CS6101 AY2014-15

IT'S ALL ABOUT SHAPE!

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Visual Computing is supposed to be fun!

So, let's play a game…

US: airplane
UK: aeroplane

*Computer graphics by i3M®

What kind of plane is it?

*Computer graphics by i3M®

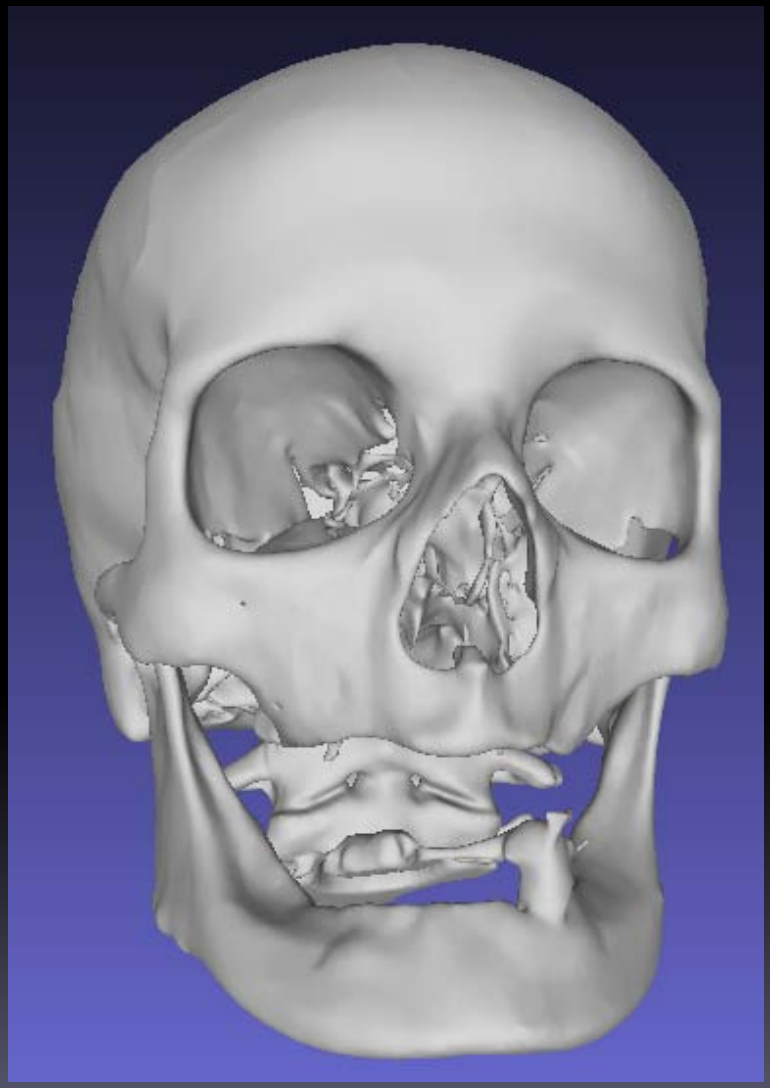
What kind of planes are these?

Shape is not about…

Shape is about…

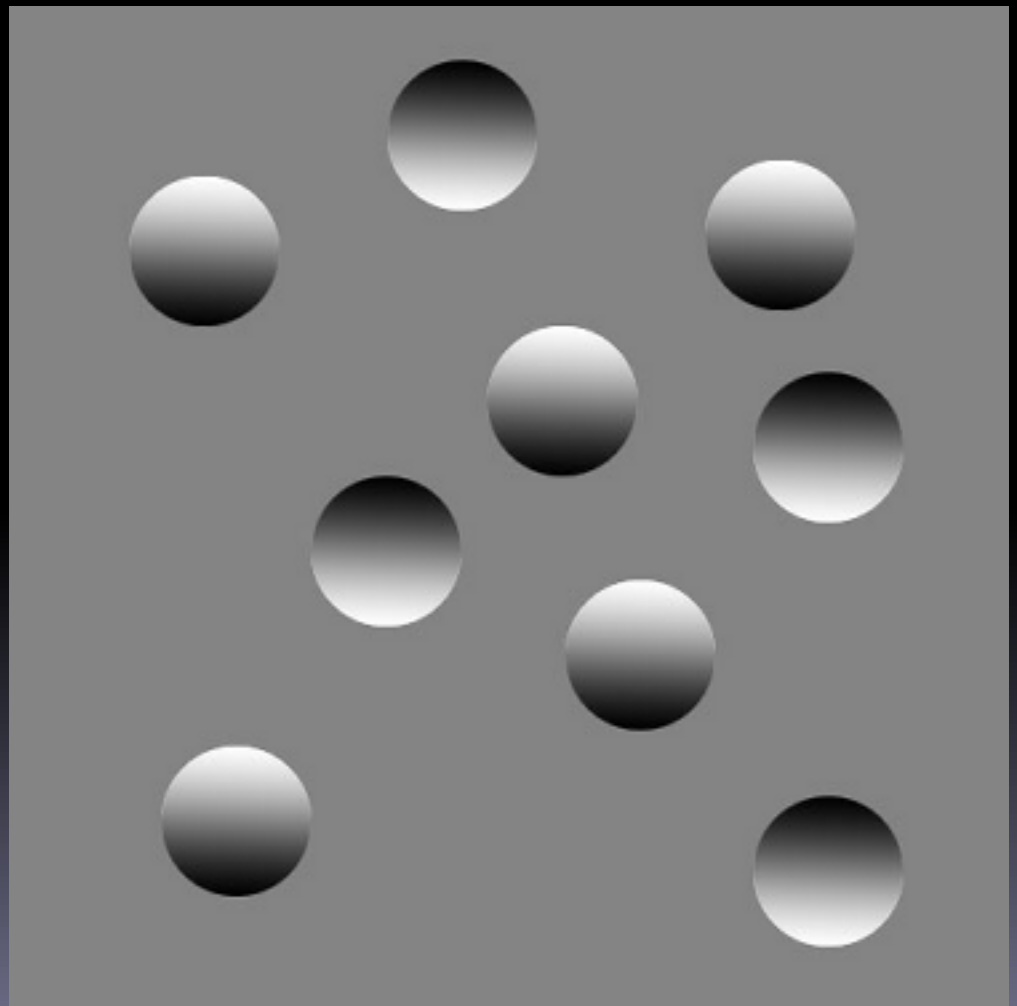
But wait…

Need shading to see 3D!



