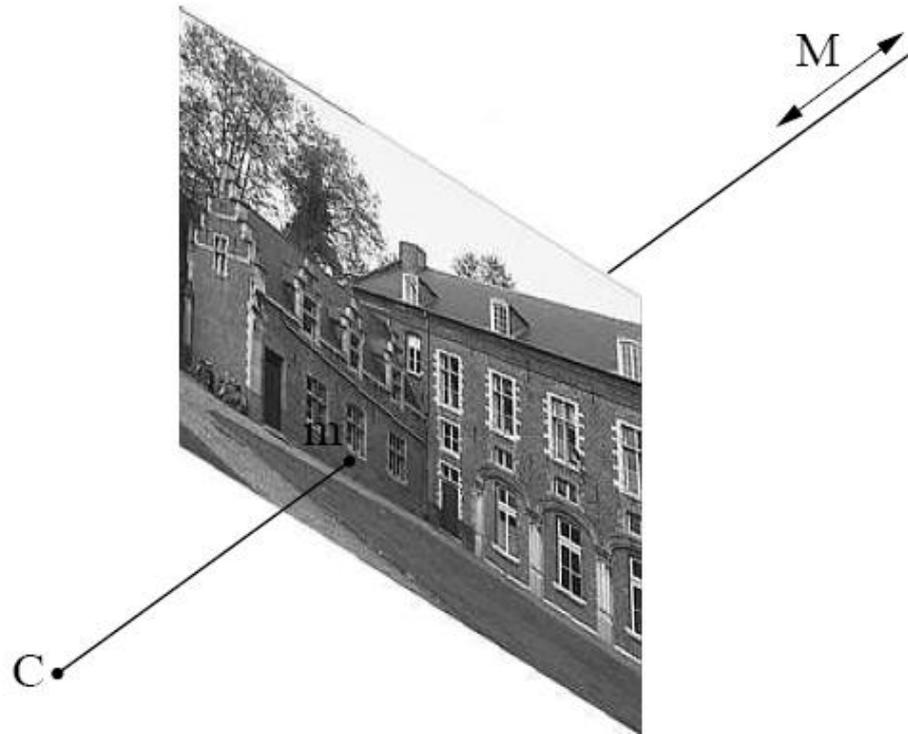


Figure 1.2: Back-projection of a point along the line of sight.

