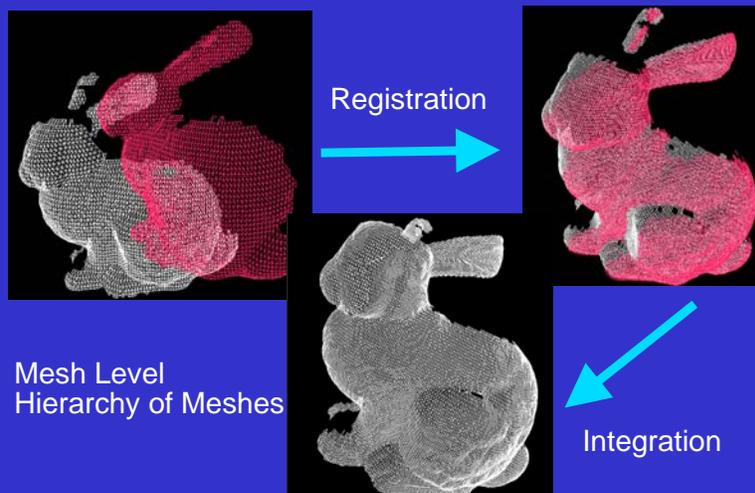## Outline

Registration (Zippered Polygon Meshes)
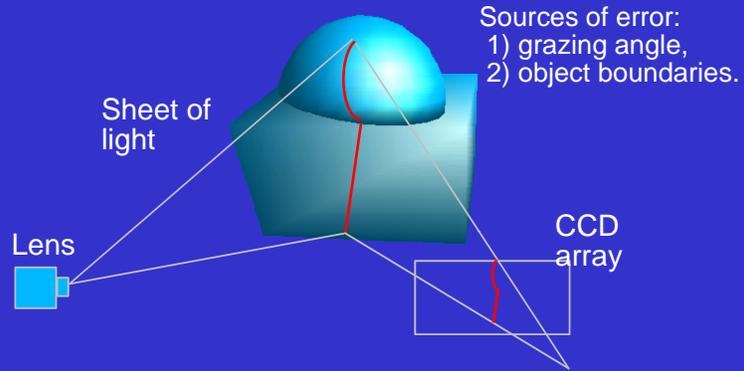
Outer surface defines enclosing volume (Zippered Polygon Meshes)

Inside volume defines outer surface (Levoy, Reed,Stamos)
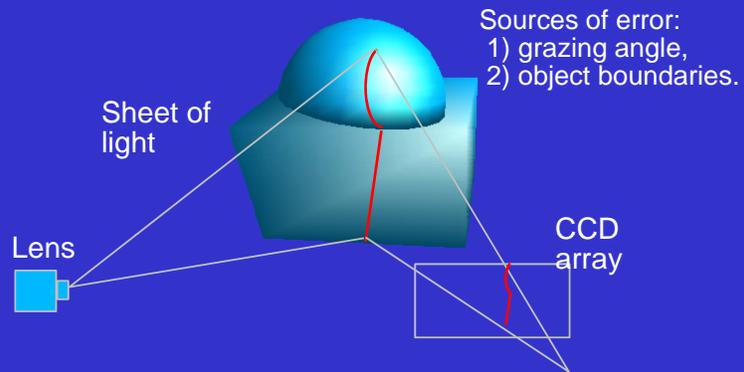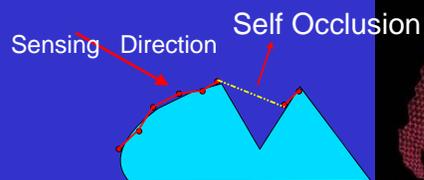
Zippered Polygon Meshes

Registration

Mesh Level
Hierarchy of Meshes

Integration

Optical Triangulation

Sheet of
light

Lens

Sources of error:
 1) grazing angle,
 2) object boundaries.

CCD
array

Optical Triangulation

Sheet of
light

Lens

Sources of error:
 1) grazing angle,
 2) object boundaries.

CCD
array

Points->Mesh

Self Occlusion

Sensing   Direction
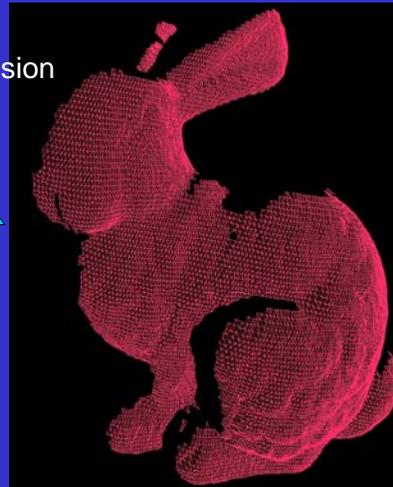
Discard long edges.
Threshold distance.
Assign confidence value to
   every vertex.

