Types of Correspondence Problems and Data Sets

Correspondence

Registration

Correspondence Problem Classification

How many meshes?

- Two: Pairwise registration
- More than two: multi-view registration

Initial registration available?

- Yes: Local optimization methods
- No: Global methods

Class of transformations?

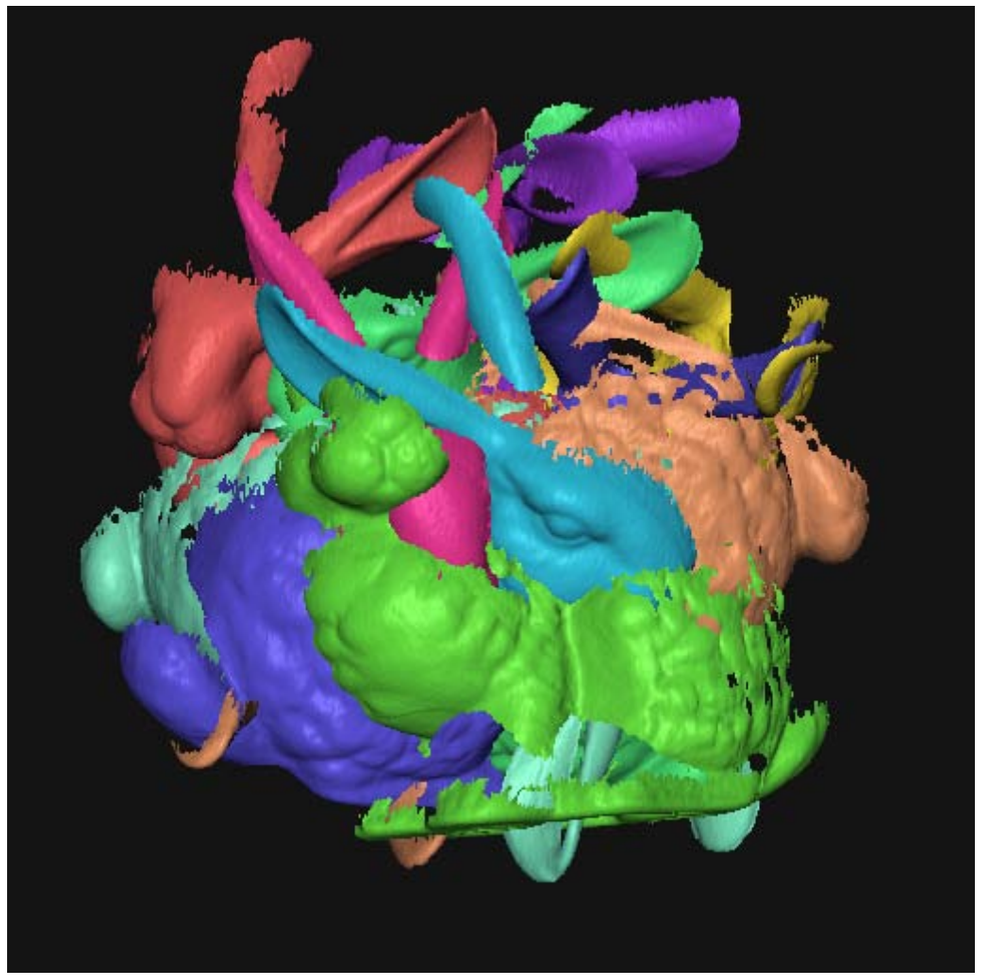
- Rotation and translation: Rigid-body
- Non-rigid deformations

Correspondence Problem Classification

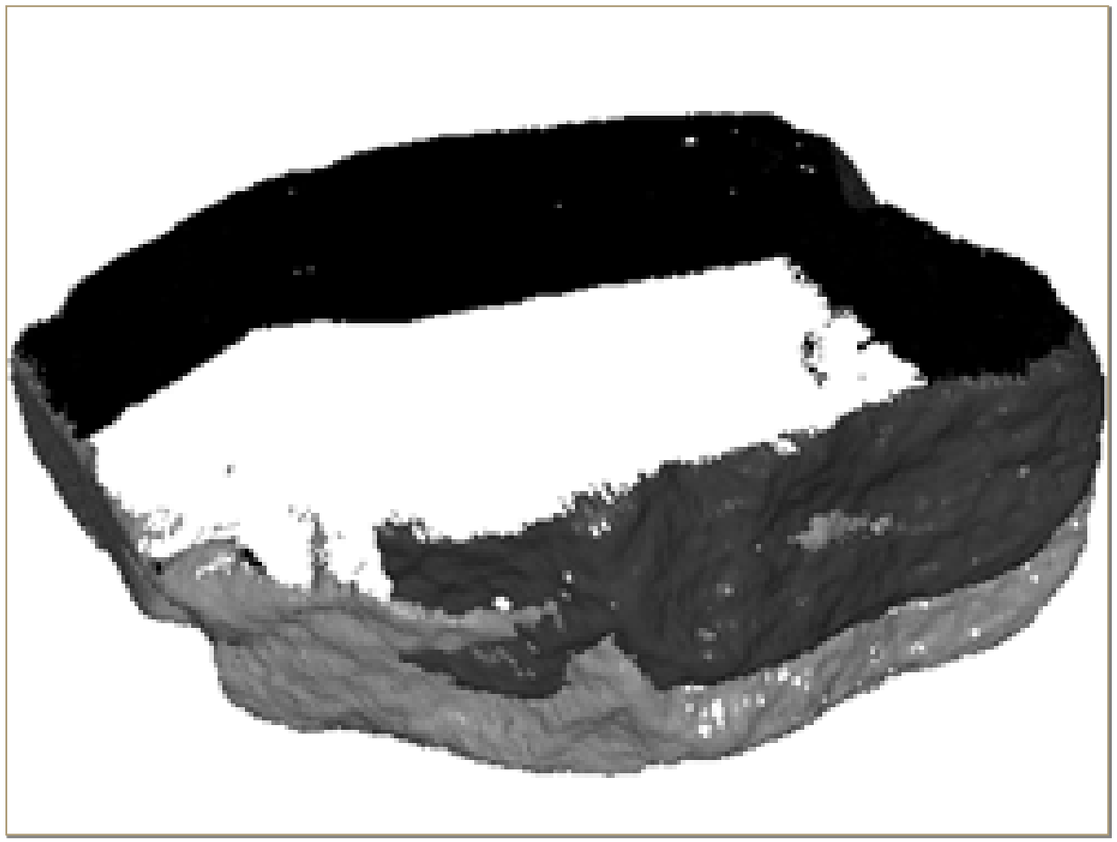
Type of algorithm can depend on type of data that is available, or desired application