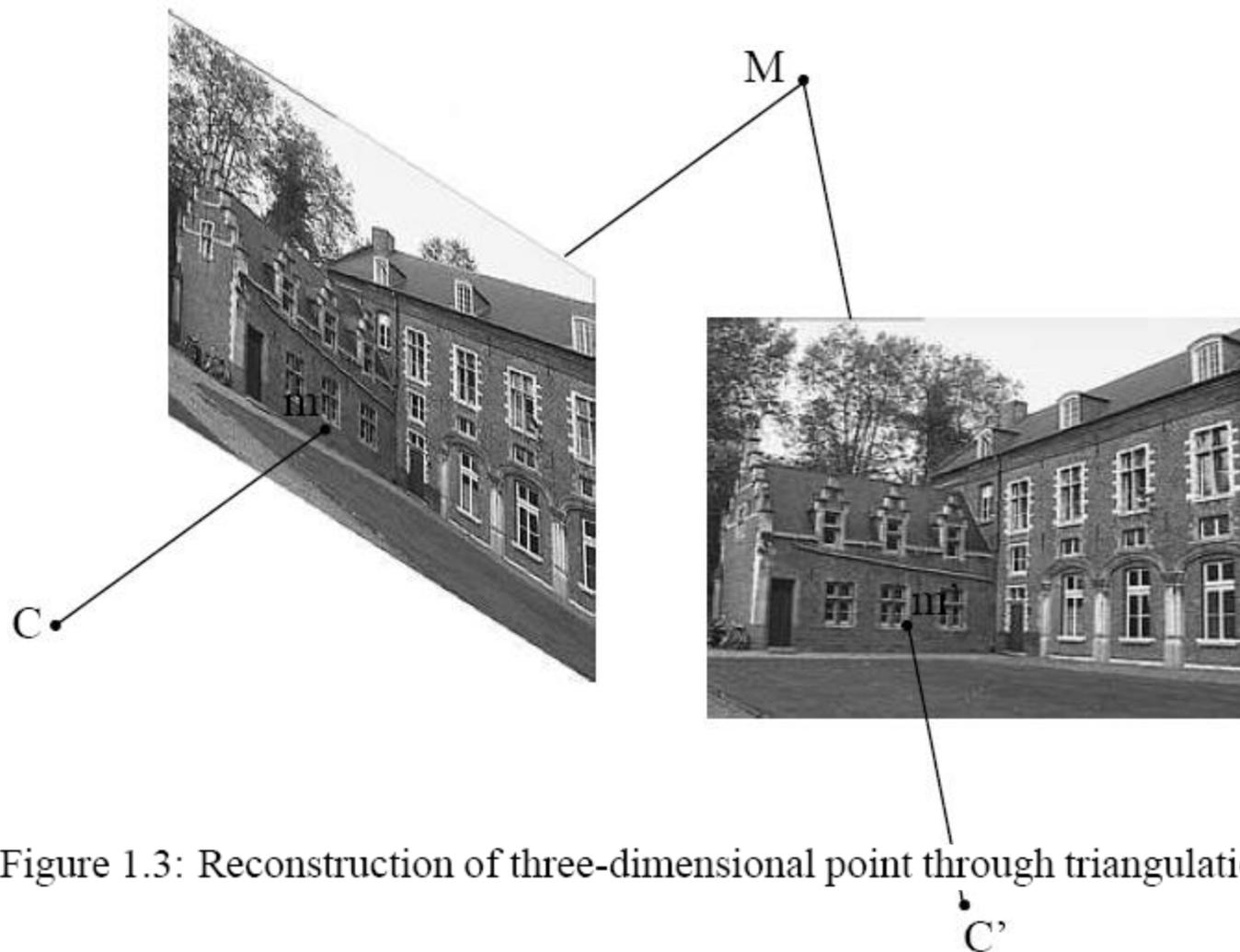
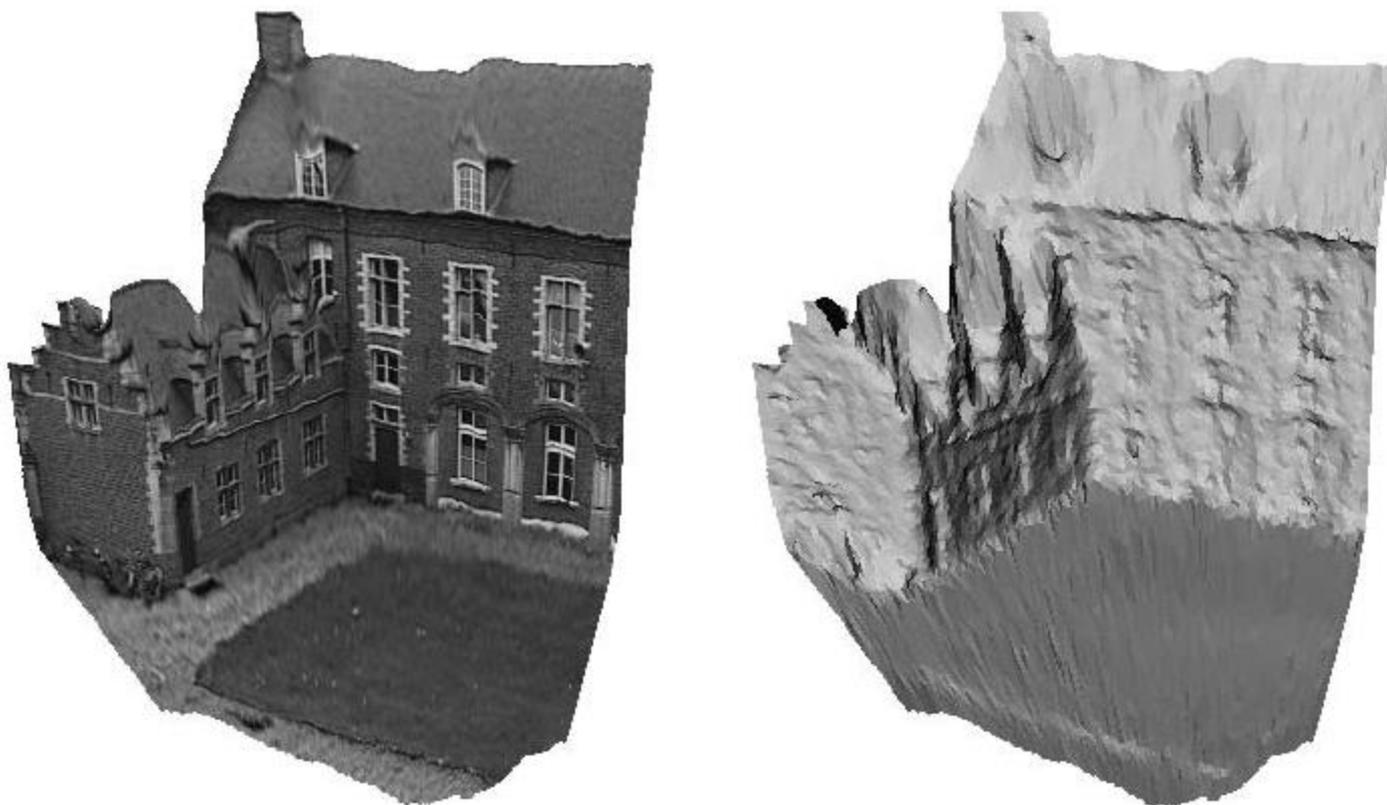


Figure 1.3: Reconstruction of three-dimensional point through triangulation.

