3D Scans

September 27, 2004

Today's Short Film

Arnold
by
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Announcement

- Class cancellation: 10/4

from last class:
- *Occlusion compatible order*
  - *Artifacts of 3D warping*
- *Layered depth image (LDI)*

Scanning 3D Objects

- UNC Laser Scanner
- Digital Michelangeo (Stanford)
- Cyberware Scanner
- ITRI Scanner and 3D Camera
- Structured Light Scanner (Intel, Light Field Mapping)

Available for Reading

- L. Nyland and A. Lastra. "Visualizing the real world". In *IEEE Computer Graphics and Application*, Vol.21, No.5, pp 6-10, Sep/Oct 2001.
- M. Levoy et al. "The Digital Michelangelo Project: 3D Scanning of Large Statues". SIGGRAPH 2000, pp 131–144.
- Cyberware homepage: http://www.cyberware.com
- W.-C. Chen et al. "Light Field Mapping" SIGGRAPH 2002, pp 447-456.

UNC Laser Scanner

- Reading room of UNC CS department
  - The depths are obtained from a laser range finder.
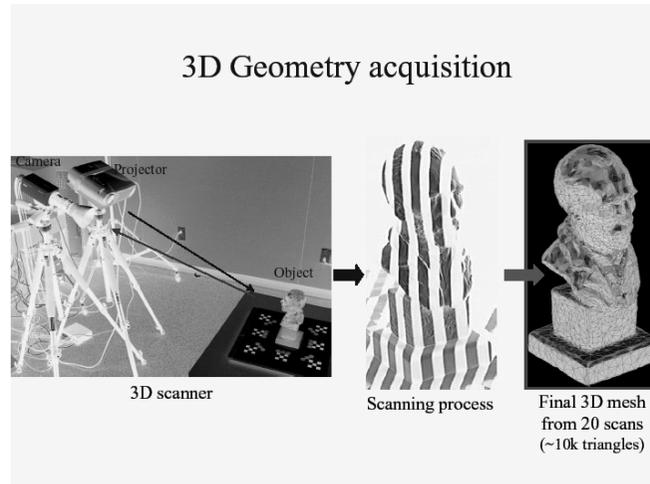
How to Get the Depths?

- Laser Rangefinder
- Cyberware scanner
  - used in Stanford's Digital Michelangelo project
- Stereo matching
  - e.g. structure from motion

Source: www.cyberware.com

Structured Light

3D Geometry acquisition

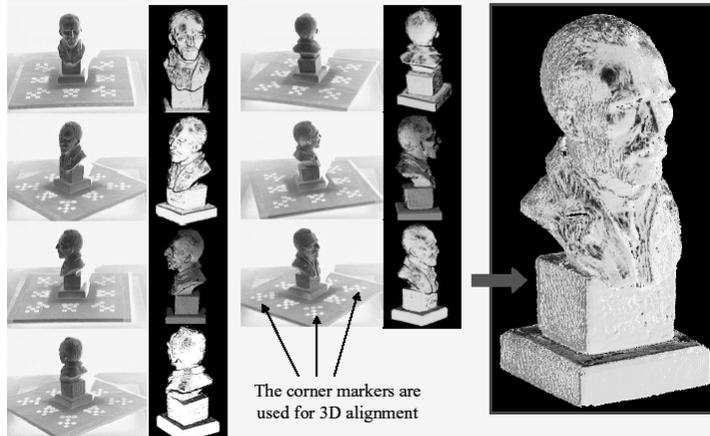3D scanner   Scanning process   Final 3D mesh from 20 scans (~10k triangles)

Object   Camera   Projector

Problems

- Merging multiple scans
- Black objects
- Shiny objects
- Public perception of the danger of laser

Capturing the complete object geometry

For complete coverage, need of multiple scans (16- 20)

The corner markers are used for 3D alignment

Computing a unique surface mesh

?

Individual (aligned) 2D meshes

Unique surface mesh describing the entire object geometry
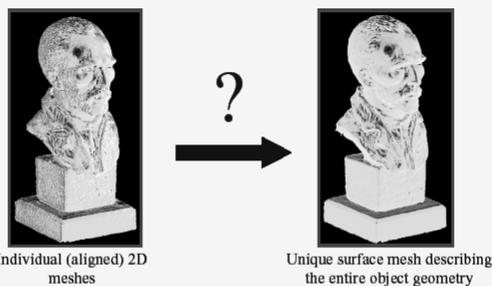
Different approaches:

- Generate a surface mesh from a set of unorganized points [Hoppe92]
- Use of a '3D wrapping" software package such as Geomagic Studio (http://www.geomagic.com)
- 'Zipper"the set of partial meshes together into unique mesh [Turk94]
- Volumetric integration using the combined signed distance function [Curless96]
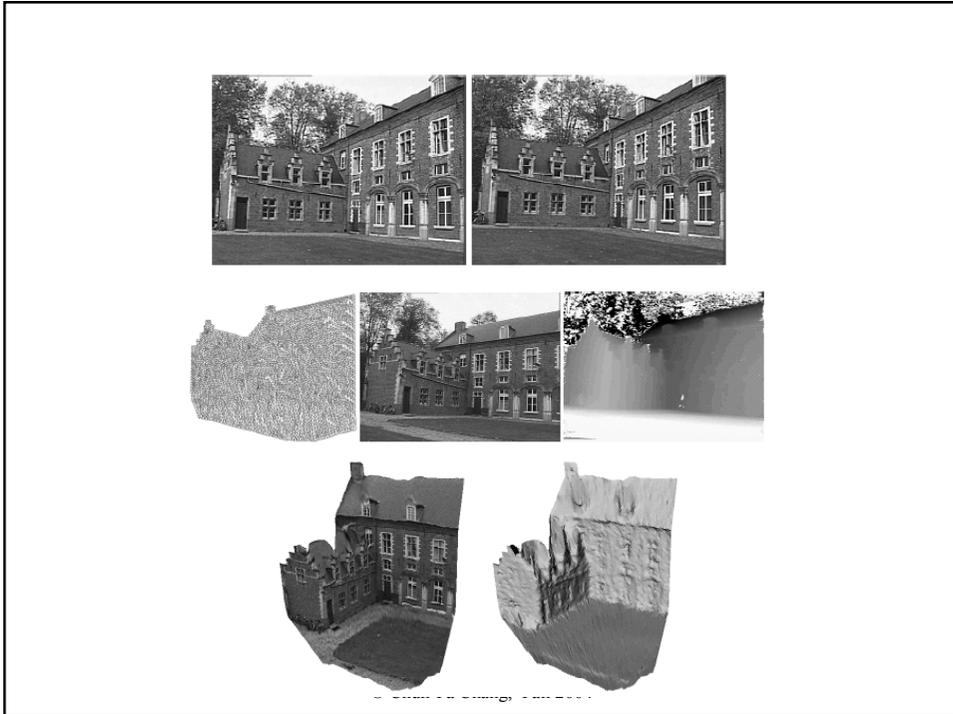
Rendering

- 3D Warping
- Rendering as 3D triangle meshes
- Rendering as 3D points
  - Qsplats
  - Surfel, Surface Splatting
- Surface light field (or light field mapping)

Modeling from Handheld Cameras

- "Obtaining 3D Models With a Hand-Held Camera" by Marc Pollefeys, SG2001 Course #2.
- Similar materials in SG2001 Course #46, Session 3.

Per-Pixel Depth: Why So Hard?

- Getting per-pixel depths is hard:
  - A classic computer vision problem: automatically finding (sparse and dense) pixel correspondences between 2D images.
- Epipolar line search:
  - Color may change (e.g., specular reflection)
  - Multiple matches possible (e.g., repeating pattern)

Visual Hulls

- Let's just give up on finding the exact match along the epipolar line.
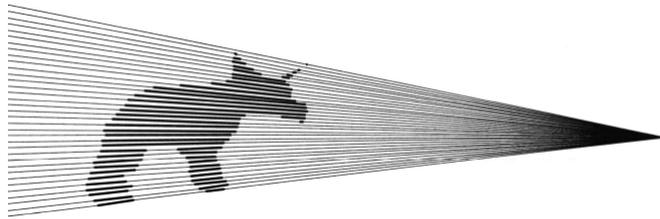- But finding the intersection with the silhouette is easy!
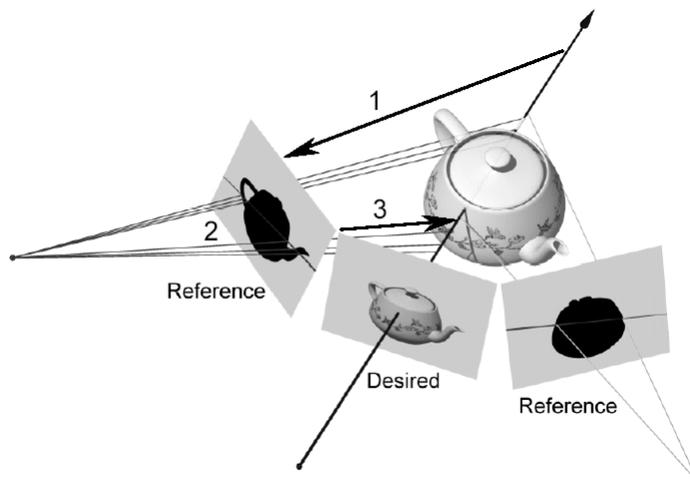
Representation

CS5520 Image-Based Rendering
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An IBVH-Based 3D Scanner

SIGGRAPH 2001 EXPLORE INTERACTION AND DIGITAL IMAGES

Simultaneous capture of IBVH shape and reflected radiance

Low-cost

Fast acquisition

Back Light

Overhead Lights

Cameras

Rotating Platform

Image-based visual hulls built from 108 (3 x 36) images

CS5520 Image-Based Rendering
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