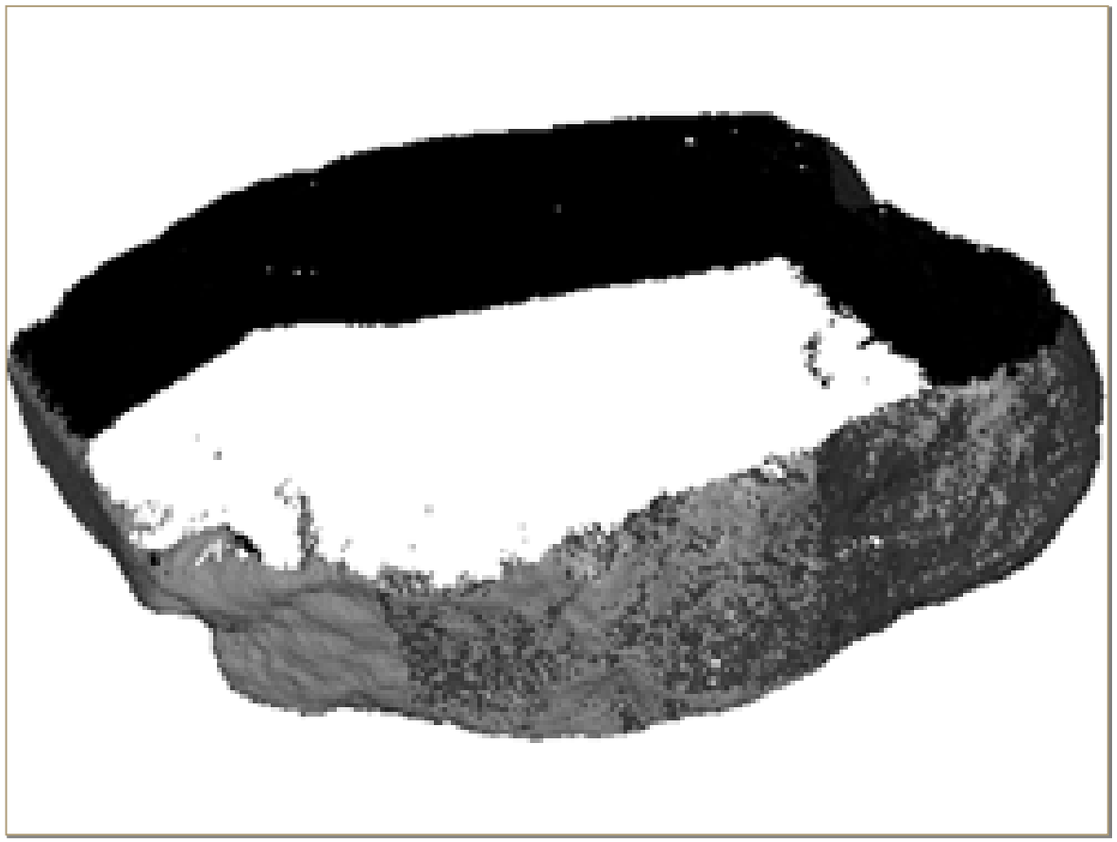
- Data: typical 3D scans
- Application: 3D model reconstruction