Visual 3D Modeling from Images



- ▶ Projective Transformations
- ▶ Camera Calibration
- ▶ Epipolar Geometry
- ▶ Feature Points
- ▶ Correspondence Search
- ▶ RANSAC Algorithm
- ▶ 3D Reconstruction

- ▶ **SIFT&ASIFT**

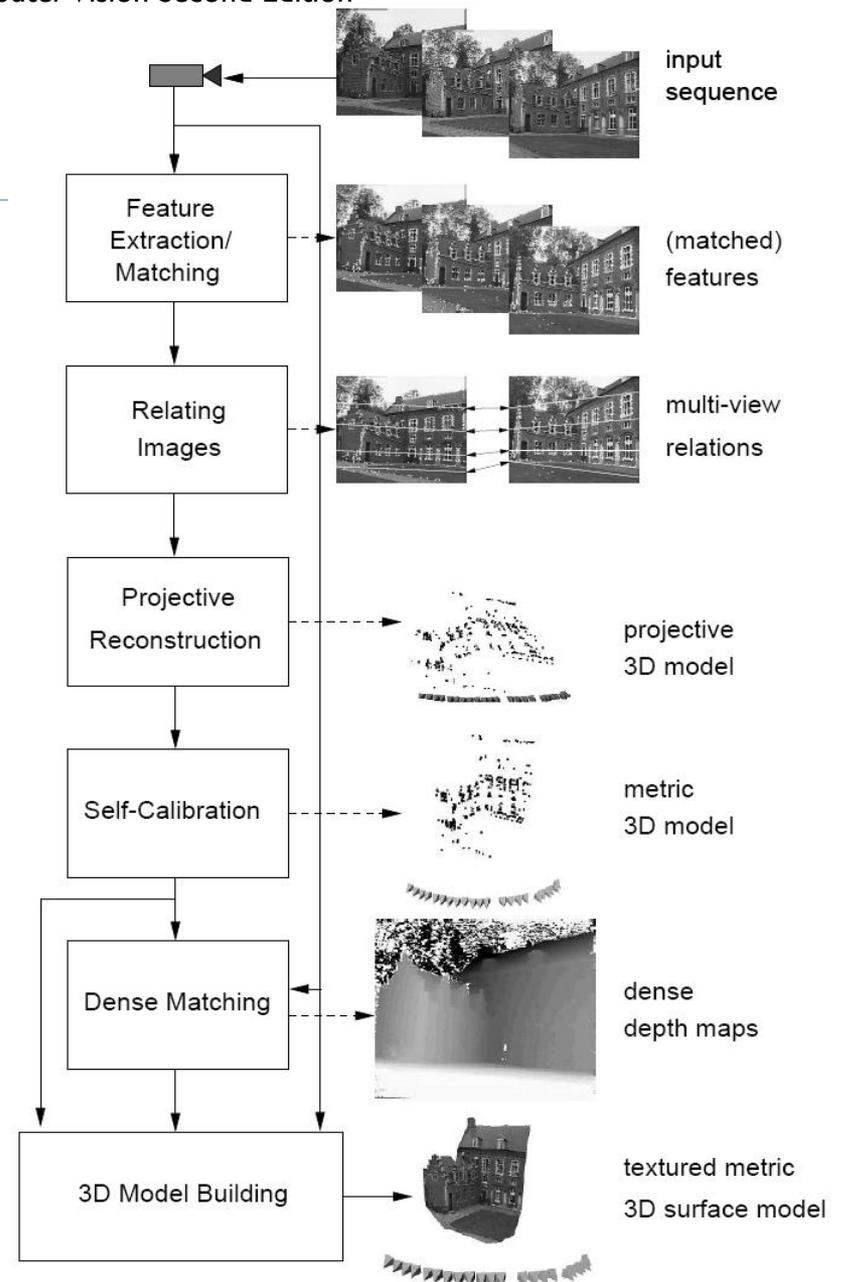




Photo Tourism

▶ <http://phototour.cs.washington.edu/>



(c)