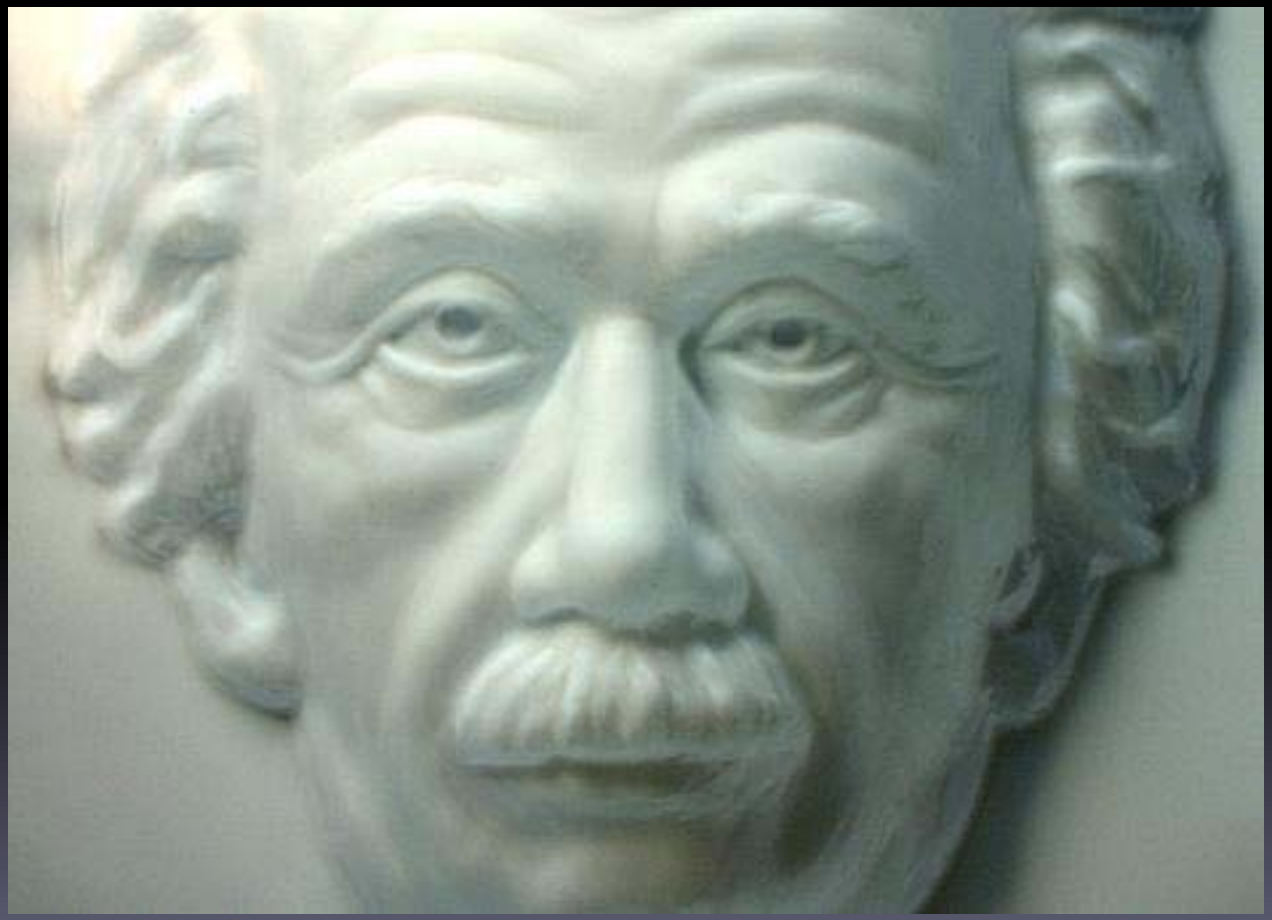
Shading is tricky…

Are these spheres convex or concave?



Shading is tricky…

How about this face?



Shading is tricky…

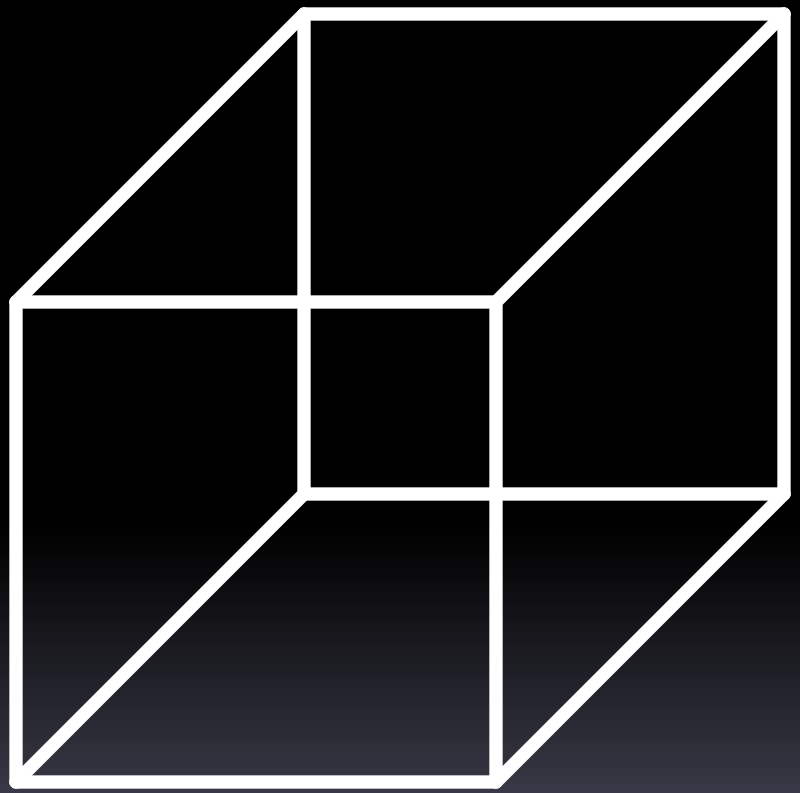
Shading doesn't have to be gray!

Shading is tricky…

Especially when it's about FACE!