The Bunny

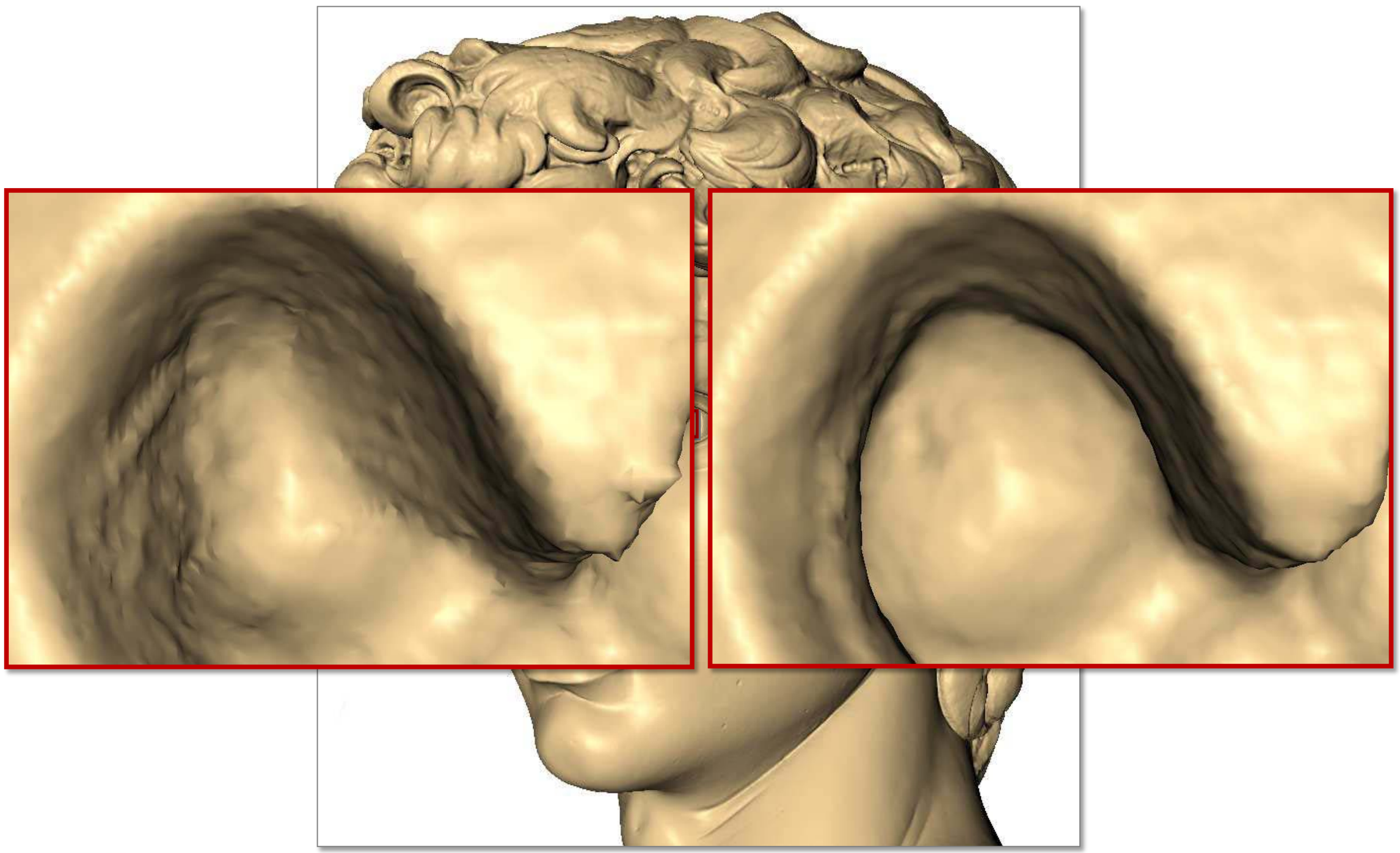


Error Accumulation and Multi-View Registration

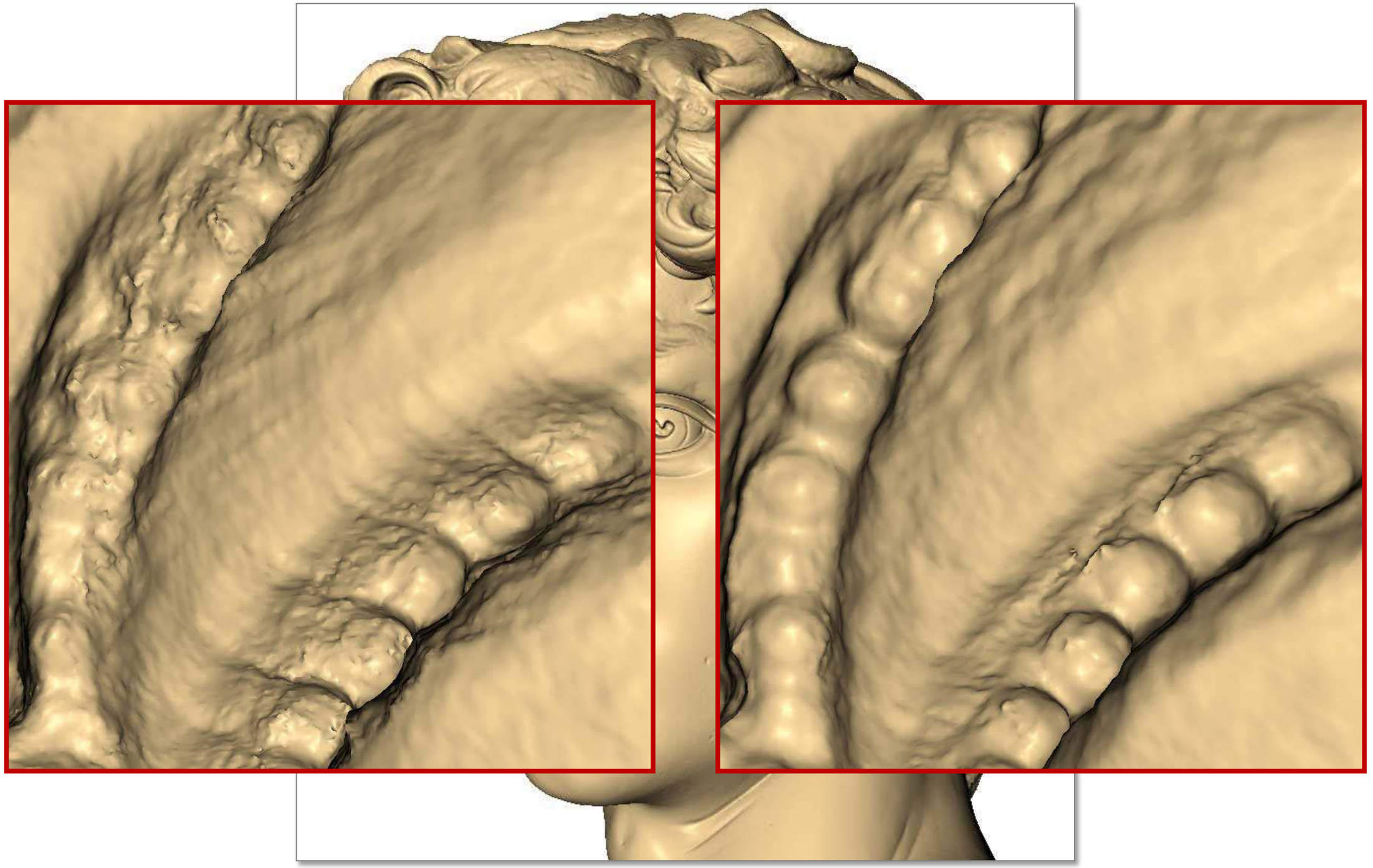




Nonrigid Alignment



Nonrigid Alignment

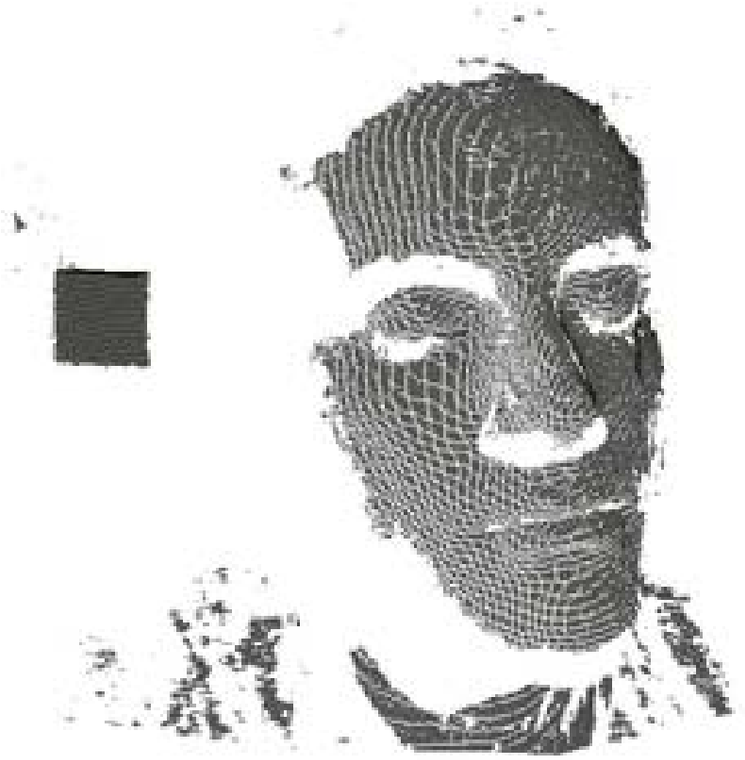


Correspondence Problem Classification

Type of algorithm can depend on type of data that is available, or desired application

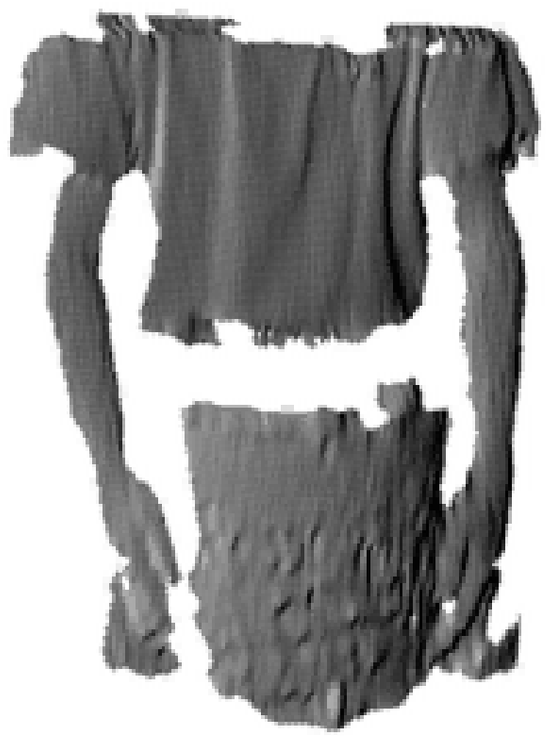
- Data: real-time 3D scans
- Application: animation reconstruction

Structured Light Scanners



space-time stereo

courtesy of James Davis,
UC Santa Cruz



color-coded structured light

courtesy of Phil Fong,
Stanford University

motion compensated structured light

courtesy of Sören König,
TU Dresden

Passive Multi-Camera Acquisition

segmentation & belief propagation

[Zitnick et al. 2004]
Microsoft Research

photo-consistent space carving

Christian Theobald
MPI-Informatik

Time-of-Flight / PMD Devices

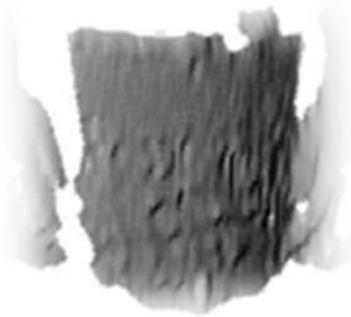
PMD Time-of-flight camera

Minolta Laser Scanner (static)