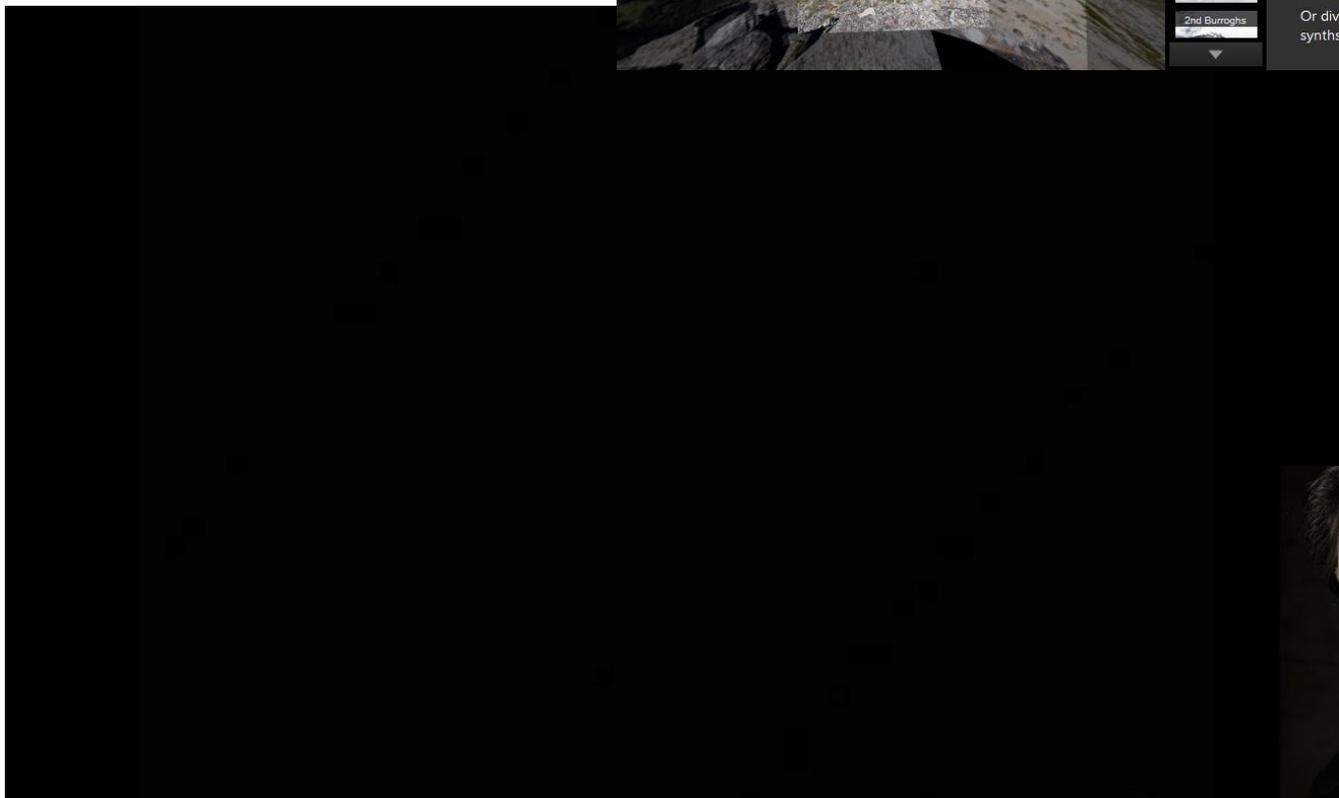
Photo Tourism
 Exploring photo collections in 3D

Noah Snavely Steven M. Seitz Richard Szeliski
University of Washington *Microsoft Research*

SIGGRAPH 2006

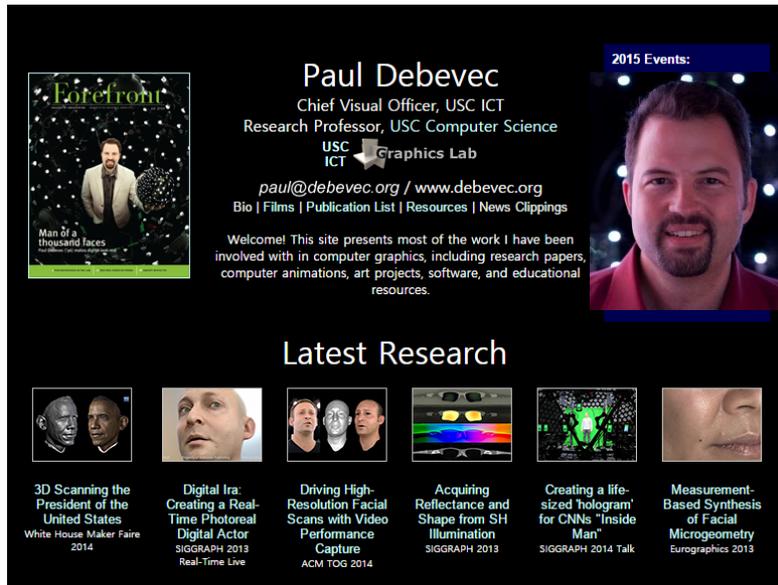
Photosynth

- ▶ DeepZoom & HD View
- ▶ <http://photosynth.net/>



Building Rome on a cloudless day





The image shows the header of Paul Debevec's website. It features a dark background with a portrait of Paul Debevec on the right. To the left, there is a 'Forefront' magazine cover with the text 'Man of a thousand faces'. Below the portrait, there is a '2015 Events:' section. The main text identifies Paul Debevec as Chief Visual Officer of USC ICT and Research Professor of USC Computer Science. It includes his email (paul@debevec.org) and website (www.debevec.org), along with links for Bio, Films, Publication List, Resources, and News Clippings. A welcome message follows, stating that the site presents his work in computer graphics, research papers, computer animations, art projects, software, and educational resources.

