3D Photography

Wednesdays 09:30-11:30 – Room 3305

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Class website: http://www.cs.hunter.cuny.edu/~ioannis/3D_f11.html

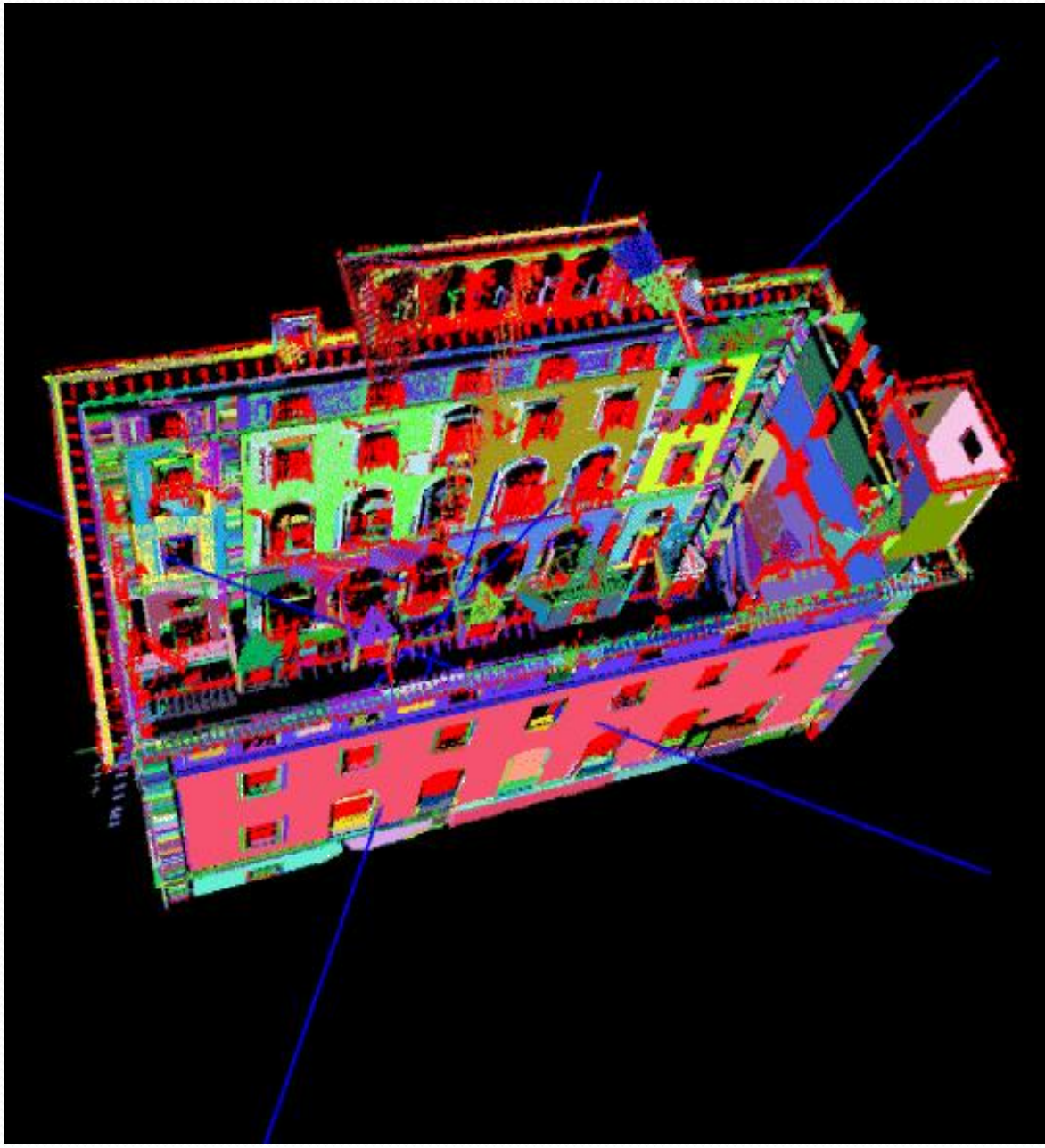
Overview

Create geometric and photometric 3D models

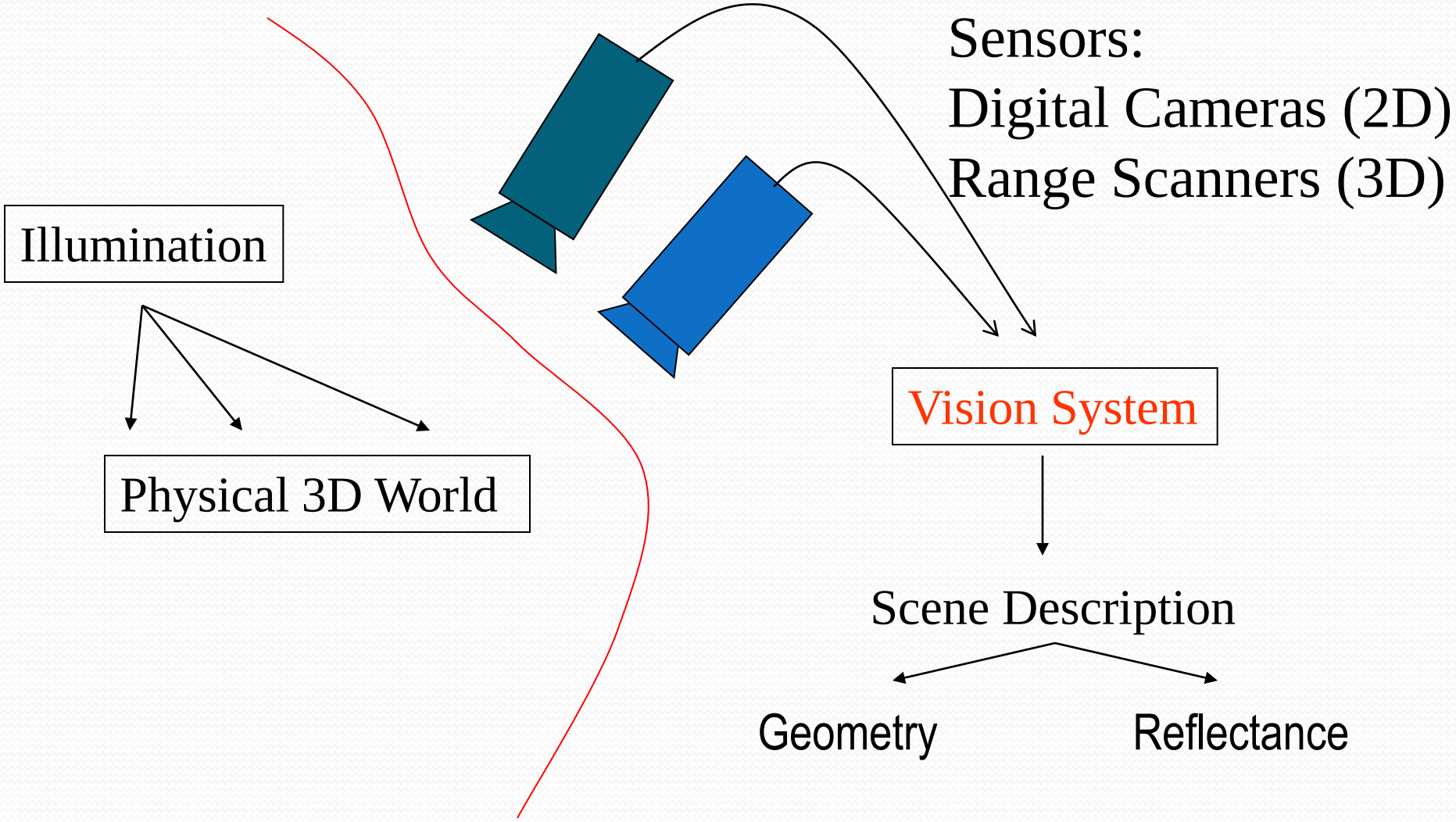
Use Range and Image Sensing

Fusing image data

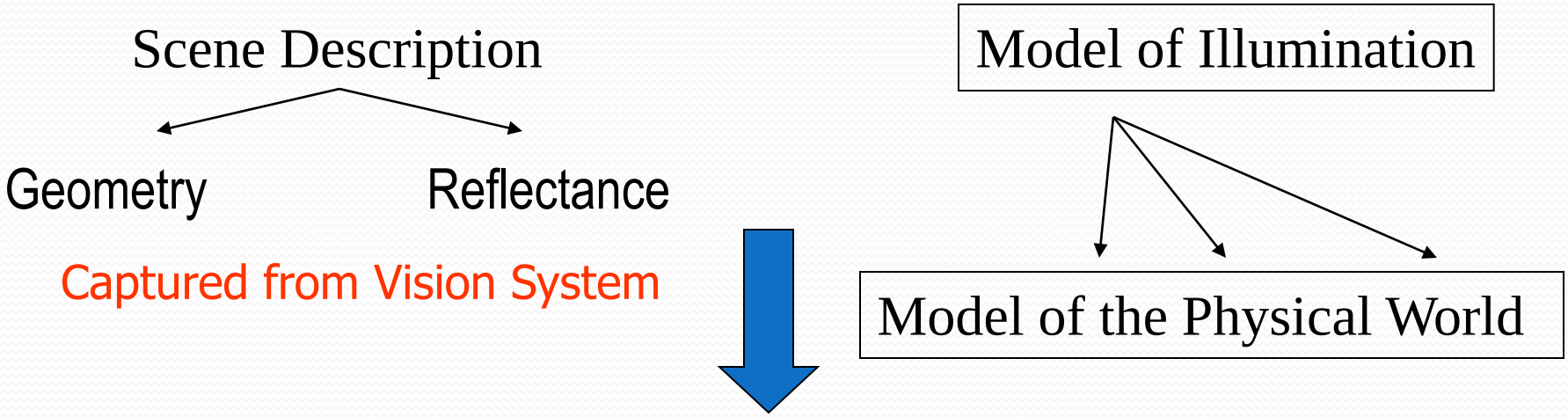
Comprehensive system with automation



Computer Vision



3D Photography & Graphics



- Modeling [Representation of 3D objects]
- Rendering [Construction of 2D images from 3D models]
- Animation [Simulating changes over time]