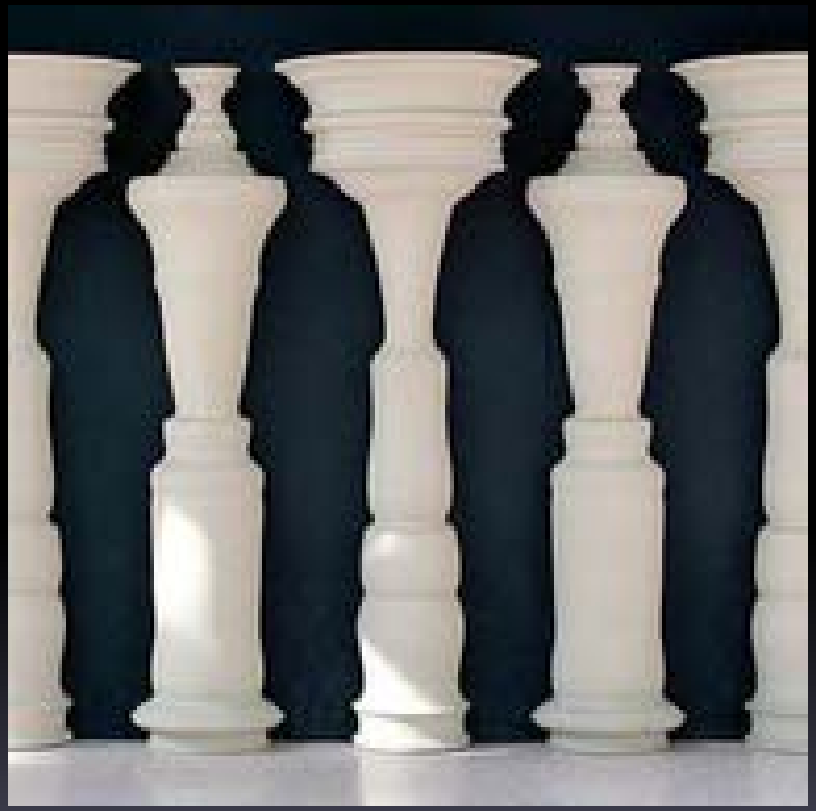
Even edges can be tricky!

Is it facing down or up?



Even edges can be tricky!

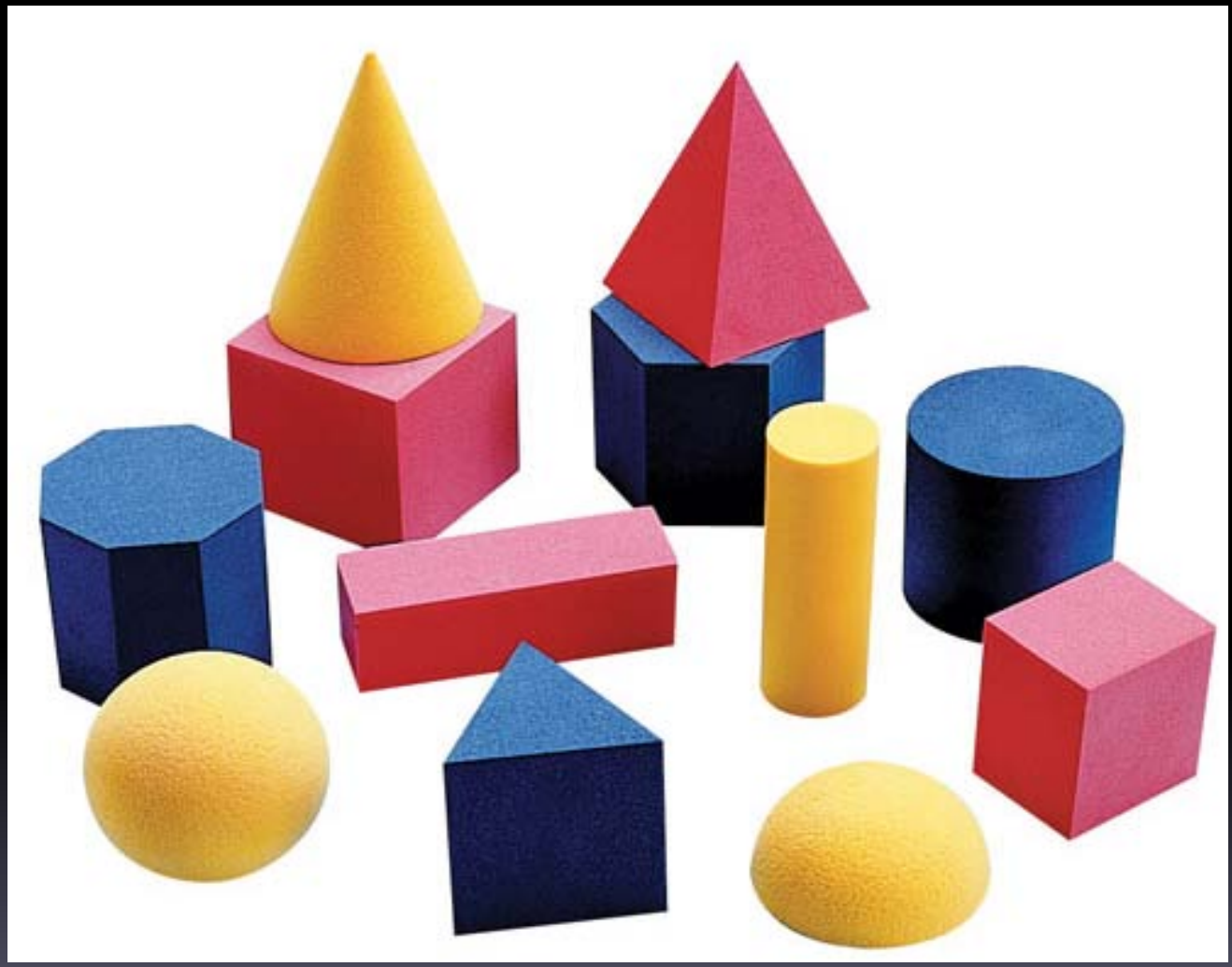
Chess pieces or human figures?



Shape analysis is very challenging!

How to represent shapes?