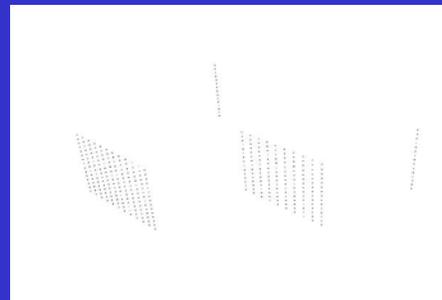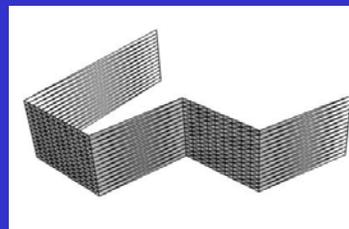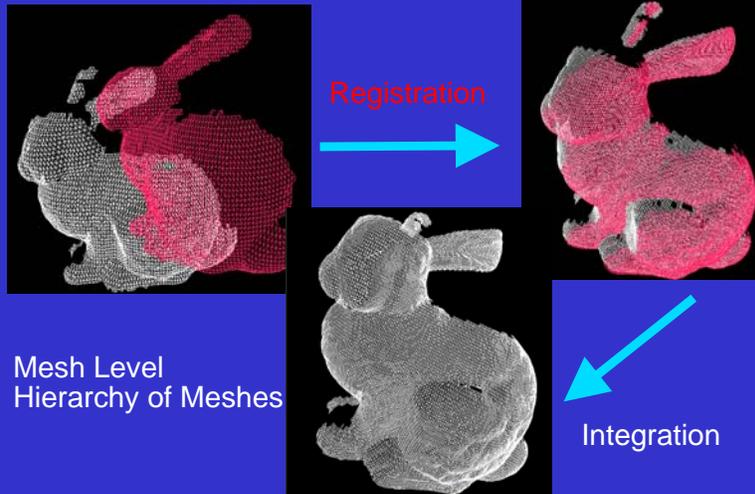# Sensor Imaging Characteristics

Range Image:
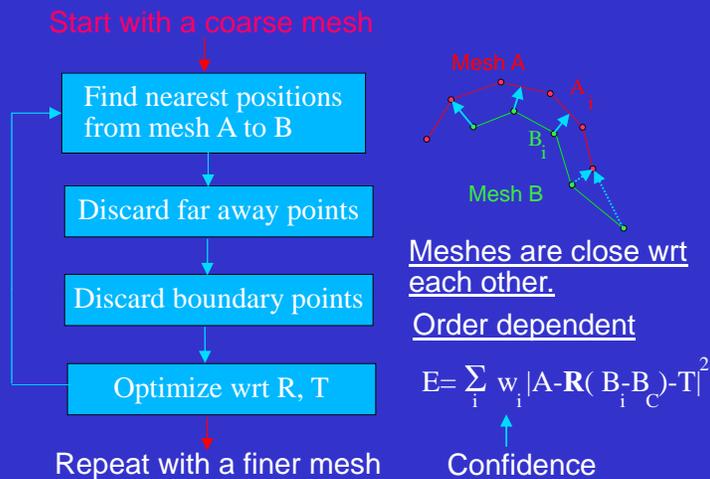
rectangular sampling

Image has structure:

surface elements

Zippered Polygon Meshes

Registration

Mesh Level
Hierarchy of Meshes

Integration

ICP Registration (Besl & McKay PAMI 92)

Start with a coarse mesh

Find nearest positions
from mesh A to B

Discard far away points

Discard boundary points

Optimize wrt R, T

Repeat with a finer mesh

Mesh A

A_i

B_i

Mesh B

Meshes are close wrt each other.

Order dependent

$$E= \sum_i w_i |A - R(B_i - B_C) - T|^2$$

Confidence

Horn

$$E = \sum_i w_i |A - \mathbf{R}(B_i - B_C) - T|^2$$

Zippered Polygon Meshes

Registration

Remove redundancy
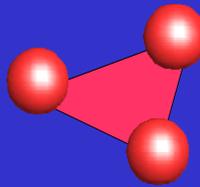
Merge boundaries

Consensus Geometry

Integration
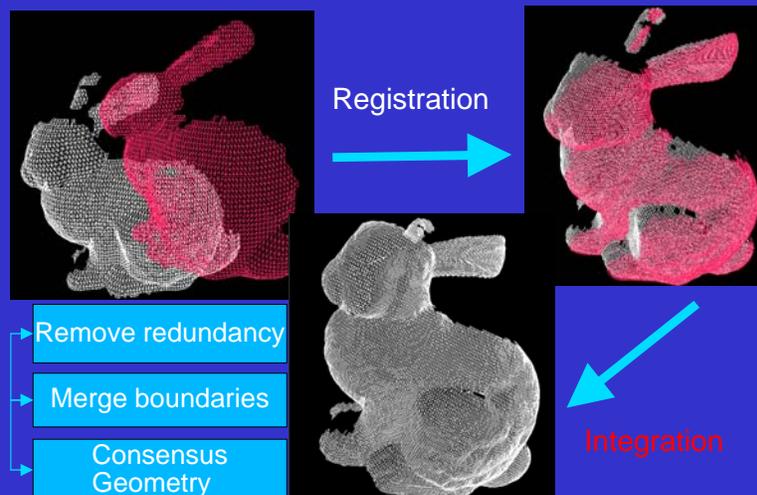
Removing Redundant Triangles