Applications

- Virtual environment generation
  - Google Earth
  - acquire model for use in VRML, entertainment, etc
  - Realistic sets: movies and video games
- Reverse engineering
  - acquiring a model from a part copying/modification
- Part inspection
  - compare acquired model to “acceptable” model
- 3D FAX
  - transmit acquired model to remote RP machine
- Architectural site modeling
- Urban Planning
- Historical Preservation and Archaeology
- Reverse Engineering of Buildings

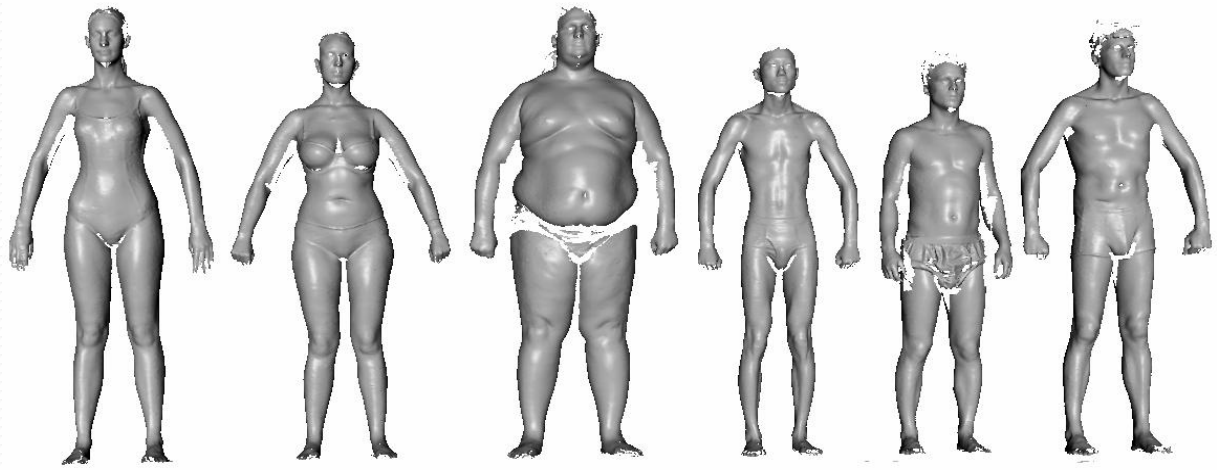
M. Reed – Columbia University [3D Fax]

Industrial Inspection

- Determine whether manufactured parts are within tolerances

3D Modeling (people)

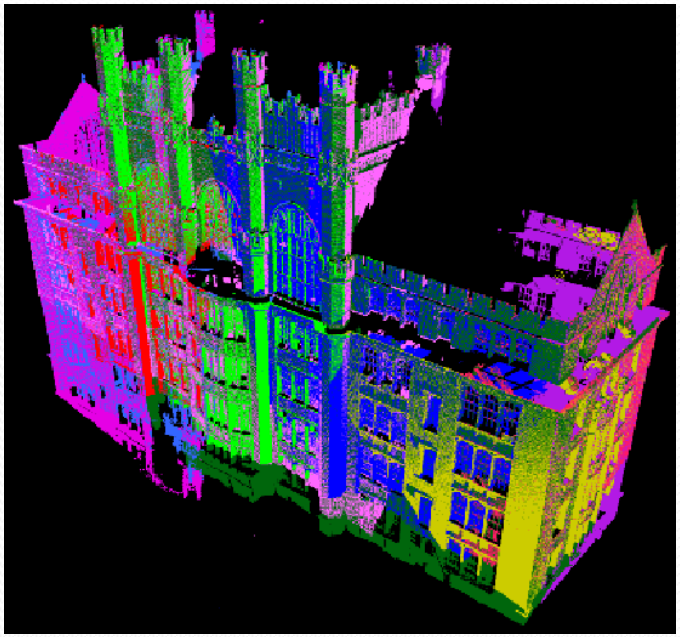
Slide courtesy of
Sebastian Thrun
http://cs223b.stanford.edu
Stanford



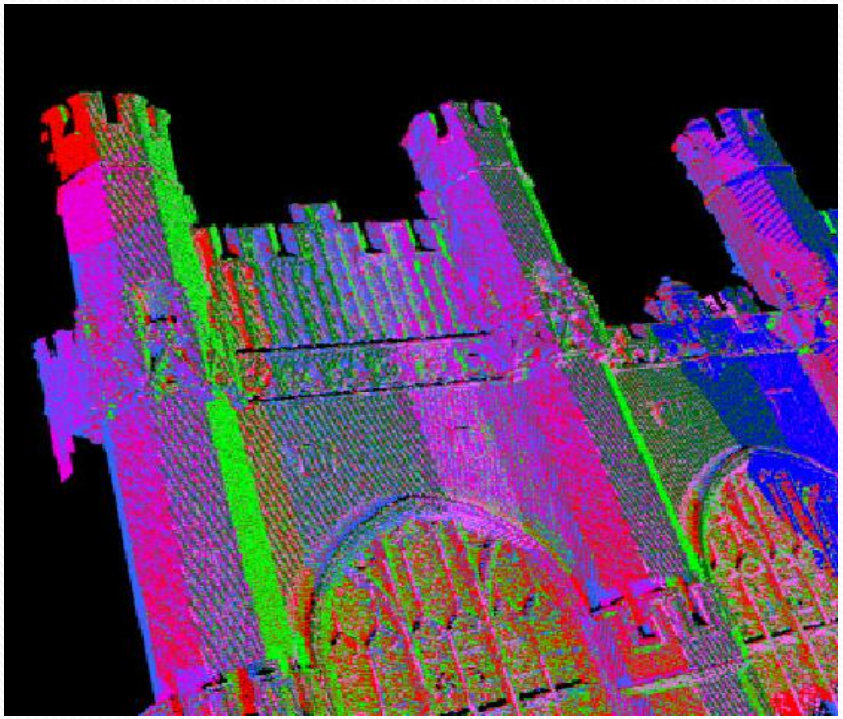
Drago Anguelov

3D PHOTOGRAPHY EXAMPLE

Buildings



Automatic registration.
Each scan has a different color.

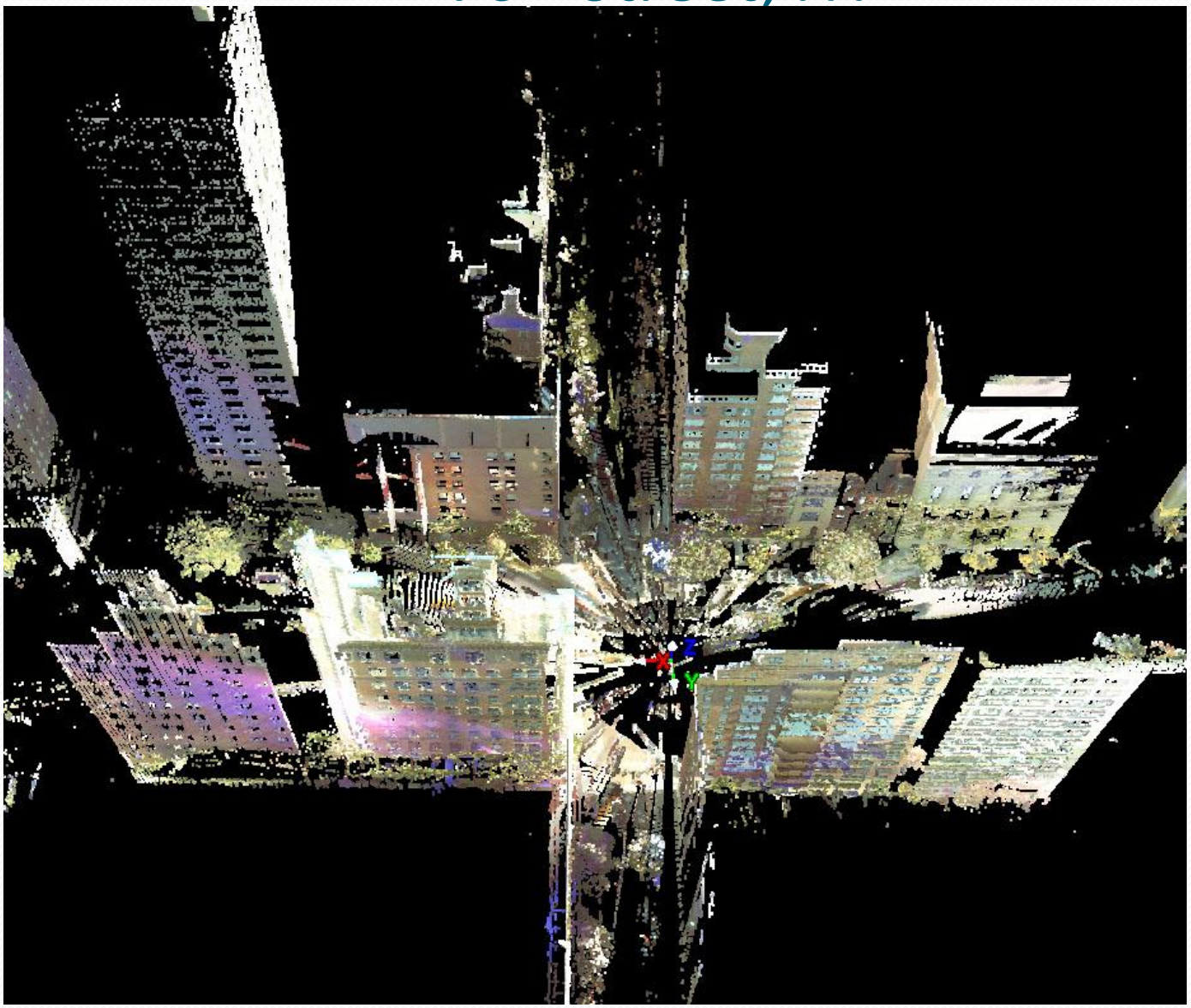


Registration details

3D PHOTOGRAPHY EXAMPLE

24 scans were acquired of façade of Shepard Hall (City College of NY)