Paul Debevec
Chief Visual Officer, USC ICT
Research Professor, USC Computer Science
USC Graphics Lab
paul@debevec.org / www.debevec.org
Bio | Films | Publication List | Resources | News Clippings

Welcome! This site presents most of the work I have been involved with in computer graphics, including research papers, computer animations, art projects, software, and educational resources.

2015 Events:

Latest Research

- 3D Scanning the President of the United States (White House Maker Faire 2014)
- Digital Ira: Creating a Real-Time Photoreal Digital Actor (SIGGRAPH 2013 Real-Time Live)
- Driving High-Resolution Facial Scans with Video Performance Capture (ACM TOG 2014)
- Acquiring Reflectance and Shape from SH Illumination (SIGGRAPH 2013)
- Creating a life-sized 'hologram' for CNNs "Inside Man" (SIGGRAPH 2014 Talk)
- Measurement-Based Synthesis of Facial Microgeometry (Eurographics 2013)



Paul Debevec is Chief Visual Officer and leads the [Graphics Laboratory](#) at the University of Southern California's Institute for Creative Technologies, and is a Research Professor in the [USC Computer Science](#) Department. He earned degrees in Math and Computer Engineering at the University of Michigan in 1992 and a Ph.D. in Computer Science from UC Berkeley in 1996.

Digital Emily Project

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Debevec's [Ph.D. thesis](#) with Prof. [Jitendra Malik](#) presented [Façade](#), an image-based modeling system for creating virtual cinematography of architectural scenes using new techniques for photogrammetry and image-based rendering. Using Façade he directed a photorealistic fly-around of the Berkeley campus for his 1997 film [The Campanile Movie](#) whose techniques were later used to create the Academy Award-winning virtual backgrounds in the "[bullet time](#)" shots in the 1999 film [The Matrix](#).

The Digital Emily Project





[About](#) [Research](#) [Prototypes](#) [Academics](#) [People](#) [Collaborators](#) [News](#) [Events](#)

Prototypes

[Overview](#)

[Current Prototypes](#)

[All Prototypes](#)

[Project One-Sheets](#)

Prototypes

Digital Emily

2008

Project Leader: Paul Debevec

In the Digital Emily project, Image Metrics and the University of Southern California's Institute for Creative Technologies (USC ICT) animated a digital face using new results in 3D facial capture, character modeling, animation, and rendering. The project aimed to cross the "uncanny valley" that divides a synthetic-looking face from a real, animated, expressive person. The key technologies included a fast high-resolution digital face-scanning process using USC ICT's Light Stage capture system and Image Metrics' video-based facial-animation system. The project generated one of the first photorealistic digital faces to speak and emote convincingly in a medium close-up.

Learn more about Digital Emily on the ICT Graphics Lab [webpage](#).

Video Overview



Photo Gallery

Click image to view larger.



[Next](#)

The Digital Emily Project

USC Institute for Creative Technologies

Graphics Lab

The Digital Emily Project: Achieving a Photoreal Digital Actor
SIGGRAPH 2008 Expo / SIGGRAPH 2009 Computer Animation Festival / SIGGRAPH 2009 Courses / CVMP 2009 / IEEE CG&A 2010

Oleg Alexander* Mike Rogers* William Lambeth* Jen-Yuan Chiang Wan-Chun Ma
Chuan-Chang Wang Paul Debevec