Animation Reconstruction

Problems

- Noisy data
- Incomplete data (acquisition holes)
- No correspondences



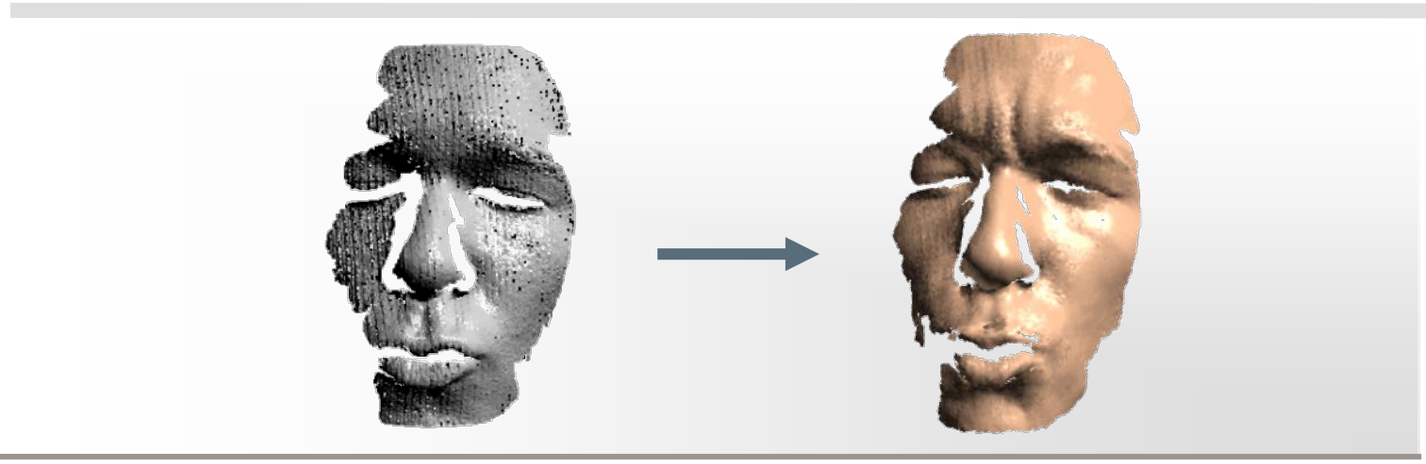
noise

holes

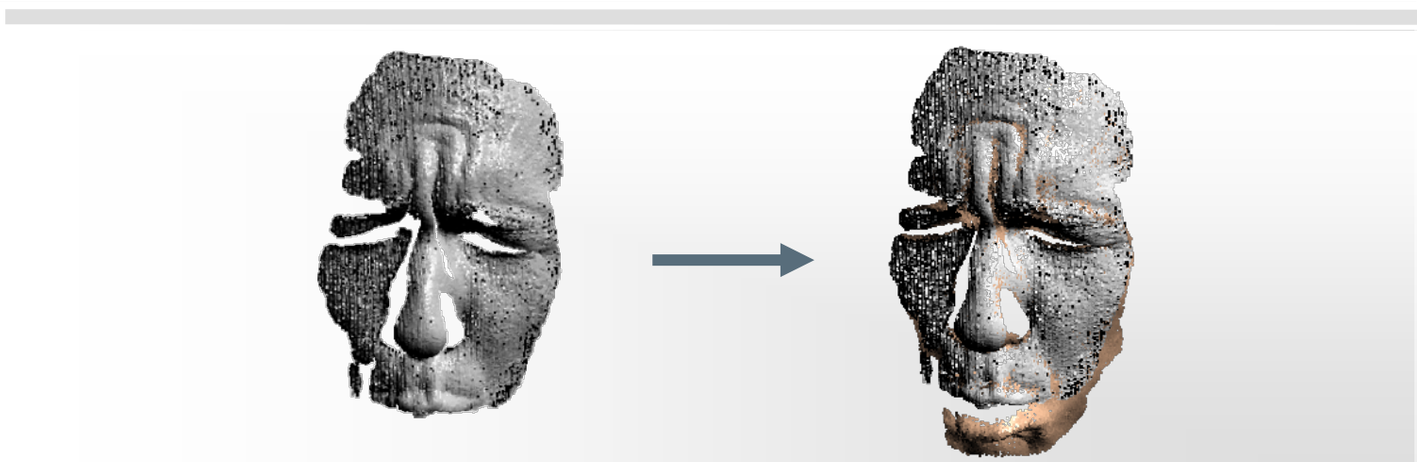
missing correspondences

Animation Reconstruction

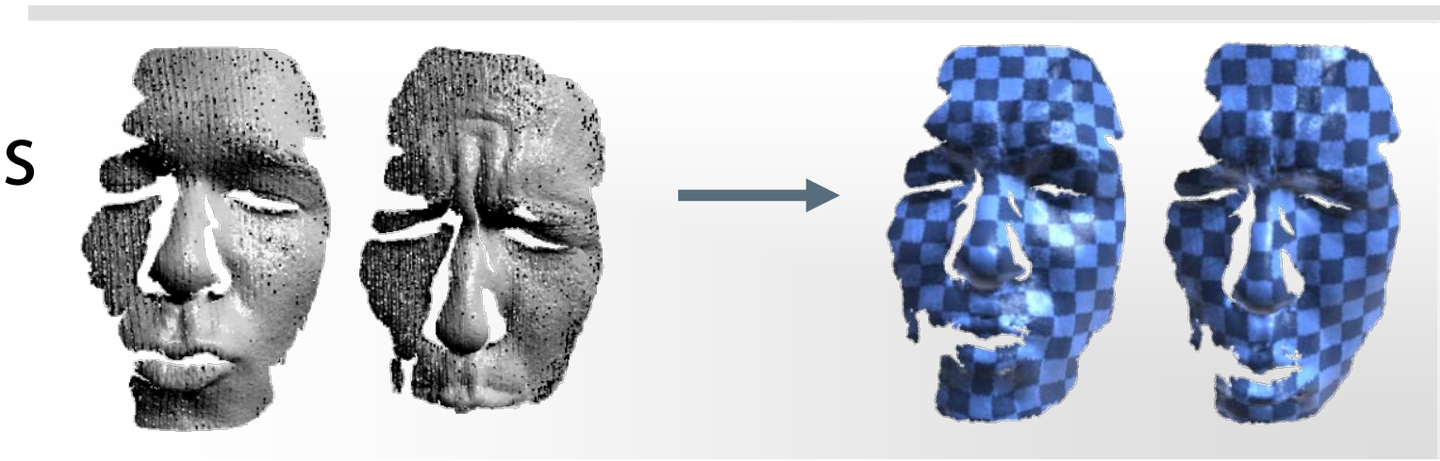
Remove noise, outliers



Fill in holes
(from all frames)