Data Acquisition, Leica Scan Station 2, Park Avenue and 70th Street, NY



Art

- The Pietà Project
  IBM Research

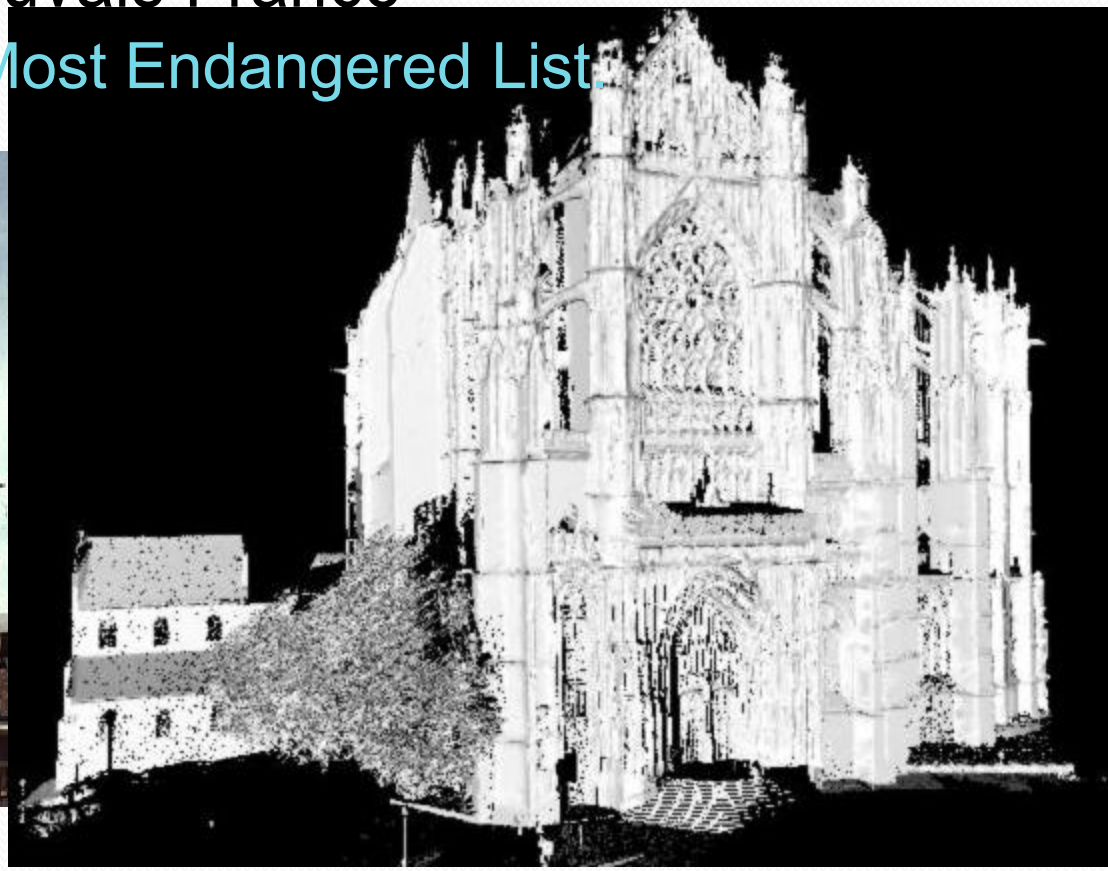
- The Digital Michelangelo Project
  Stanford University