USC Institute for Creative Technologies Image Metrics*

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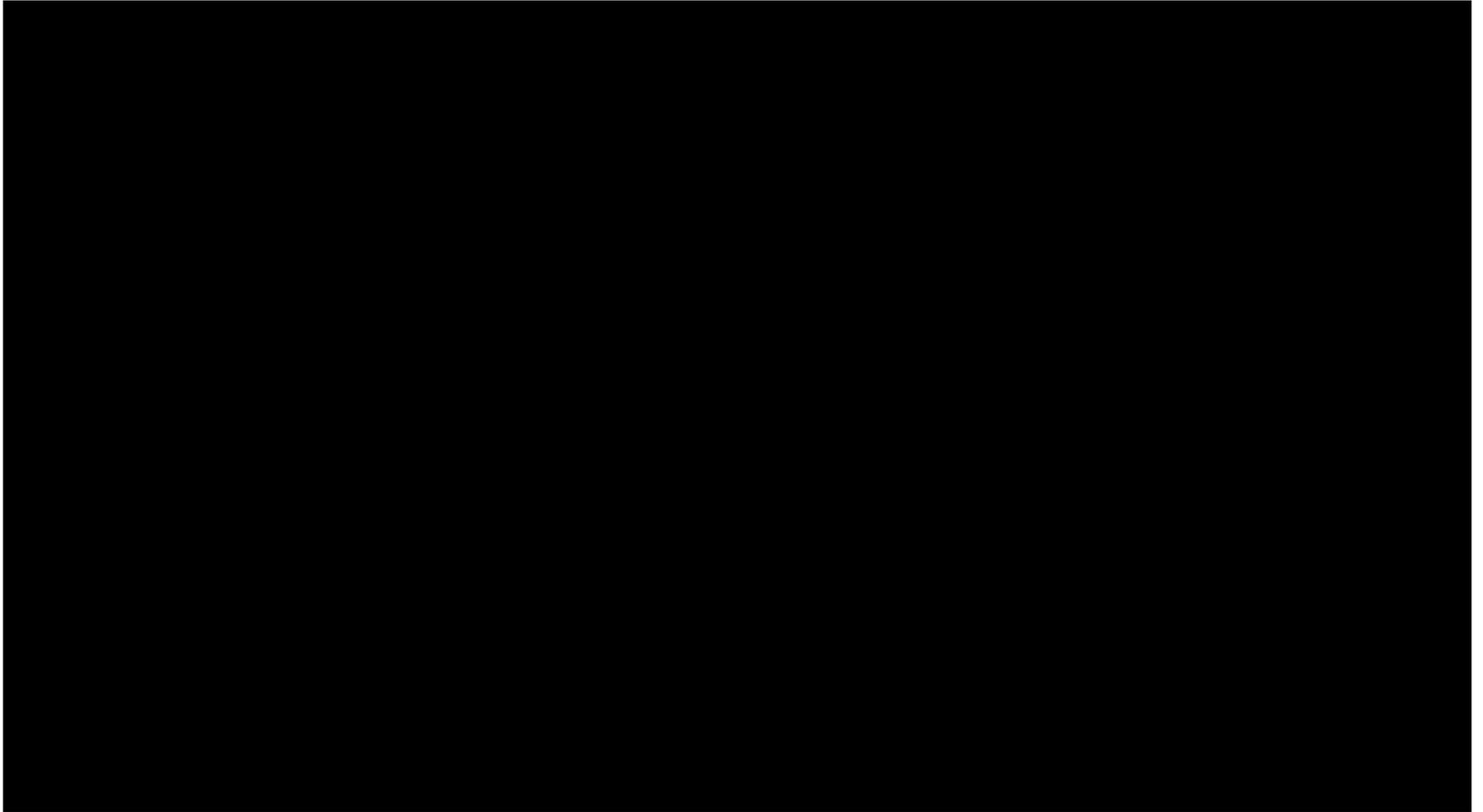
a collaboration between Image Metrics
and the USC Institute for Creative Technologies Graphics Lab

The Digital Emily Project: Achieving a Photoreal Digital Actor "digital_emily"



Papers and Video:
IEEE CG&A July/August 2010 Article: DigitalEmily-IEEECGA-2010.pdf, 9 MB. (Adobe Acrobat)
CVMP 2009 Paper: DigitalEmily_CVMP2009.pdf, 10.6 MB. (Adobe Acrobat)
SIGGRAPH 2009 CAF Video: EmilyCAF09_1280x720_H264.mov, 132 MB. (QuickTime)
TEDxUSC Talk, March 2009 (also on TED.com):