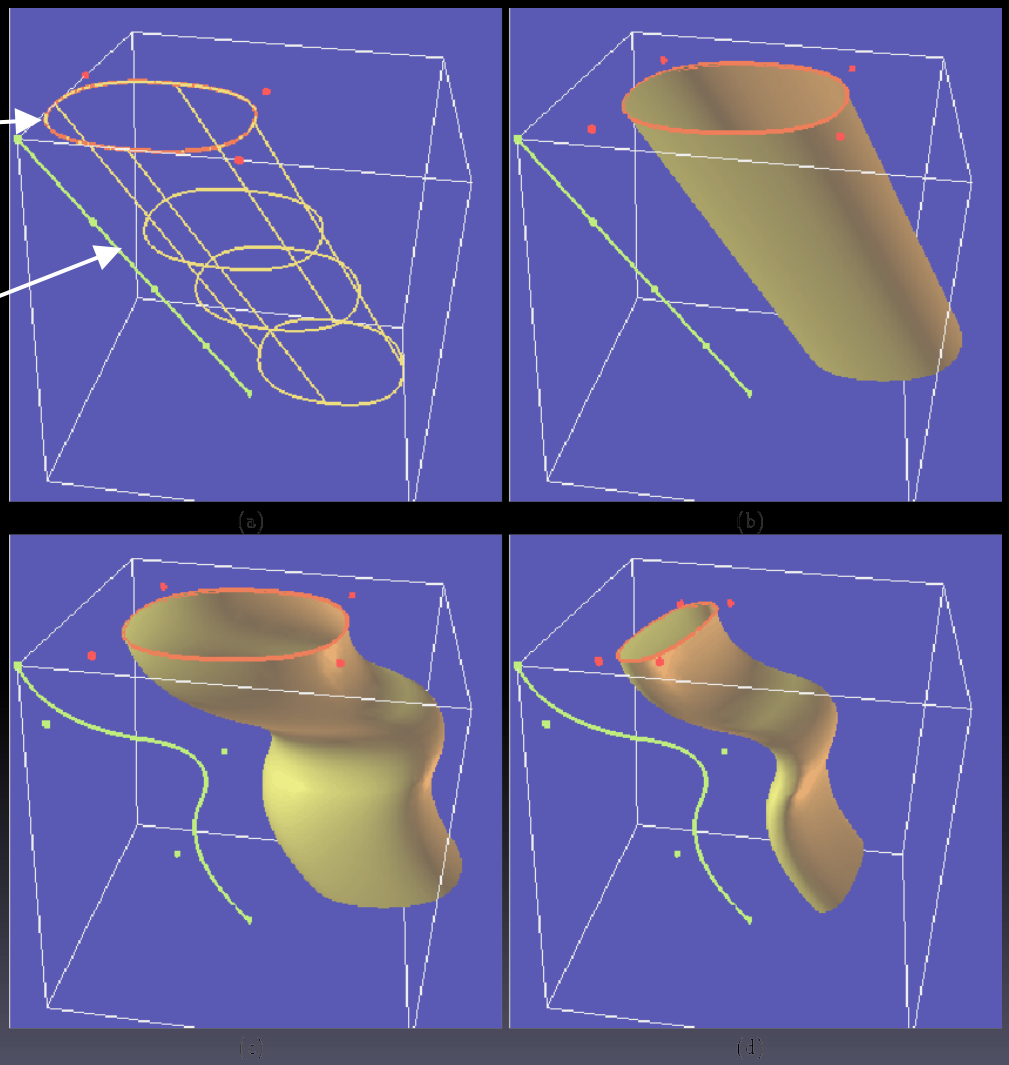
Geometric Primitives



Generalised Cylinder

cross section

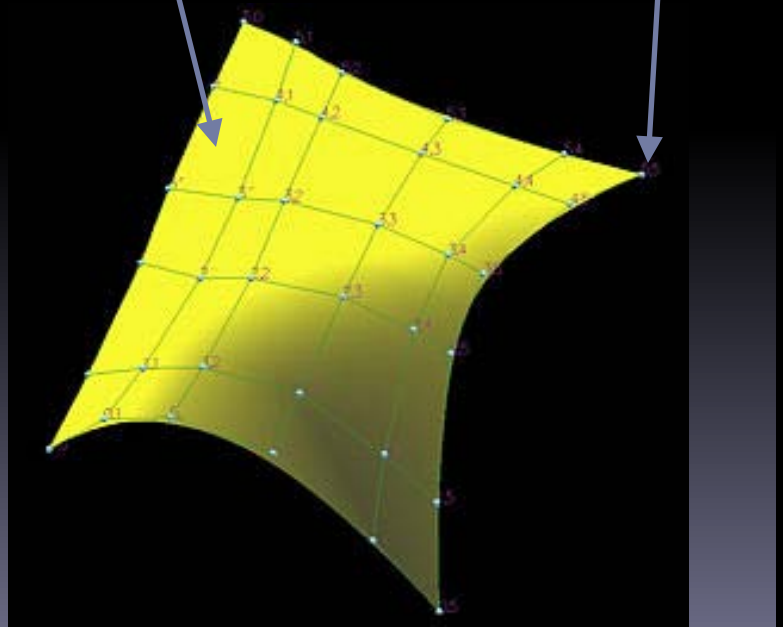
axis

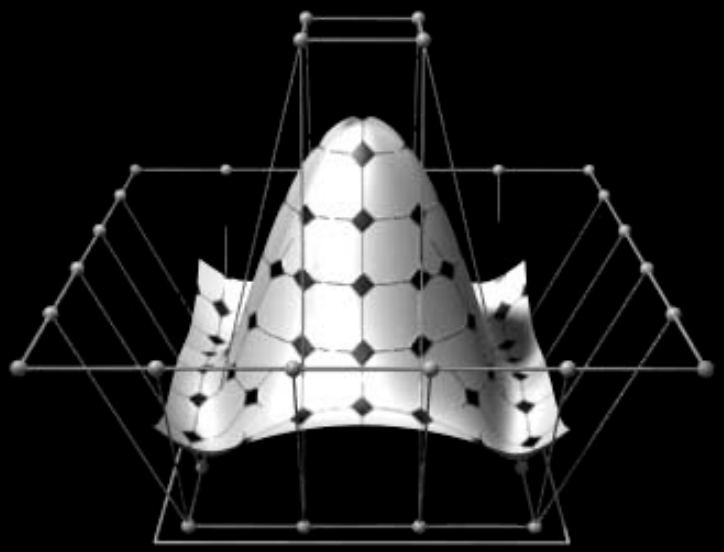


Parametric Models

- Use parametric equations: polynomial, Bézier, B-Spline, NURBS
- General form:

$$\mathbf{p}(u,v) = \sum_{i,j} K_{ij}(u,v)\mathbf{p}_{ij}$$

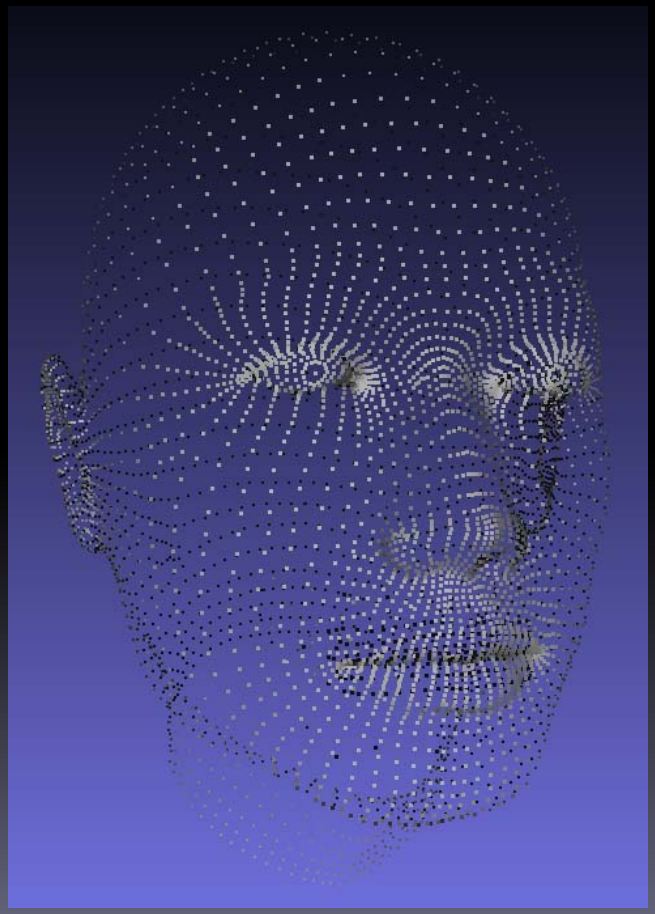




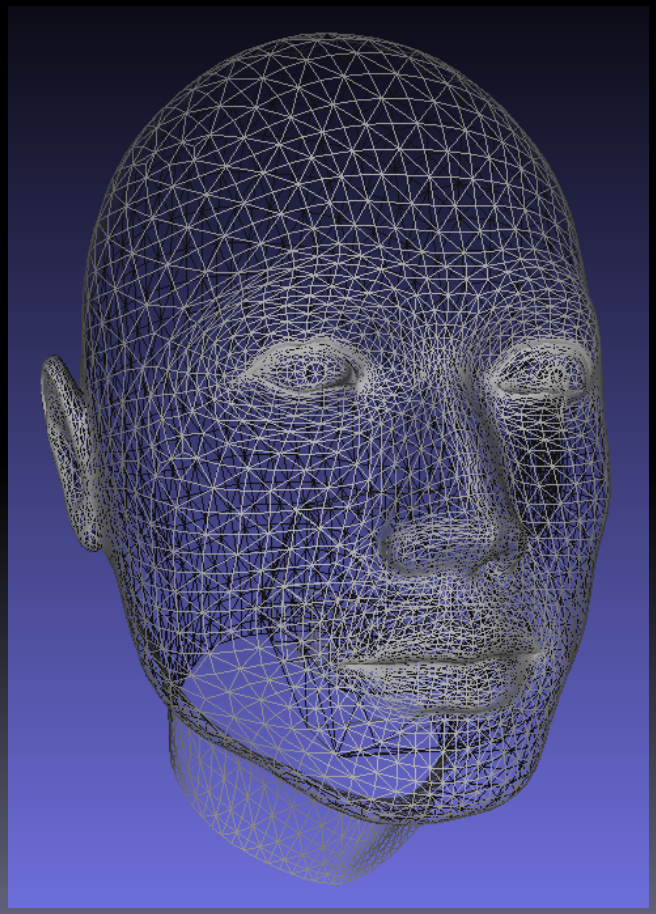
Mesh Model

- Connect points into triangles or polygons

points / vertices

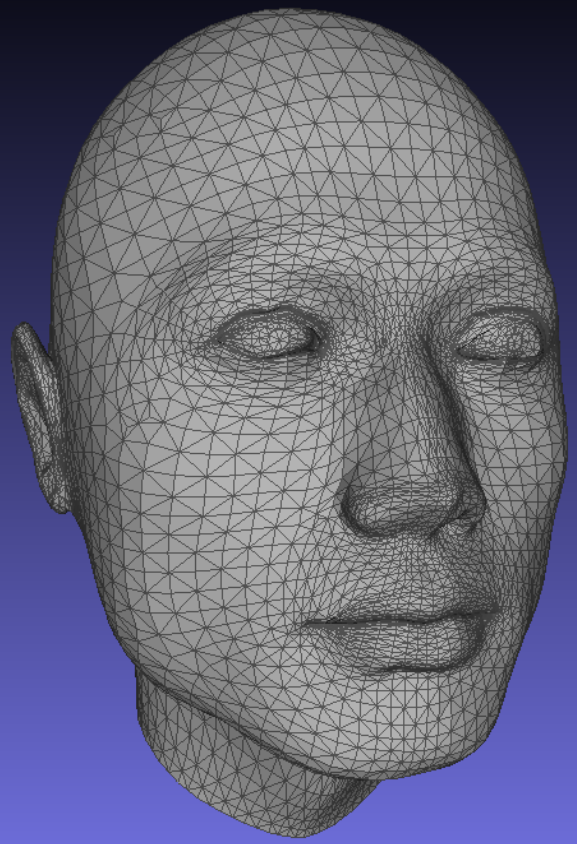