- The Great Buddha Project
  University of Tokyo

Historical Preservation and Archeology

St. Pierre Cathedral, Beauvais France

World Monuments Fund's Most Endangered List

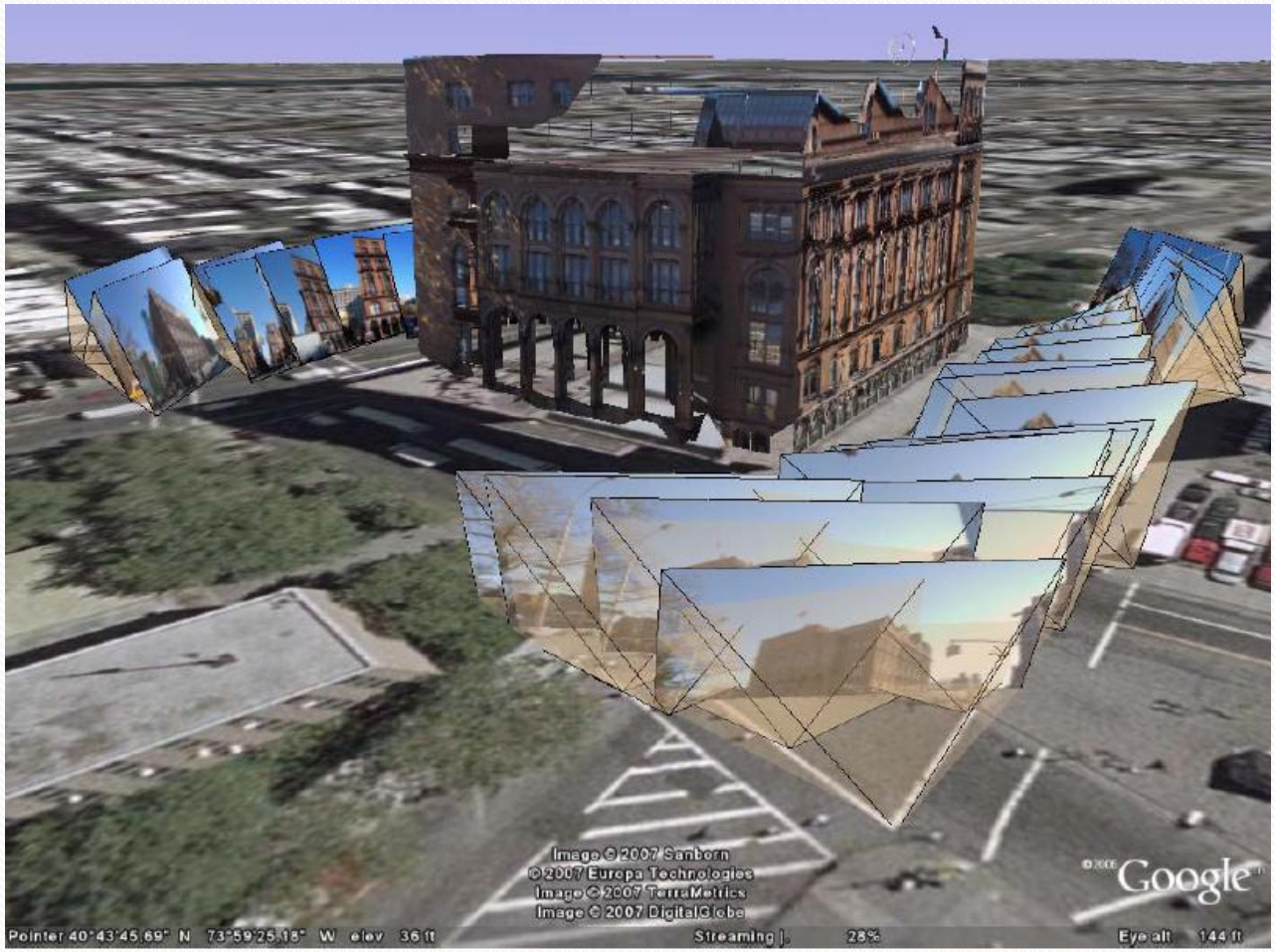


Photograph

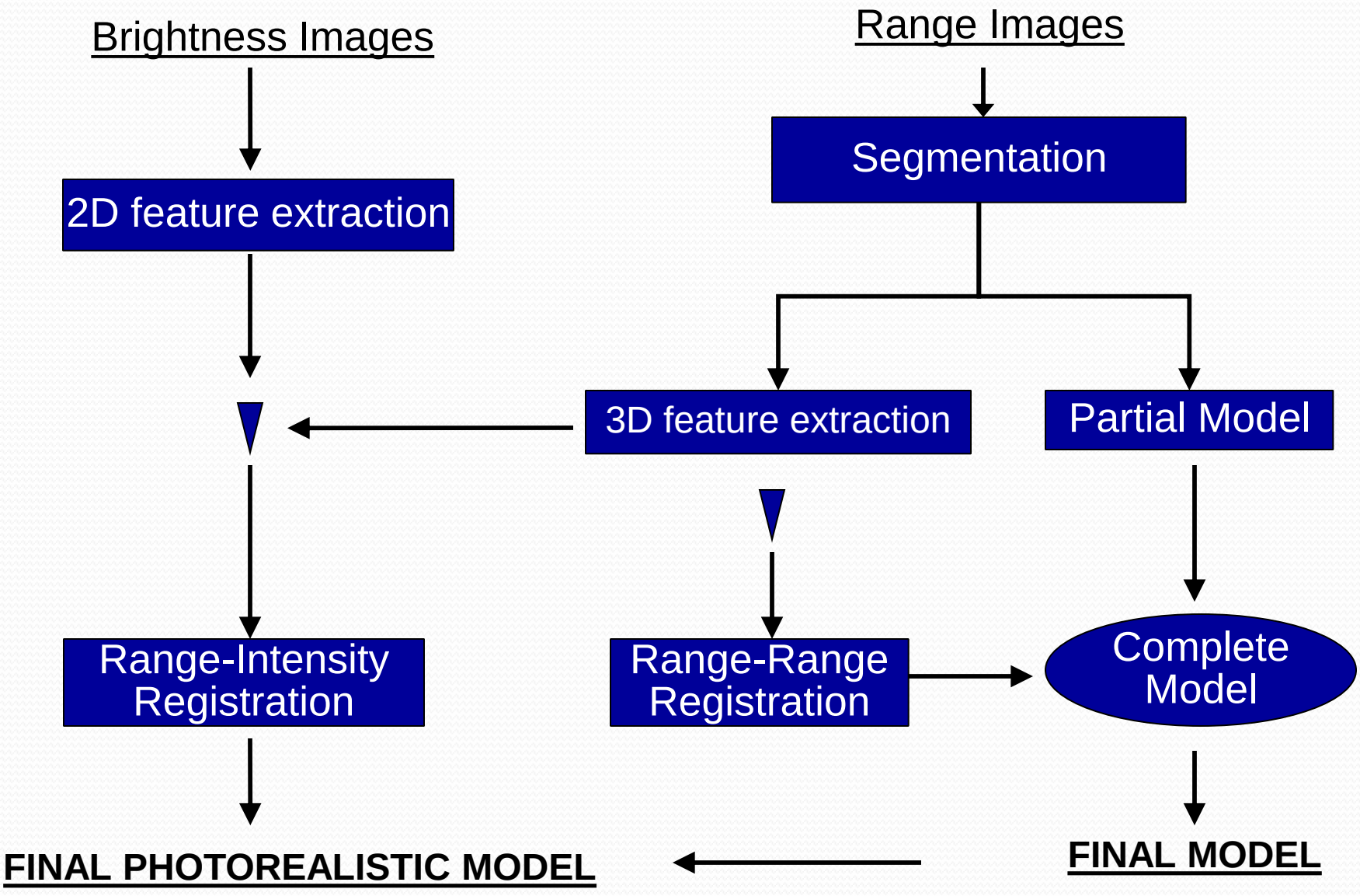
Combined 3D mesh

(with P. K. Allen, Columbia University)