The Digital Emily Project



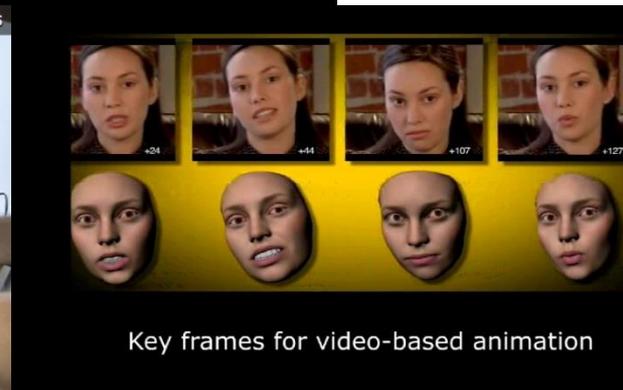
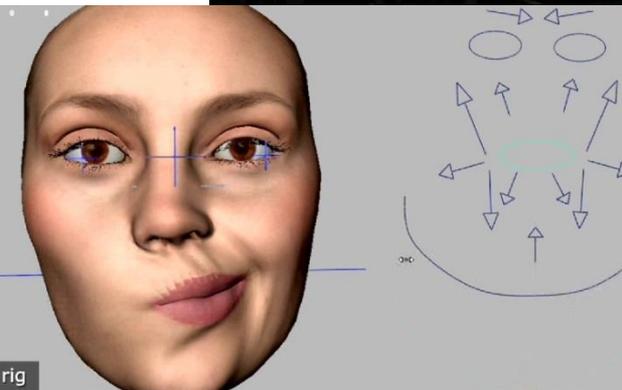
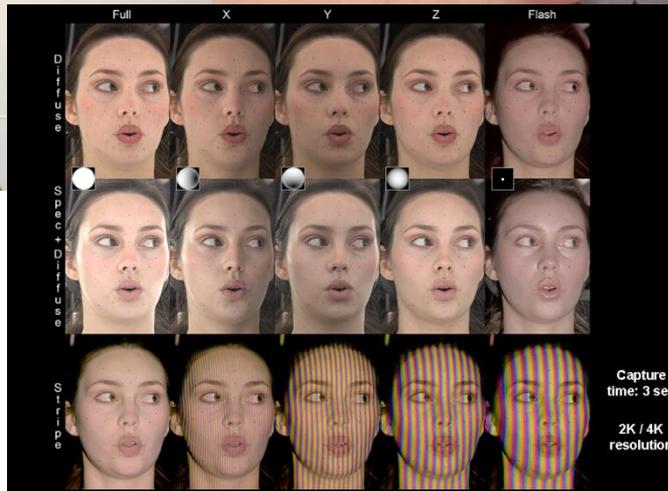
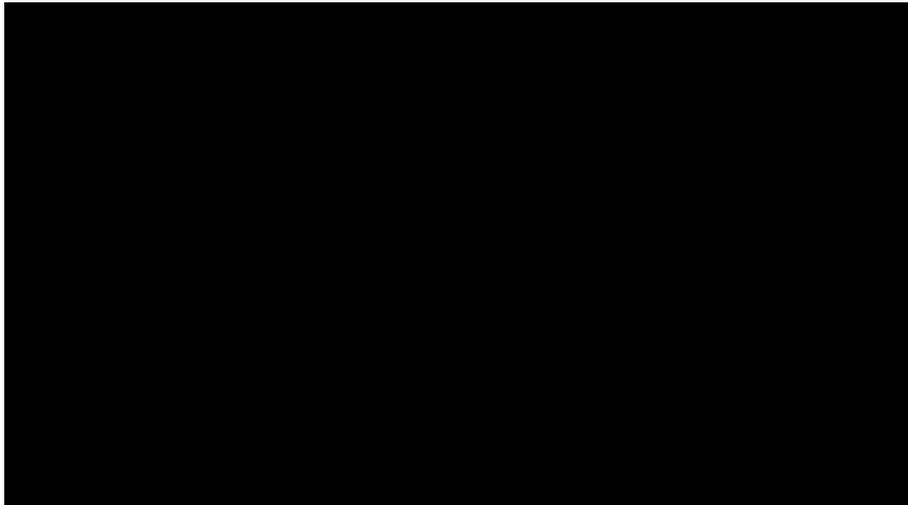
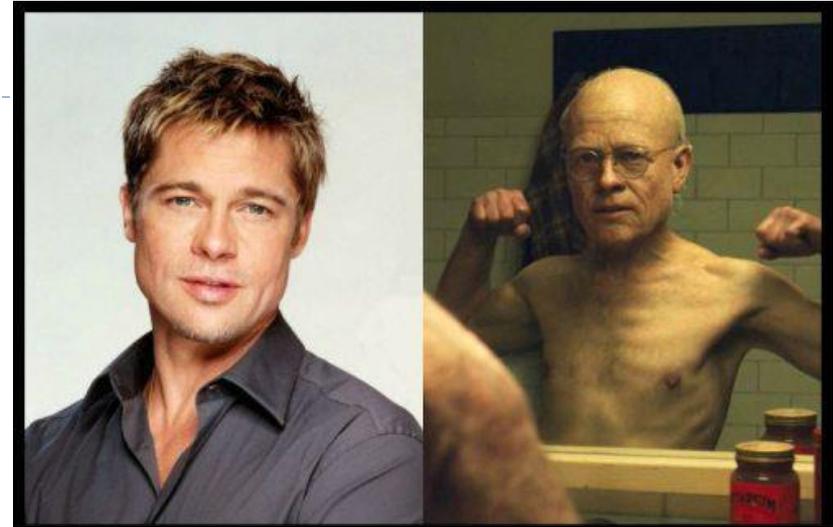