Find dense, temporally coherent correspondences

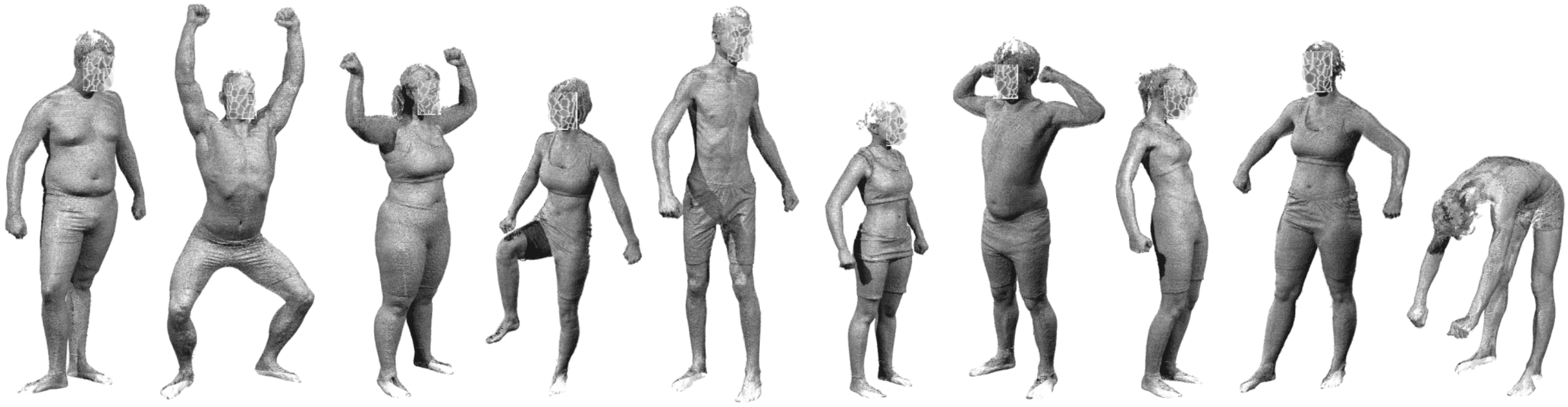


Correspondence Problem Classification

Type of algorithm can depend on type of data that is available, or desired application

- Data: collection of models
- Application: statistical shape model

Statistical Shape Spaces



Courtesy of N. Hassler, MPI Informatik

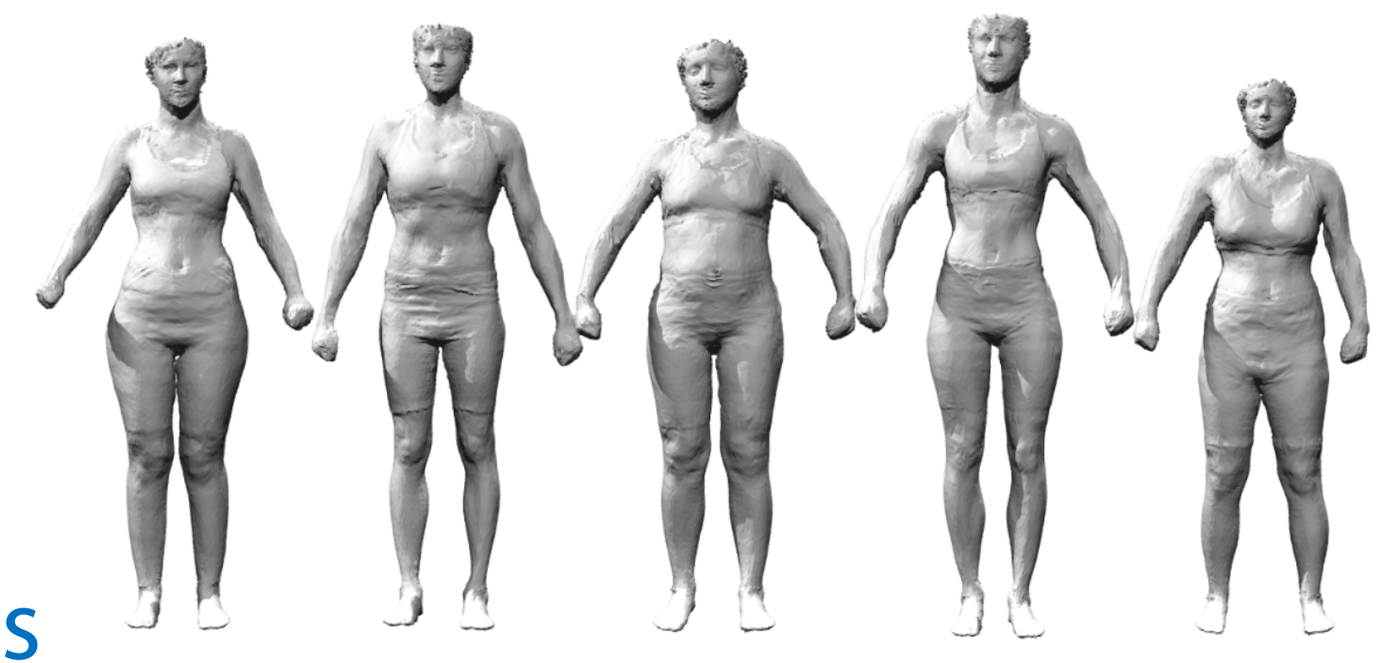
- Scan a large number of individuals
  - Different poses
  - Different people
- Compute correspondences
- Build shape statistics (PCA, non-linear embedding)

Statistical Shape Spaces

Numerous Applications:

- Fitting to ambiguous data (prior knowledge)
- Constraint-based editing
- Recognition, classification, regression