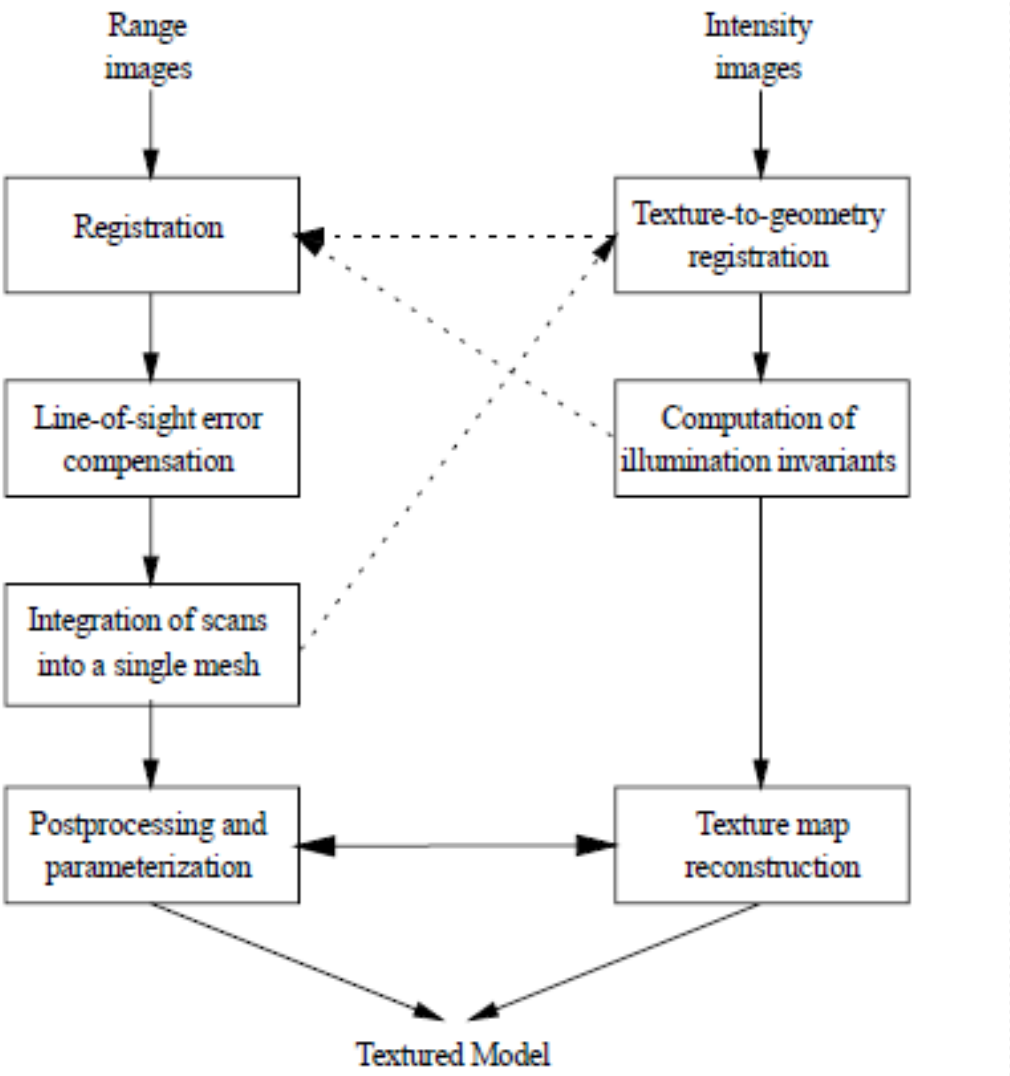
Inserting models in Google Earth



Registration/Modeling Pipeline

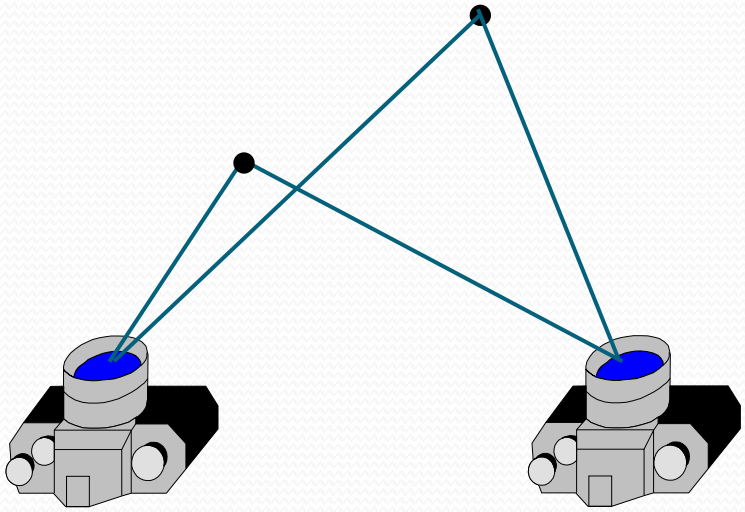


3D Acquisition Pipeline



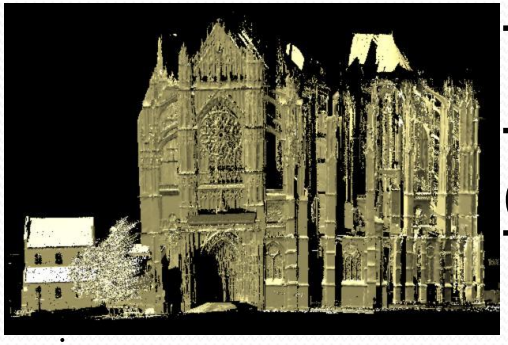
Main Topics

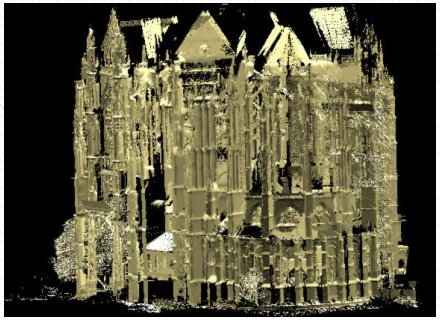
Data Acquisition and Representation

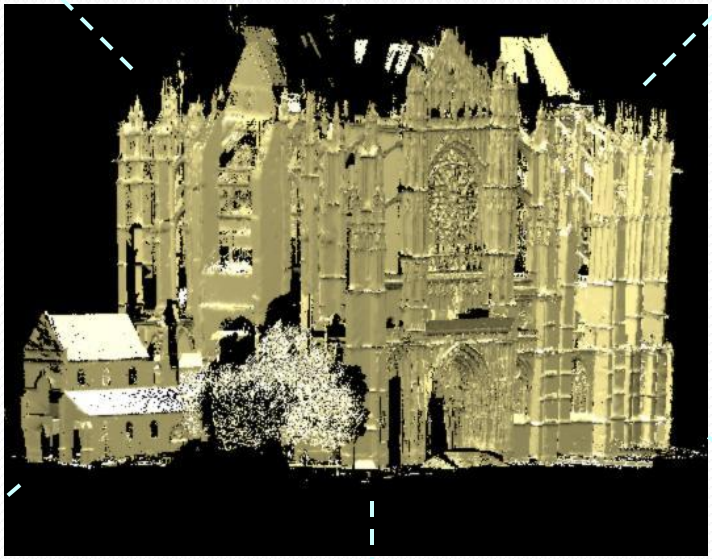