lines / edges

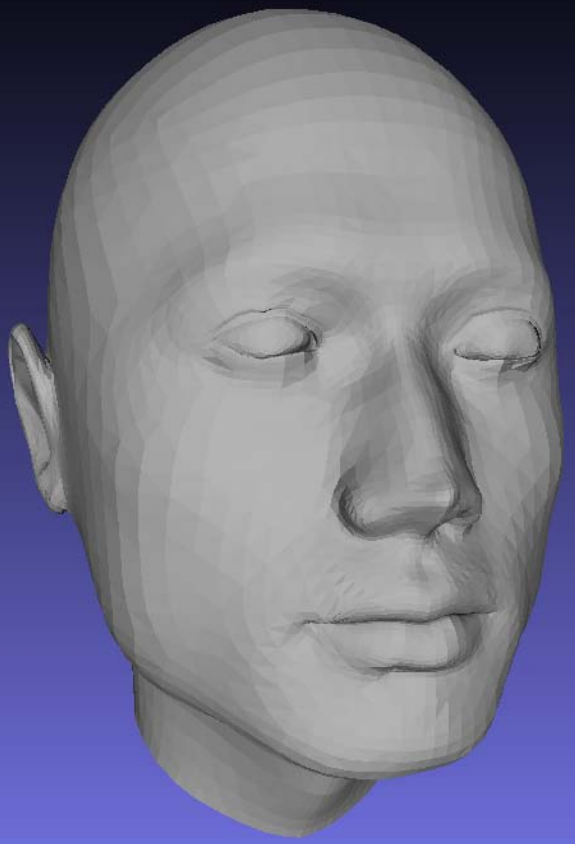


Mesh Model

lines with shading



shading

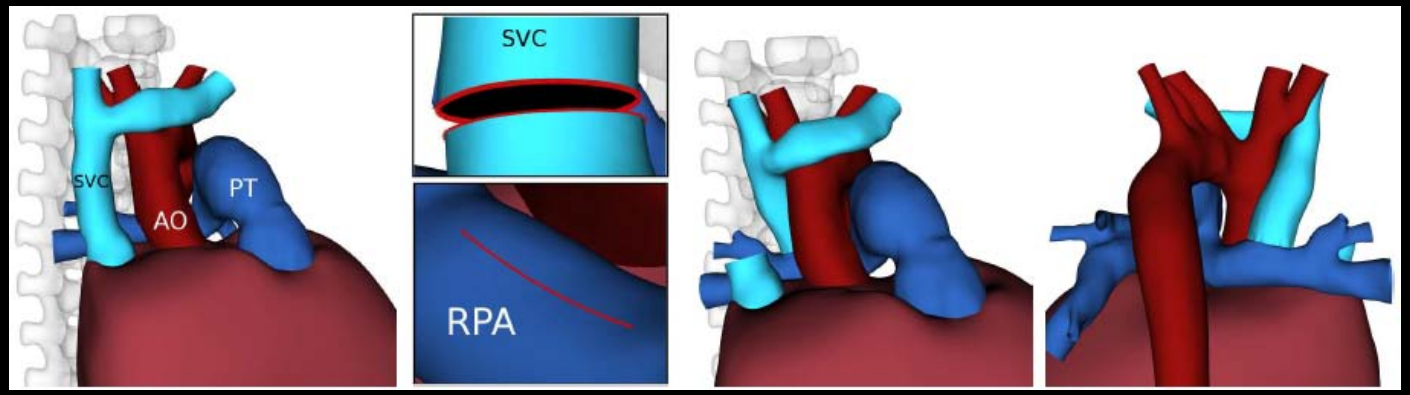


smooth shading

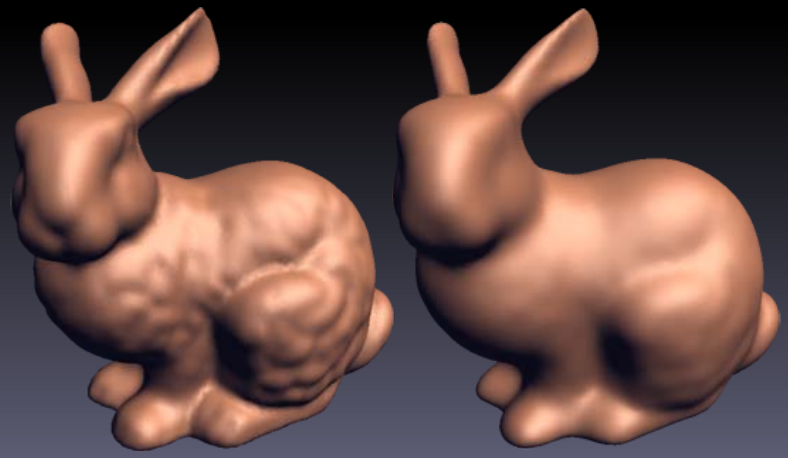
What to do with shapes?