Courtesy of N. Hassler, MPI Informatik



Courtesy of N. Hassler, MPI Informatik

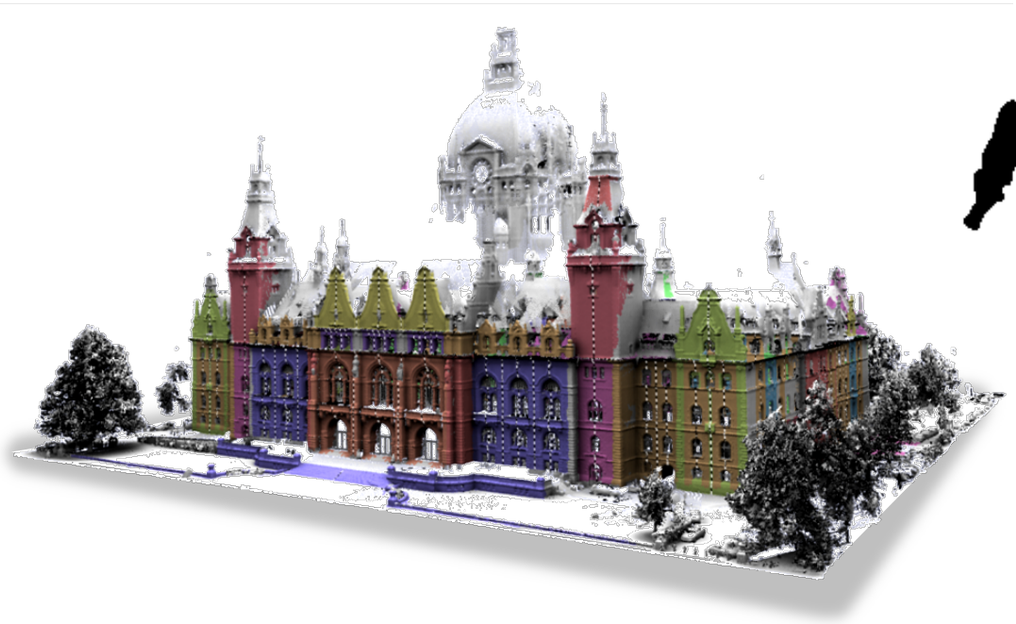
Building such models requires correspondences

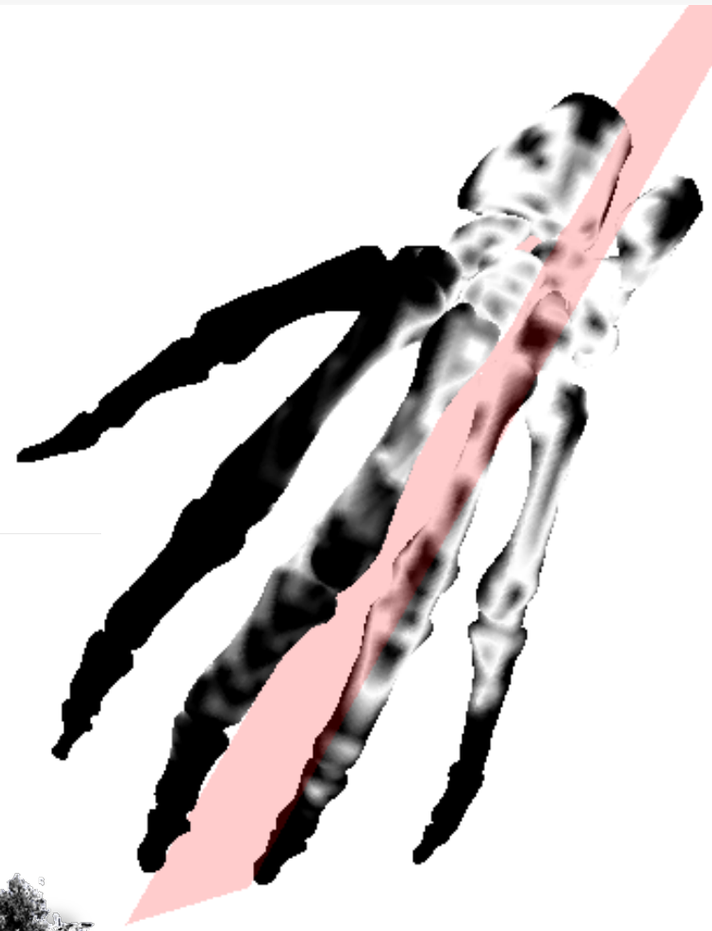
Correspondence Problem Classification

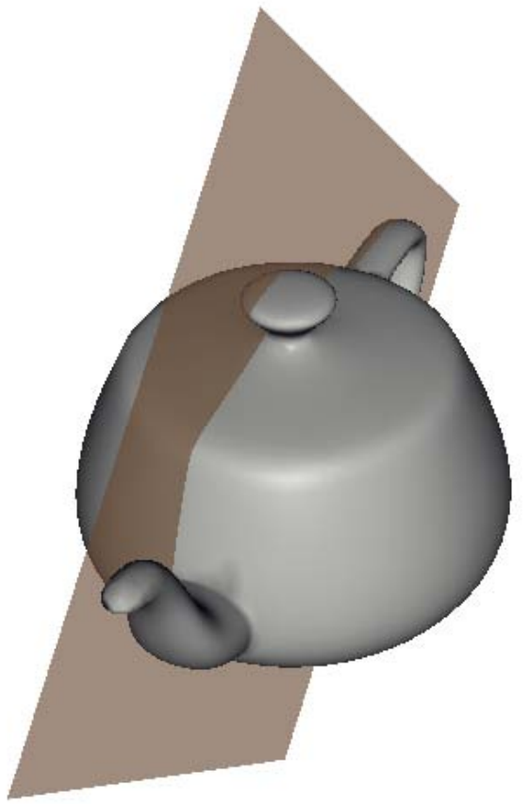
Type of algorithm can depend on type of data that is available, or desired application

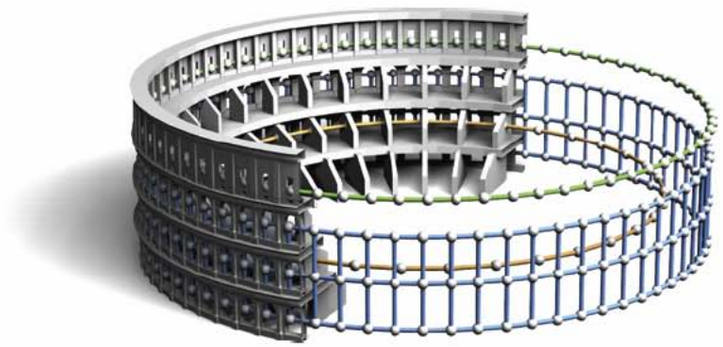
- Data: single 3D model
- Application: extract symmetries