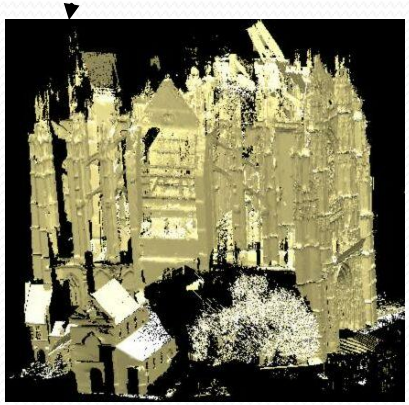
Segmentation

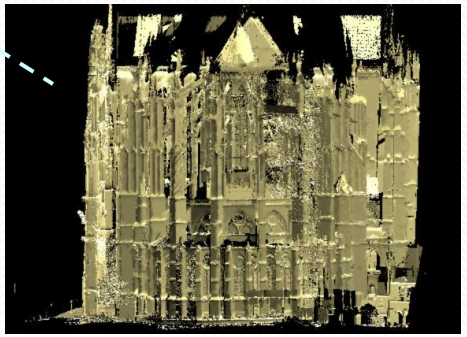
REGISTRATION pairwise & global

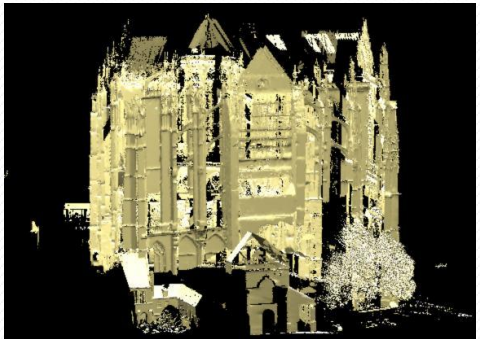




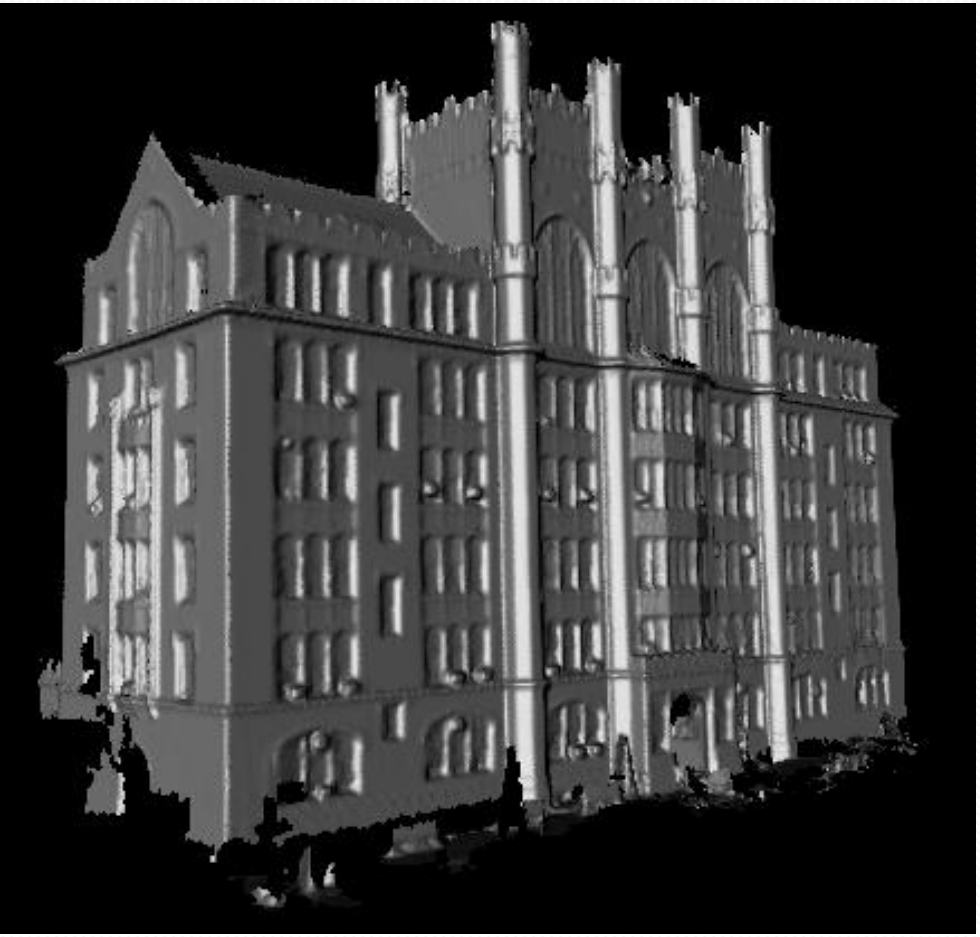




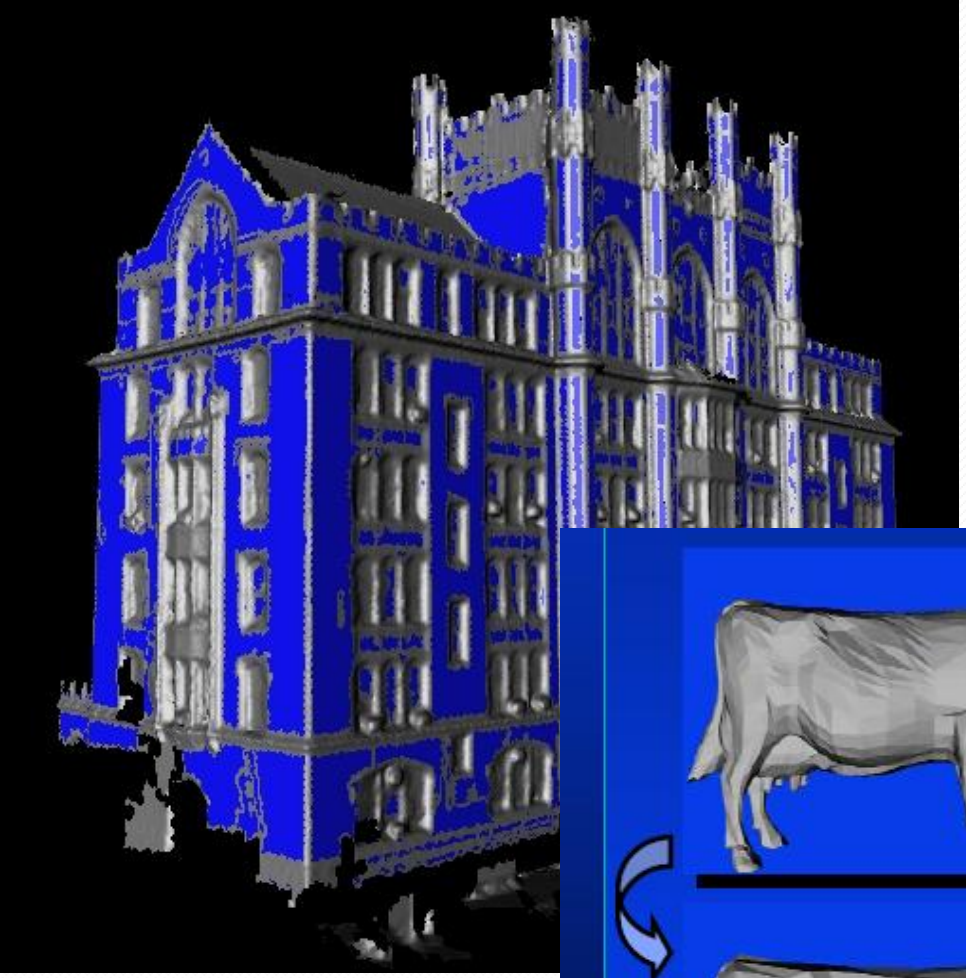


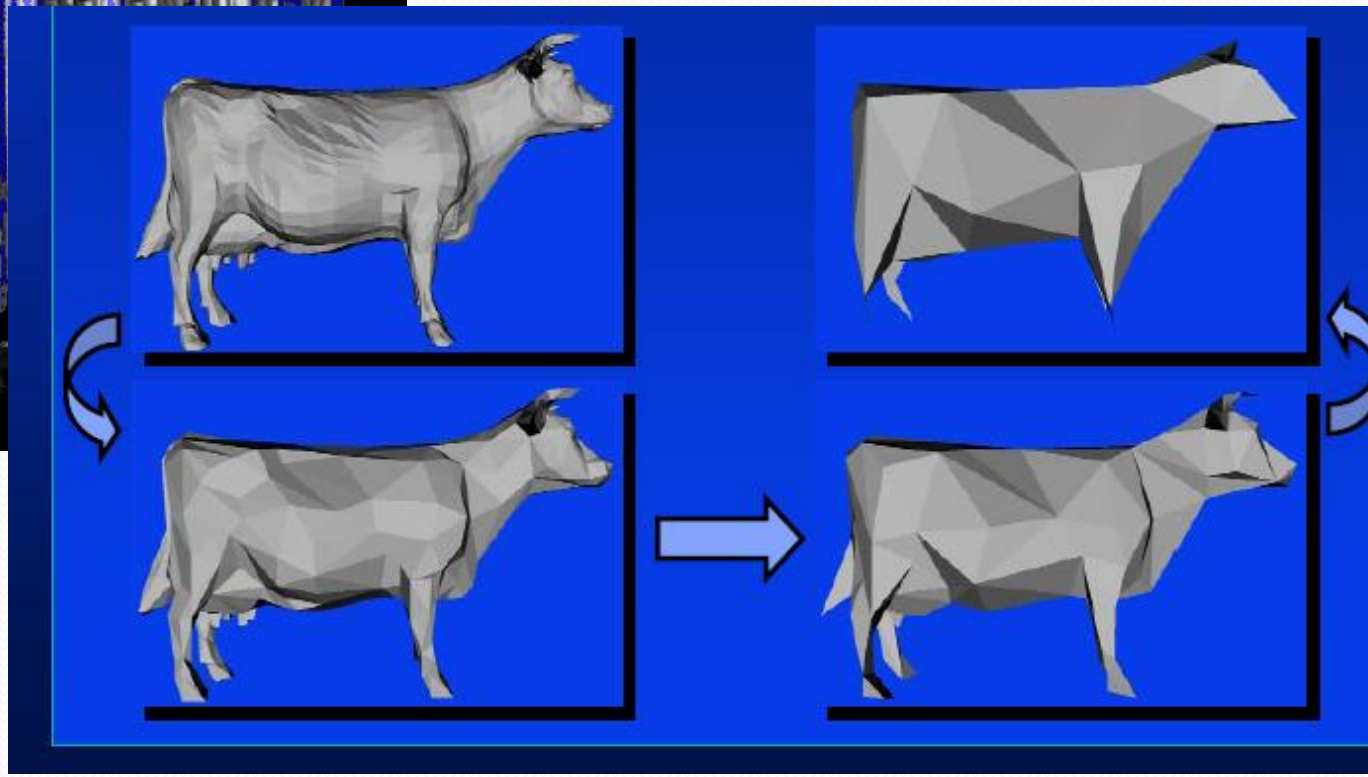


3D Modeling (Mesh or volumetric)