Shape Processing

- Cutting, merging, hole-filling

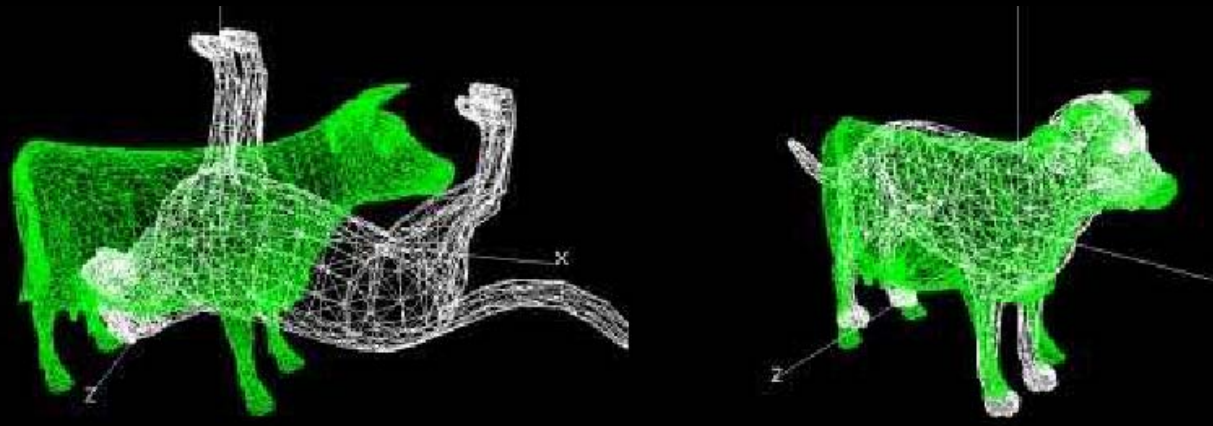


- Remeshing, up-/down-sampling, smoothing

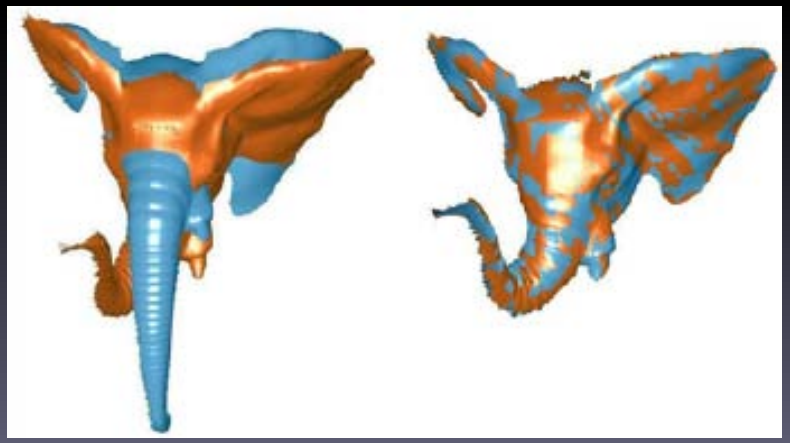


Shape Registration

- Rigid registration: size, position, orientation

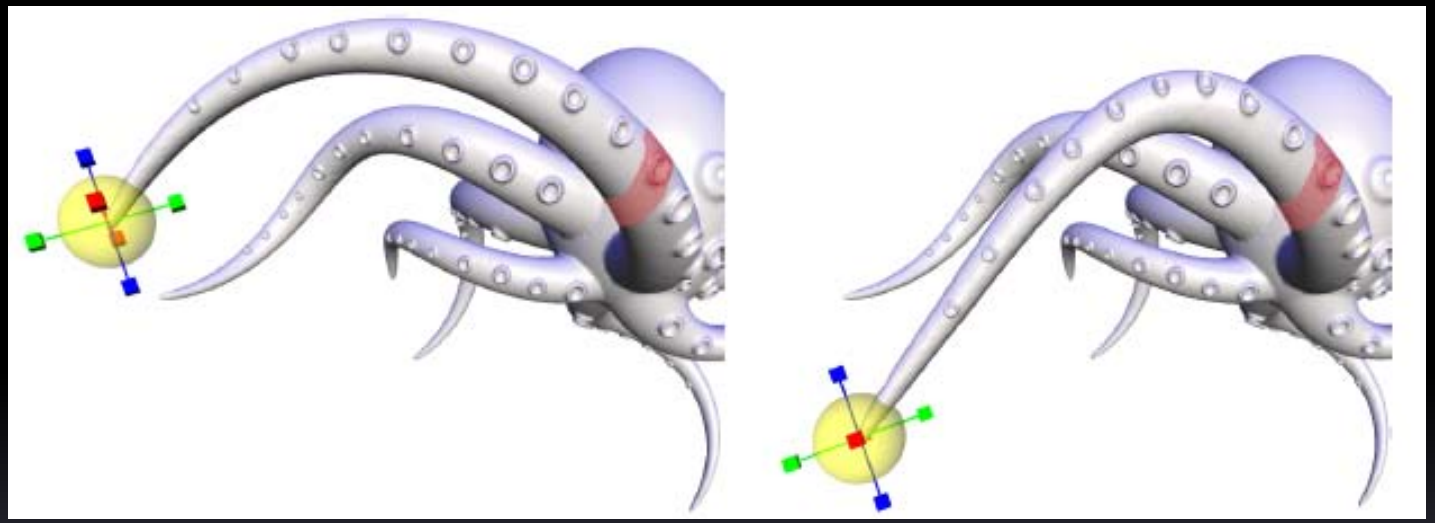


- Non-rigid registration: change shape



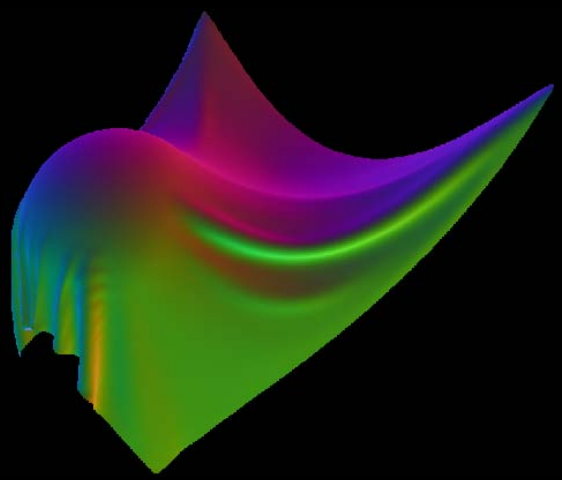
Shape Deformation

- Non-physically-based
  - Free-form deformation
  - Laplacian deformation