Remove redundant triangles on the boundary of mesh A	→	Remove redundant triangles on the boundary of mesh B

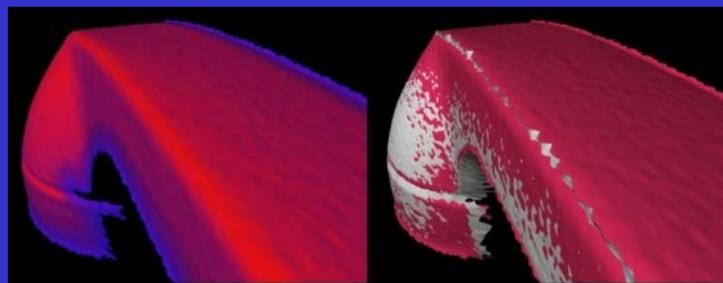Until both meshes remain unchanged

Search regions for points in B

Take into account confidence

Fill tiny holes

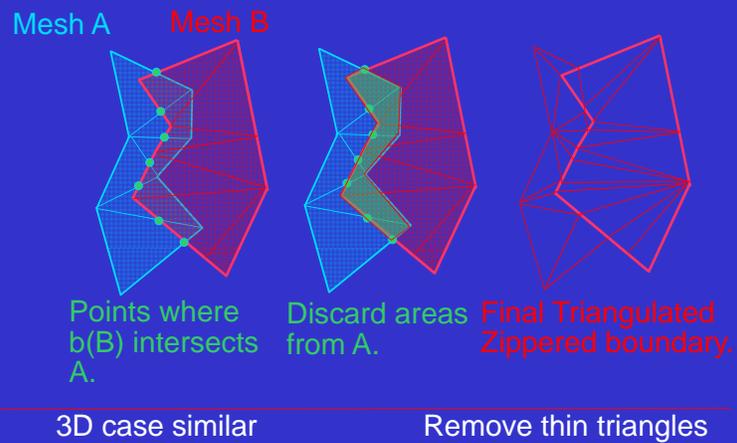T triangle on mesh boundary of A

Result

Input mesh with confidence values

Overlapping meshes
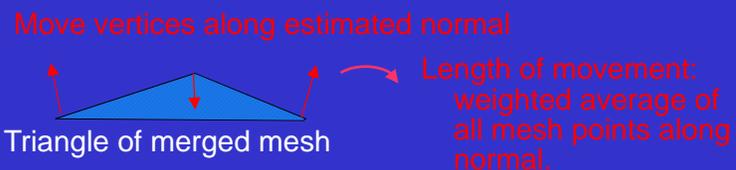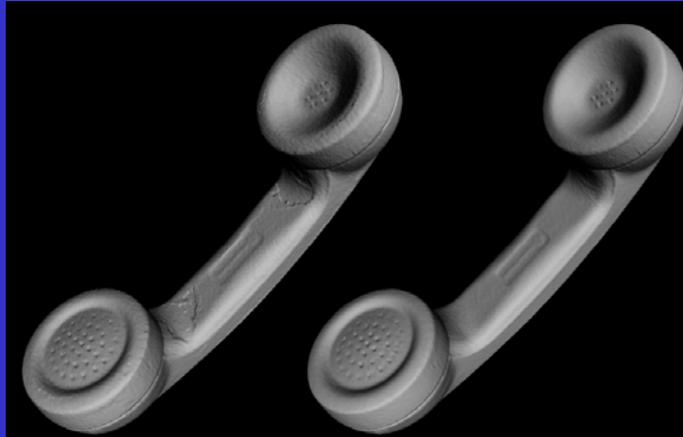
Result

Boundary Merge->Two meshes become one.

Mesh A   Mesh B

Points where b(B) intersects A.

Discard areas from A.

Final Triangulated Zippered boundary.

3D case similar   Remove thin triangles

Consensus Geometry

Refine geometry of final mesh.

Use information from all previous meshes.

Correct each vertex of final mesh.

Move vertices along estimated normal

Triangle of merged mesh

Length of movement: weighted average of all mesh points along normal.

Result

Summary

Mesh Registration and Integration.

Takes into account range uncertainty.

Consensus geometry.

Does not guarantee hole filling.

Order dependent algorithm (undesirable).

Does not provide framework for planning.

Fails in areas of high curvature.

A big number of scans needed.