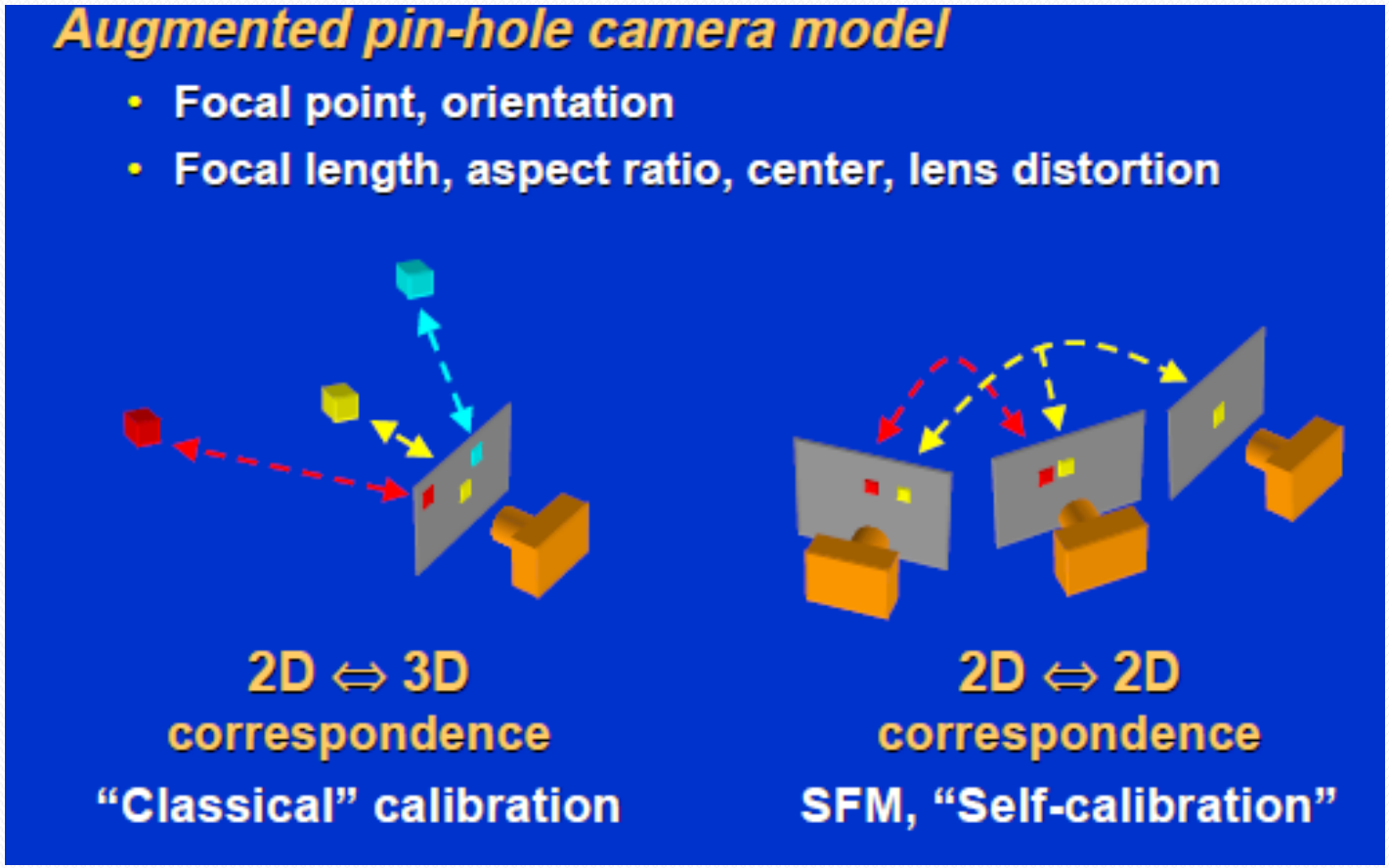


Model simplification

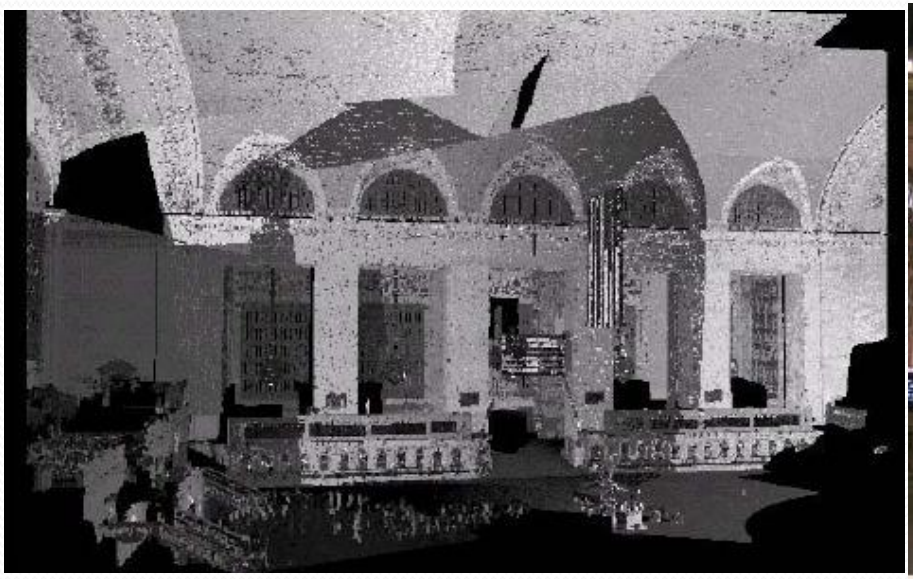




Passive techniques: Stereo and Structure from Motion



3D range to 2D image registration

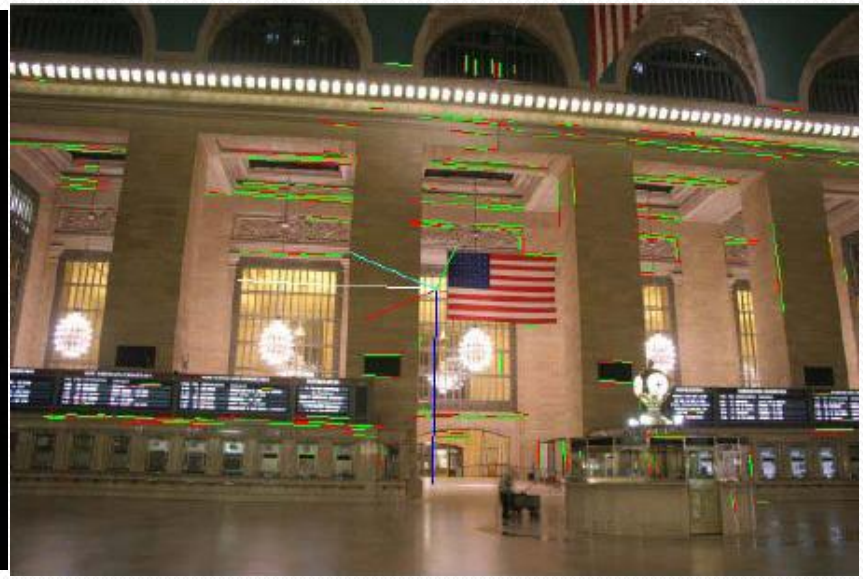


3D scene

2D image

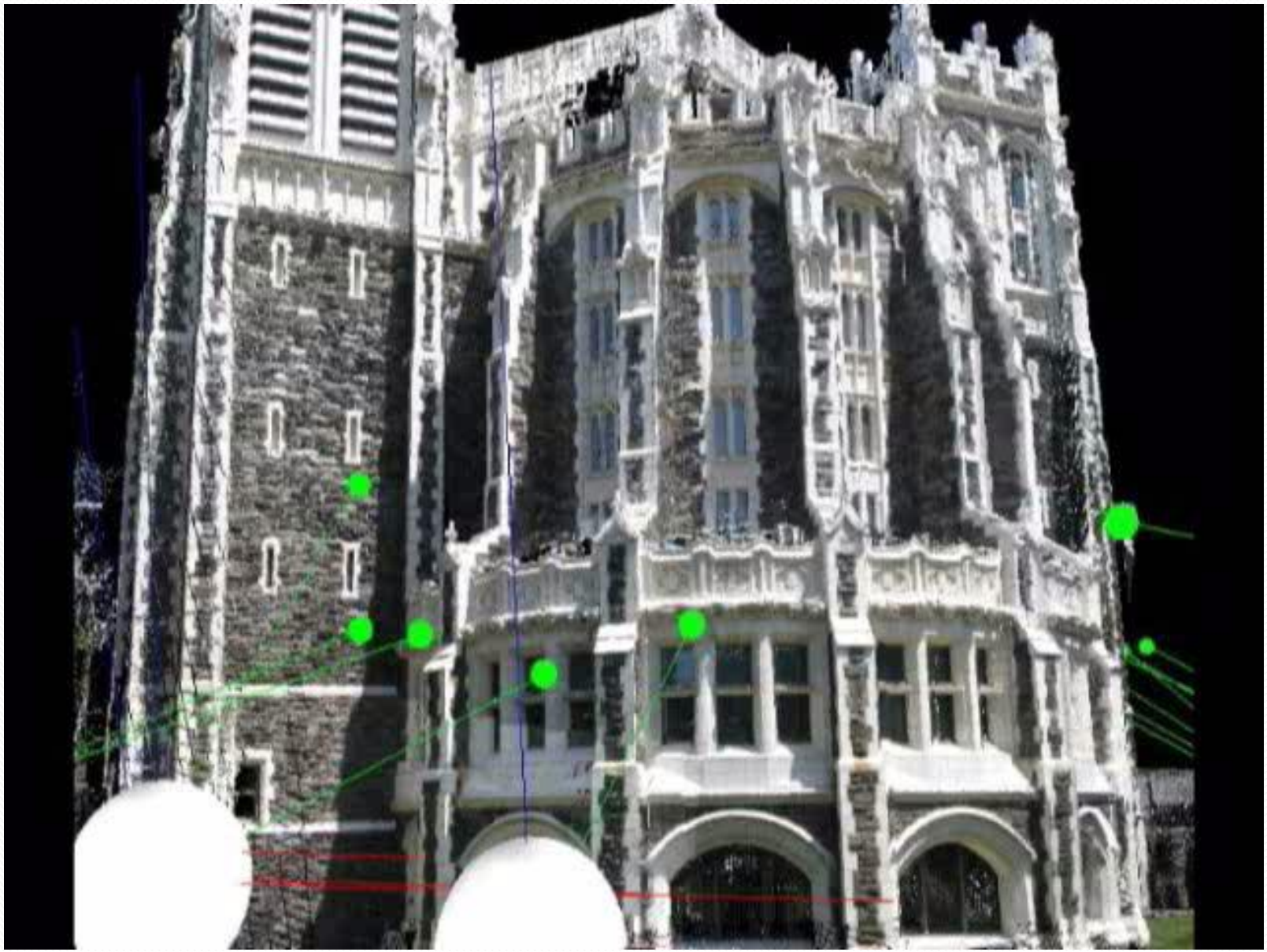
3D range to 2D image registration

Texture mapped 3D model

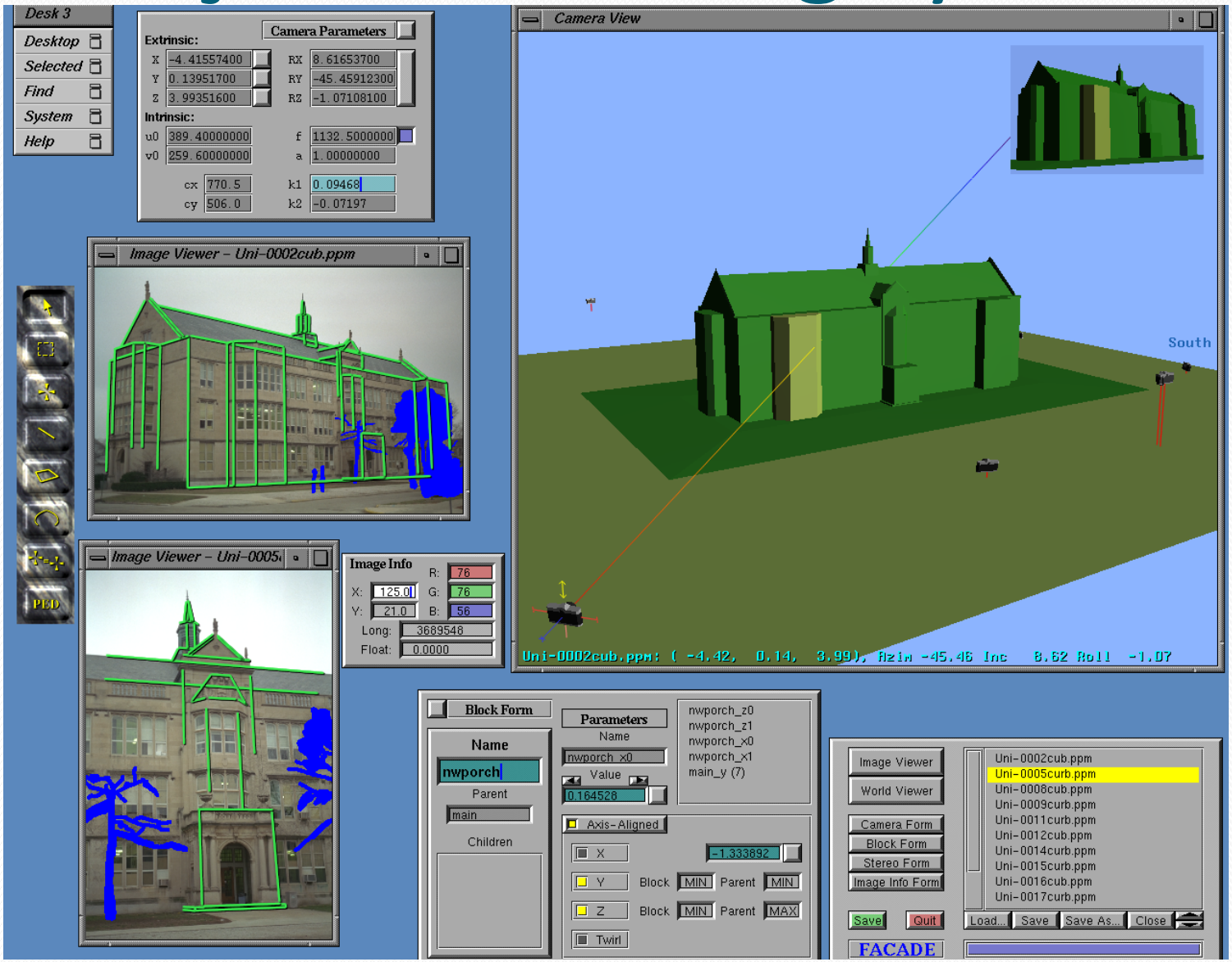


Corresponding 2D/proj. 3D lines

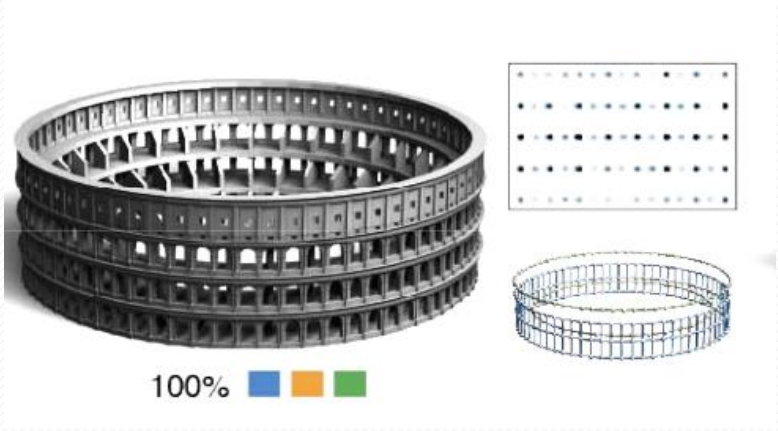
TEXTURE MAP ANIMATION

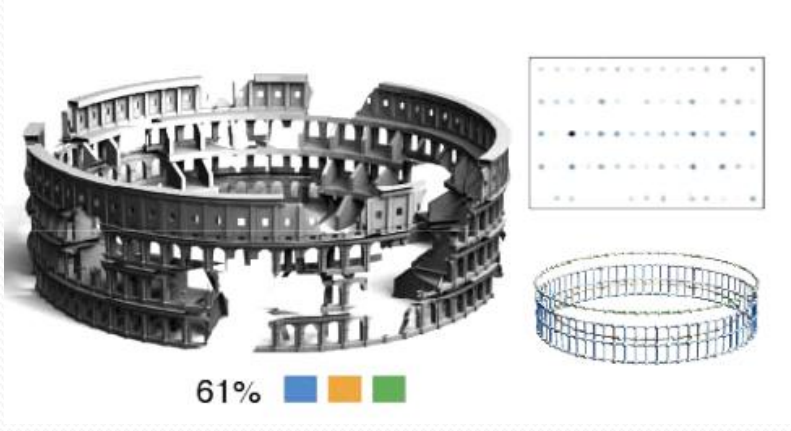


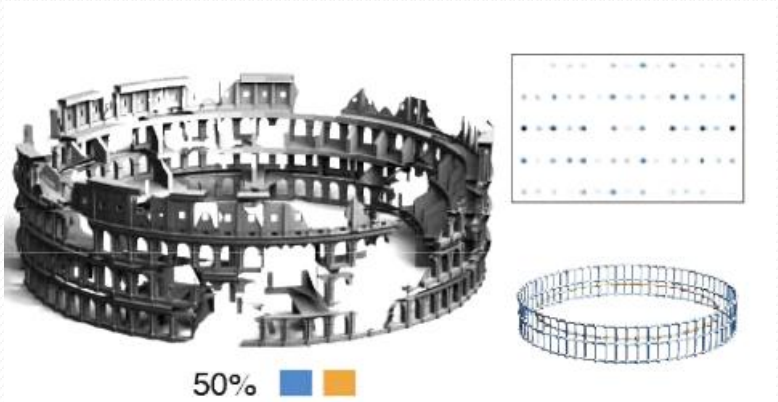
The Façade Modeling System



Symmetry Detection







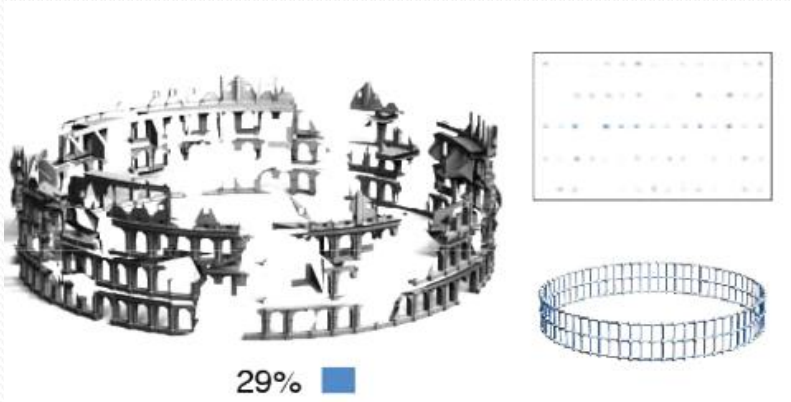
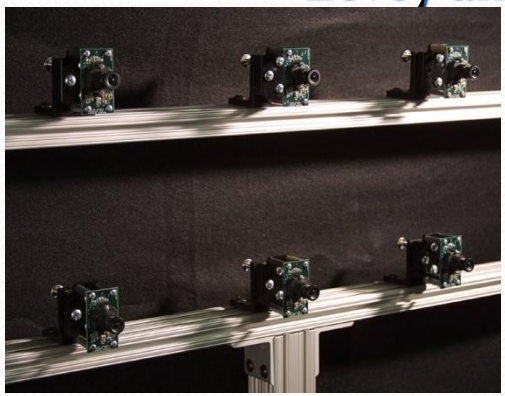
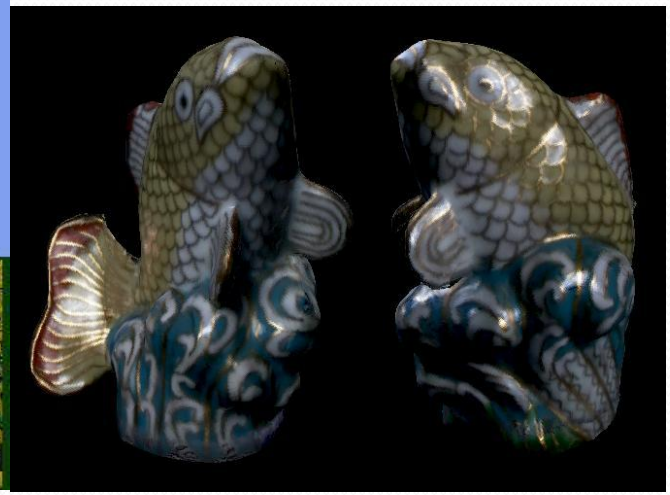


Image-Based Rendering

- Chen and Williams (1993) - view interpolation
- McMillan and Bishop (1995) - plenoptic modeling
