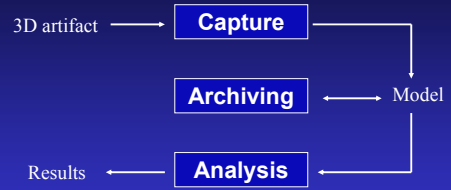


# Cultural Heritage Applications of Vision and Graphics

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## Anatomy of the Process



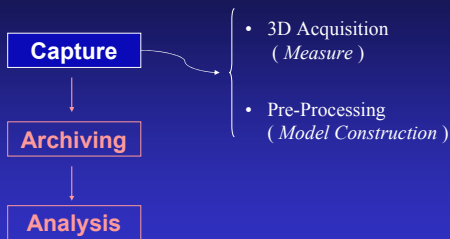
- *Usual pipeline, new & more powerful tools*

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XI Congresso Brasileiro de Arqueologia 2001

2

## Process: Step by Step

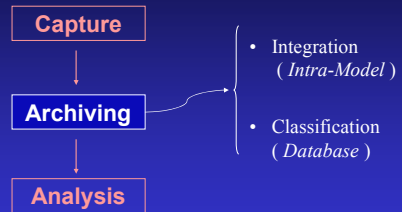


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## Process: Step by Step

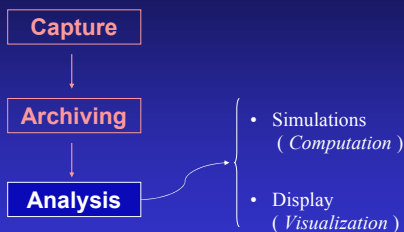


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## Process: Step by Step



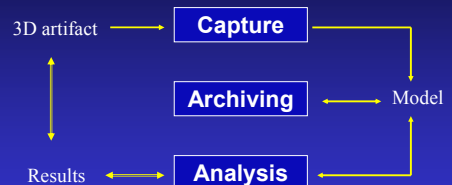
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## Characteristics of the Process

- Process can be Interactive (*feedback*)



\* *Usually Application Dependent*

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## Advantages of using Computers

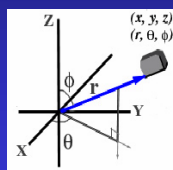
- Science and History
  - Digital Record
  - Global Controlled Archive
  - Computation and Simulation
- Culture and Education
  - Virtual Exhibitions
  - Interactive Content
  - Physical Replicas

## Case Studies

- Archeological Excavations
  - *GeoScape* (MIT Media Lab)
- Statues and 3D Objects
  - *Digital Michelangelo* (Stanford University)
  - *Pieta Project* (IBM T.J. Watson)
  - *Minerva Project* (CNUCE)
- Bass-Relief Artifacts
  - *Forma Urbis Romae* (Stanford University)
  - *Cuneiform Tablet Visualization* (HP Labs)

## GeoScape: MIT Media Lab

- Digital Tape Measure
  - Wireless Connection to Laptop
  - Length and Orientation
  - (3D Vector - Absolute or Relative)



## GeoScape in Action

- Building a Site Map (Database)



## Digital Michelangelo: Stanford Lab

Create a 3D computer archive of the principal statues and architecture of Michelangelo

### Motivations

- push 3D scanning technology
- tool for art historians
- lasting archive

### Technical goals

- scan a big statue
- capture chisel marks
- capture reflectance



## Capturing Chisel Marks

- Day (Medici Chapel)



5 mts

1/4 mm

20,000 : 1 → 20,000<sup>2</sup> ≈ 1 billion

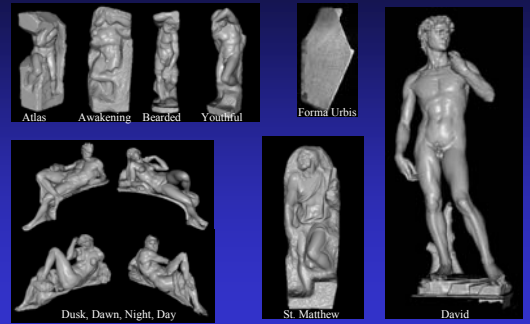
## Digital Michelangelo: Technical Details

- Scanning Technology
  - Geometry: time-of-flight laser
  - Color: high-res camera
  - \* Custom Made by Cyberware
- Some Statistics (*David*)
  - 480 individually aimed scans
  - 2 billion polygons
  - 7,000 color images
  - 32 gigabytes
  - 30 nights of scanning / 22 people



\* from Levoy 2000

## Digital Michelangelo: Results (3D Archive)



\* from Levoy 2000

## Pieta Project: IBM T.J. Watson

3D Acquisition of Michelangelo Florentine Pieta for studies by art historian Jack Wasserman

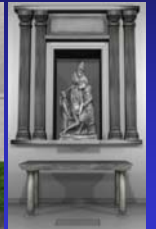
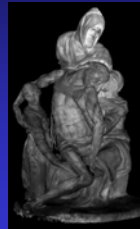
- Scanning Technology
  - Multi-view Stereo
  - Shape from Shading
  - \* Virtuoso Camera



## Pieta Project: Results (Book + CD)

3D Model

Visual Simulations

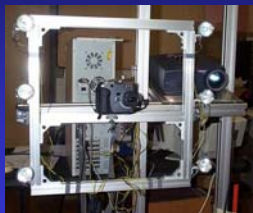


\* from Bernardini 2001

## Minerva Project: CNR

Support Restoration of the Minerva Statue by the Soprintendenza Archeologica Toscana

- Scanning Technology
  - Structured-Light Stereo
  - Consumer Electronics (*low-cost*)



## Minerva Project: Results

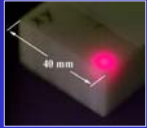


Original  
(before restoration)

3D Model

## Photometry / Reflectance Models

- Important both for Capture and Visualization



## Realistic Rendering



photograph



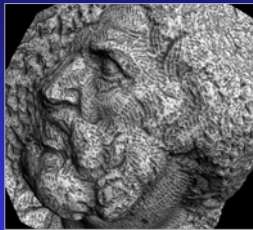
1.0 mm computer model

## Enhanced Visual Simulation

Diffuse Shading

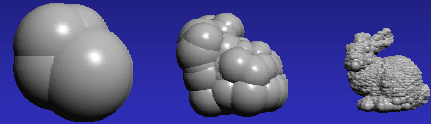


Accessibility Shading



## Real-Time Visualization

- Qsplat Interactive Viewer (*Stanford*)  
– hierarchy of bounding spheres



\* Live Demo



## Illumination Textures

- Polynomial Texture Map (Malzbender, SIGGRAPH 2001)
  - Images of Object illuminated from many directions
  - Store as a single map that allows fast rendering



## Tablet Visualization: HP-Labs

- *Archaeological Research Collection (USC)*



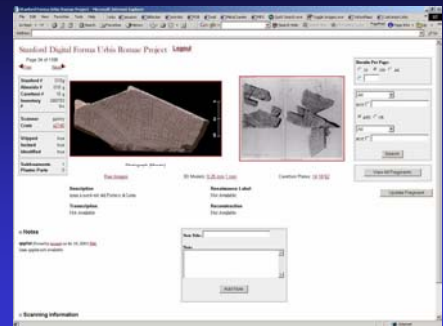
\* Live Demo



## Forma Urbis Romae



## Cultural Heritage Databases



## Virtual Museums

- Website Project
  - Egypt Government / IBM