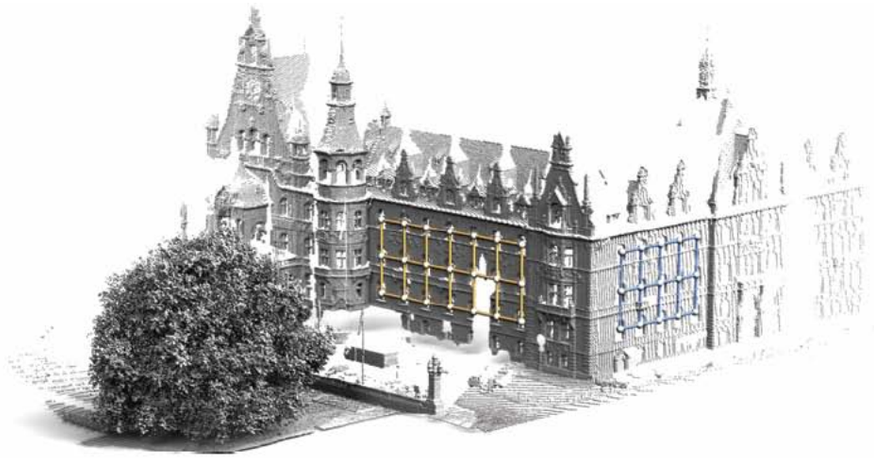
Symmetries: Exact, Approximate, Partial











Scanner Data – Challenges

"Real world data" is challenging, due to limitations in acquisition

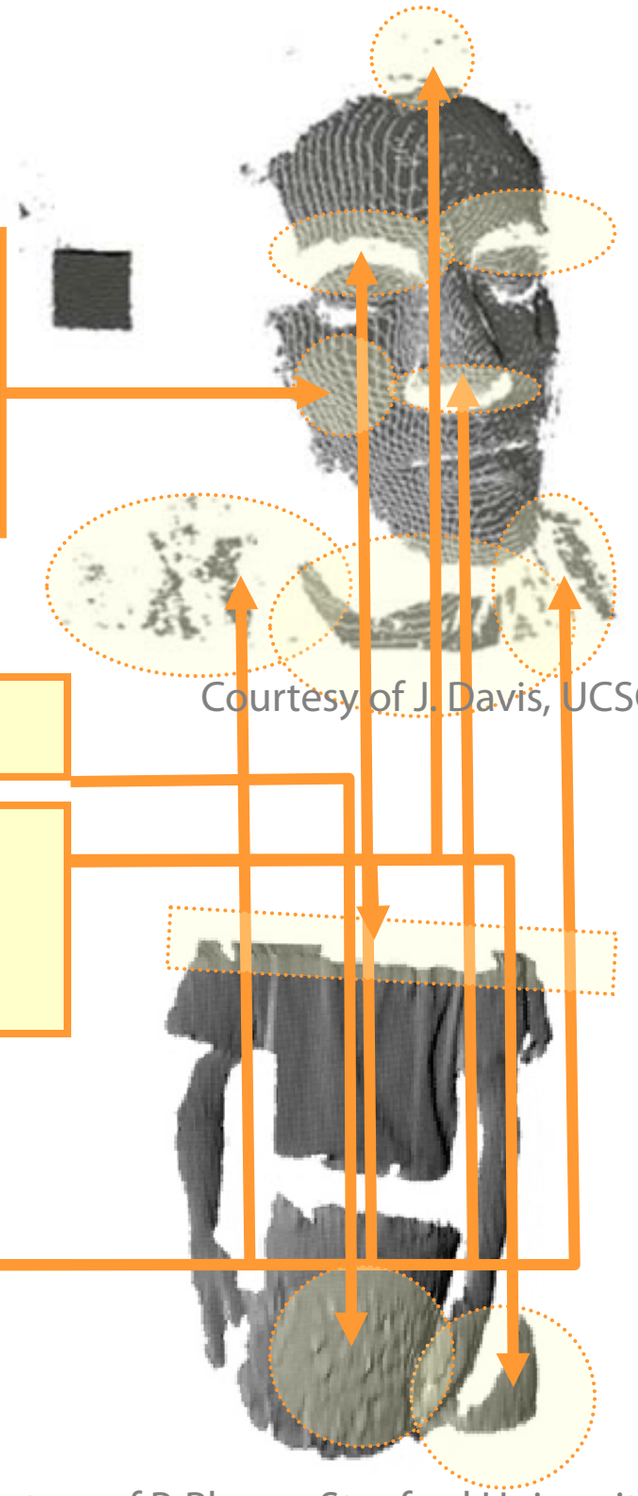
- More noise for large working volumes
- Dynamic harder than static
- Passive (e.g. stereo) less robust than active

More than just "Gaussian noise"…

Challenges

"Noise"

- "Standard" noise types:
  - Gaussian noise (analog signal processing)
  - Quantization noise
- More problematic: structured noise
  - Spatio-temporal correllations
  - Structured outliers
  - Reflective / transparent surfaces
- Incomplete Acquisition
  - Missing parts
  - Topological noise



Courtesy of J. Davis, UCSC

Courtesy of P. Phong, Stanford University

Correspondence Problem Classification

How many meshes?

- Two: Pairwise registration
- More than two: multi-view registration

Initial registration available?

- Yes: Local optimization methods
- No: Global methods

Class of transformations?

- Rotation and translation: Rigid-body
- Non-rigid deformations

Today We Will Explore...

Pairwise, local registration

- Rigid, non-rigid

Animations

- Many meshes, but (trivial) initial guess available

Global registration

- Rigid, non-rigid

Symmetry

- Special case: align mesh to transformation of itself
- Rigid, non-rigid