- Levoy and Hanrahan (1996) - light field rendering

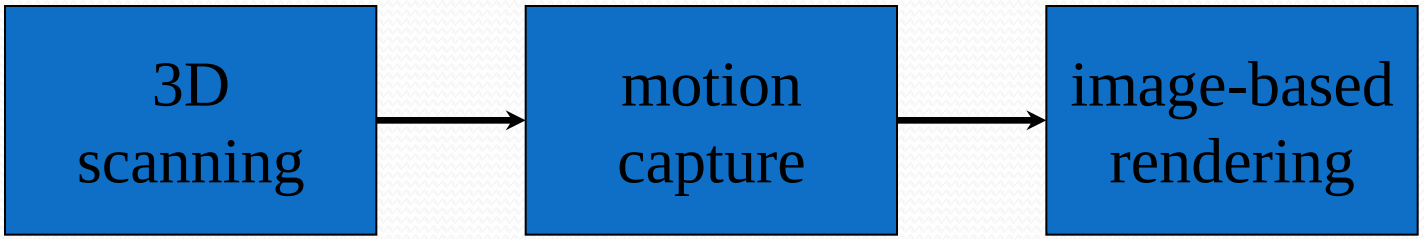




The graphics pipeline

the traditional pipeline

the new pipeline?

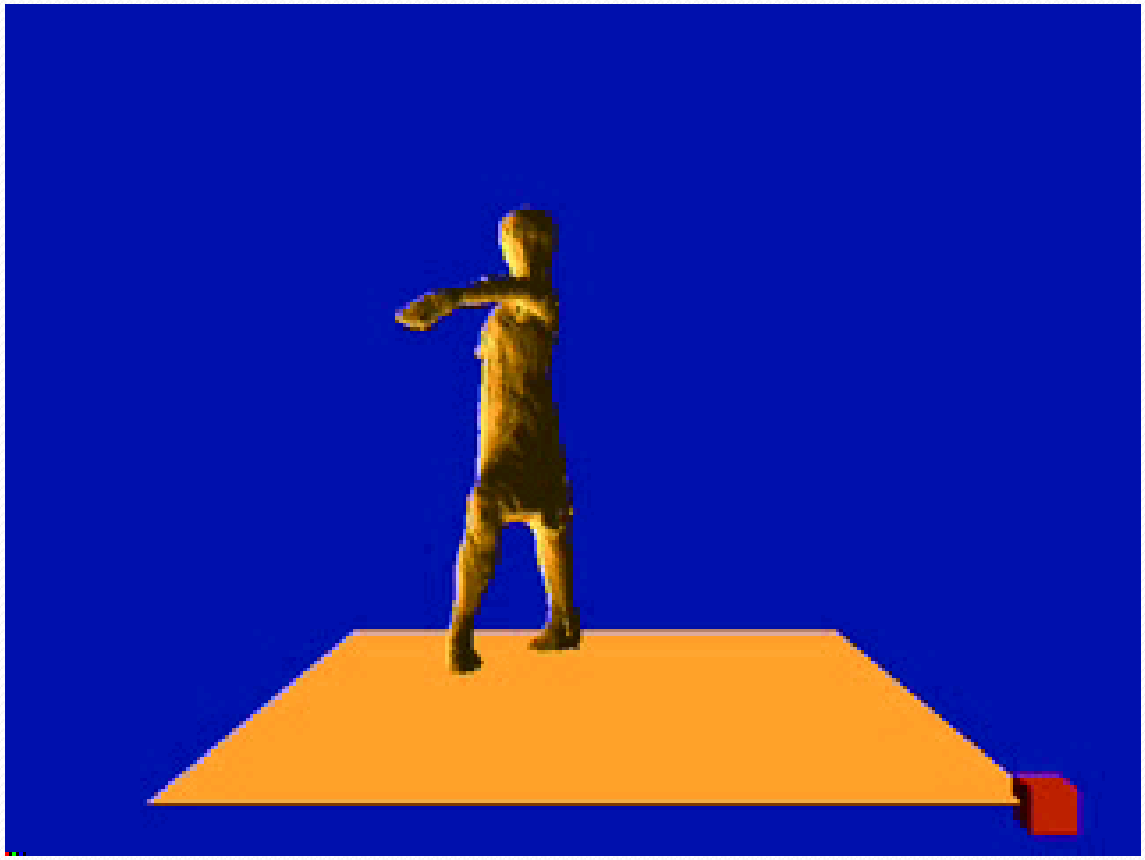


Slide courtesy Marc Levoy

Dynamic Scenes

Image sequence (CMU, Virtualized Reality Project)
http://www.ri.cmu.edu/projects/project_144.html

Dynamic Scenes



Dynamic 3D model (CMU, Virtualized Reality Project)
http://www.ri.cmu.edu/projects/project_144.html

Dynamic Scenes

Dynamic texture-mapped model (CMU, Virtualized Reality Project)
http://www.ri.cmu.edu/projects/project_144.html

Libraries

- Open Inventor Graphics Libraries
- Coin3D implements Open Inventor API: http://www.coin3d.org/
- Online book: http://www-evasion.imag.fr/Membres/Francois.Faure/doc/inventorMentor/sgi_html/
- **Book:** The Inventor Mentor : Programming Object-Oriented 3D Graphics with Open Inventor, Release 2