Image Metrics





Andy Serkis – Gollum in The Lord of the Rings



Brad Pitt – The Curious Case of Benjamin Button



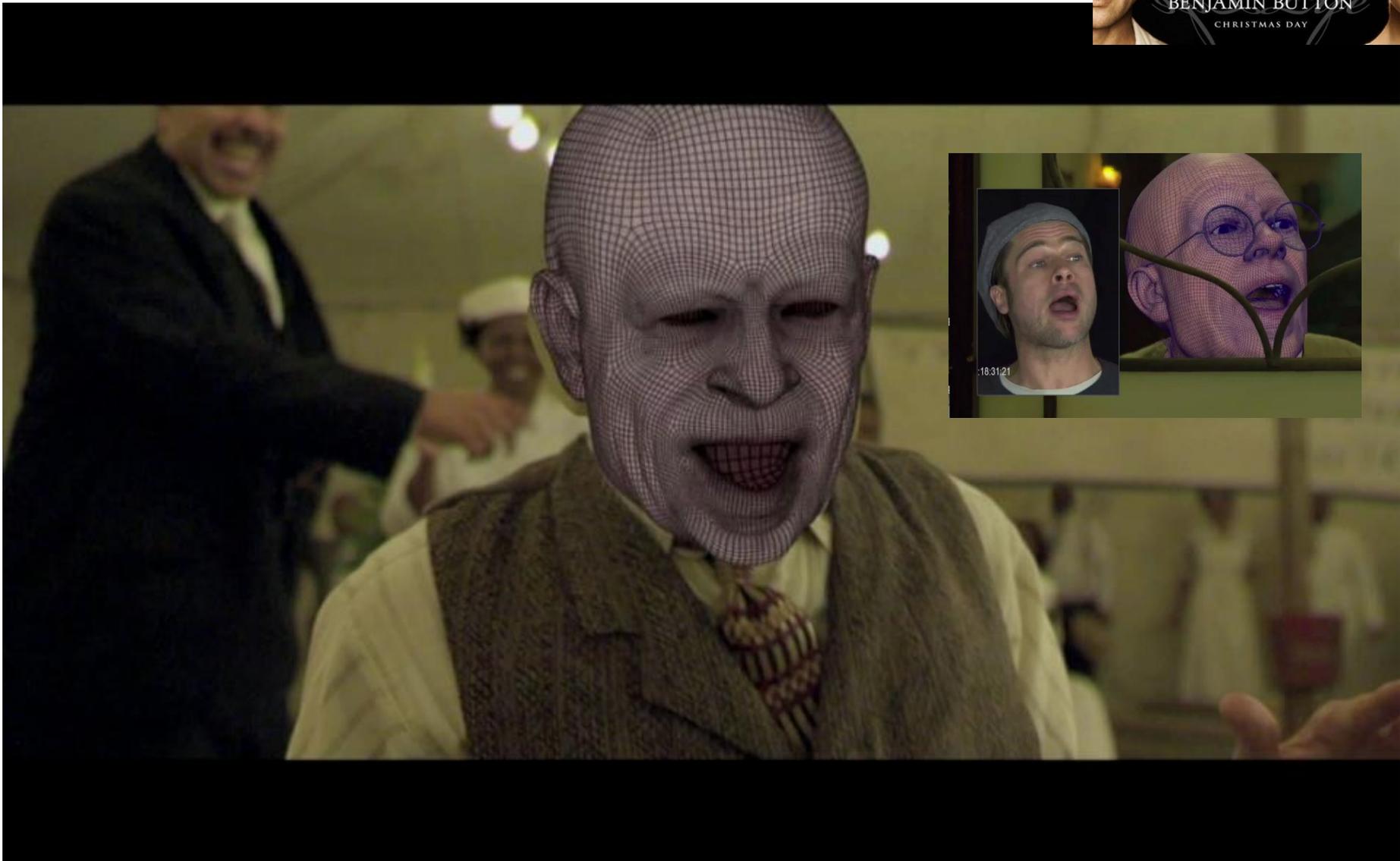
Cchi Ponder – Avatar



Gary Oldman – Hannibal









Photorealistic Digital Face

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Paul Debevec:

Animating a photo-real digital face

TEDxUSC · 06:06 · Filmed Mar 2009

23 subtitle languages

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Computer graphics trailblazer Paul Debevec explains the scene-stealing technology behind Digital Emily, a digitally constructed human face so realistic it stands up to multiple takes.

Interactive transcript



Animating a Photoreal Digital Face



3D Face Reconstruction

Real-time face 3D model reconstruction

Researchers from the University of Washington prepared interesting presentation for the European Conference on Computer Vision (ECCV-2014). It is a real-time [3D face reconstruction from the video](#).



Using the video from YouTube, the program automatically builds highly detailed face 3D-model for each video frame.

This is a very impressive result, given the complexity of the problem, because the facial expressions of the human face is very complex. For emotion recognition, it is important to see the exact position of the eyes, bending eyebrows, wrinkles. The smallest error in reconstructed 3D-model is highly noticeable.

DSLR 100대를 활용한 3D Photoscanning 및 3D Printing 기술 보유
1초만에 360도 동시 촬영이 가능한 고해상도의 Photoscanning
3D 리얼 피규어 360도 View가 가능한 3차원 3D 화보 3D 마케팅

3D Figure Printer