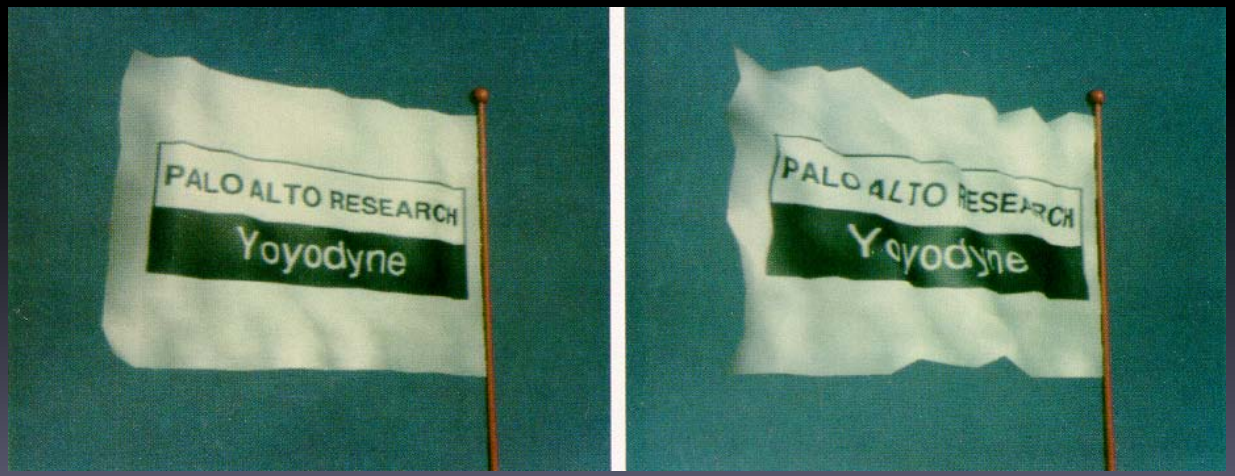


Shape Deformation

- Physically-based
  - Mass-spring model

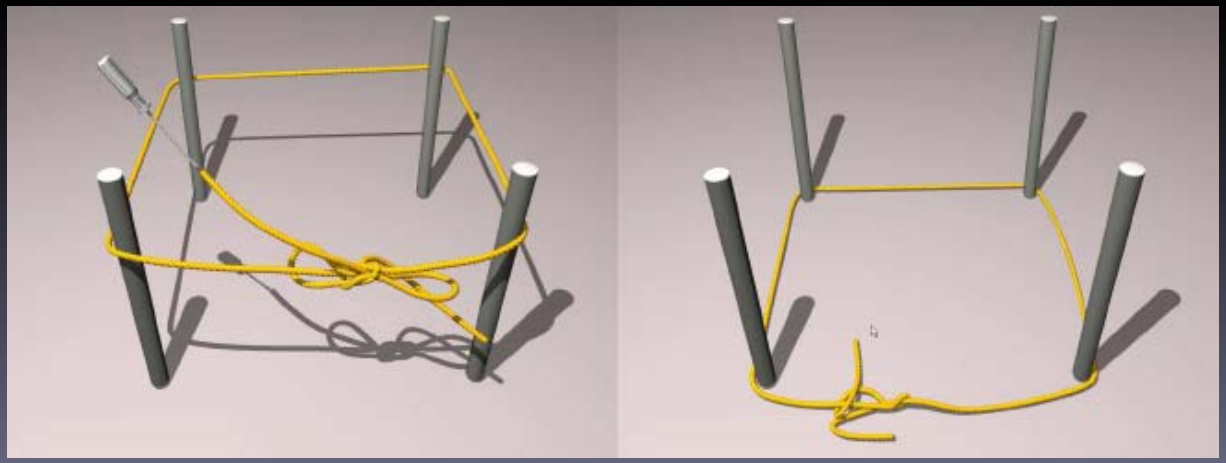


  - Thin-Plate Spline



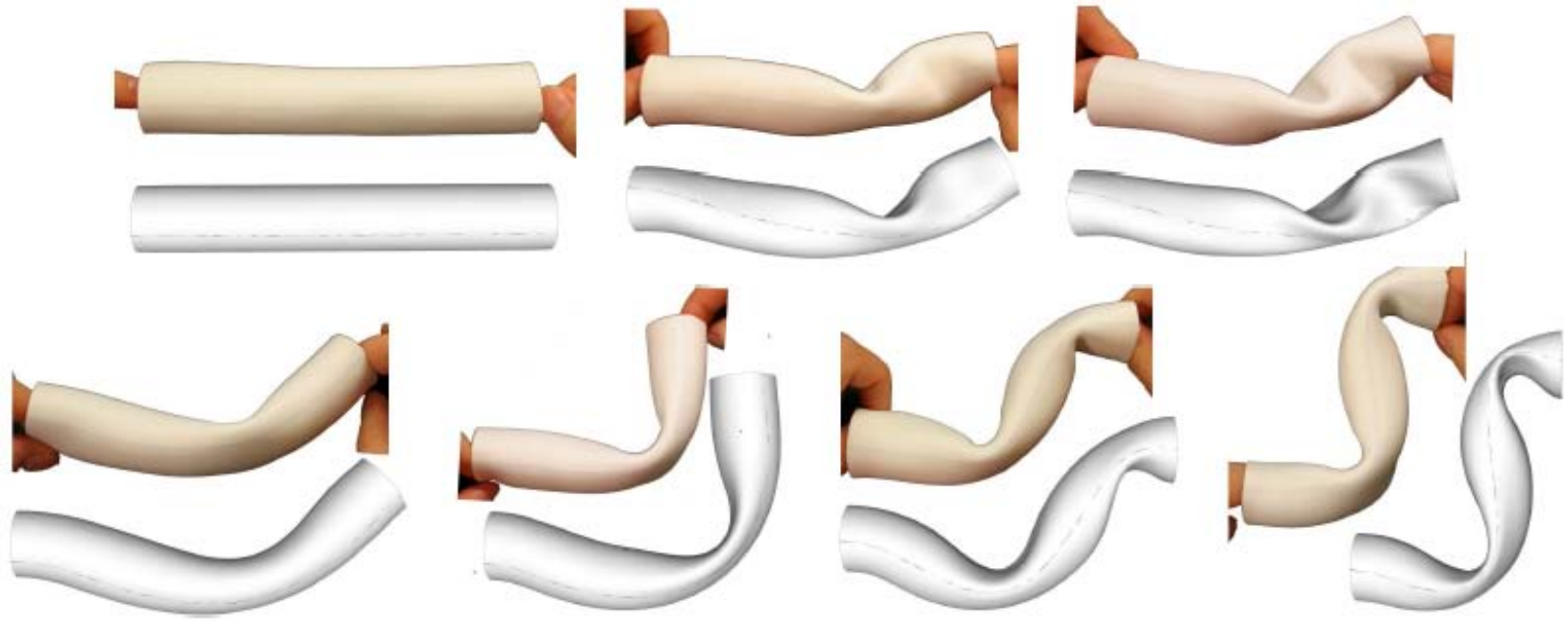
Shape Deformation

- Physically-based
  - Cosserat rod: very thin solid rod



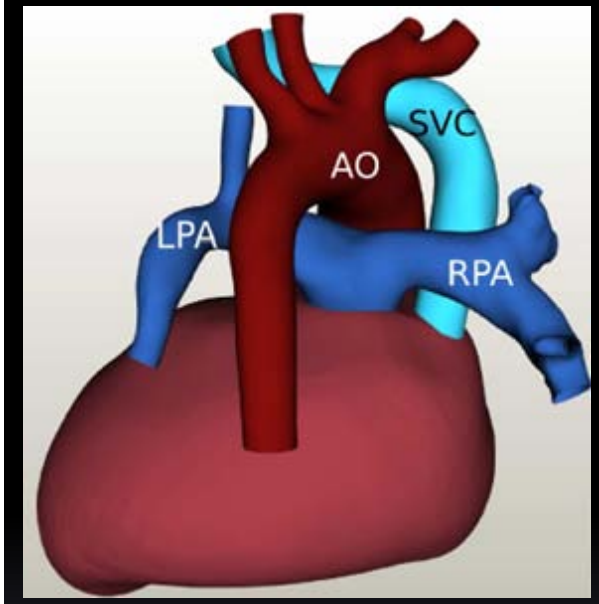
Shape Deformation

- Physically-based
  - Cosserat rod + thin shell: hollow tube

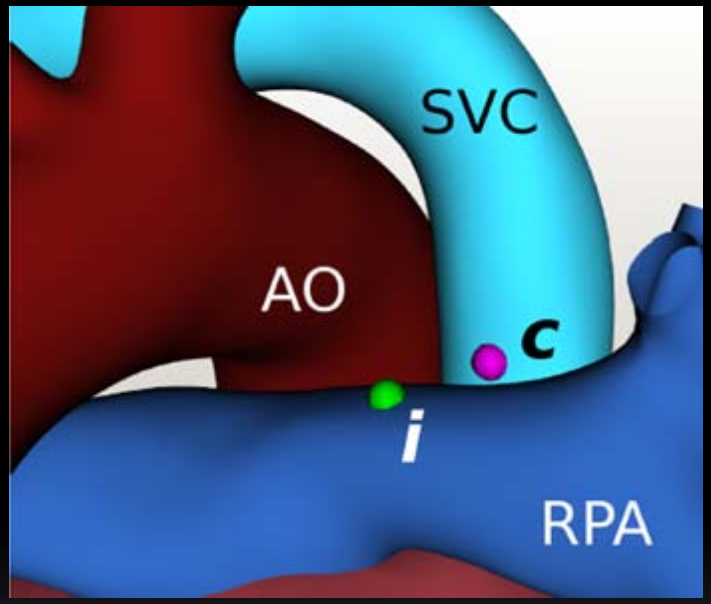


Cosserat Rod + Thin Shell

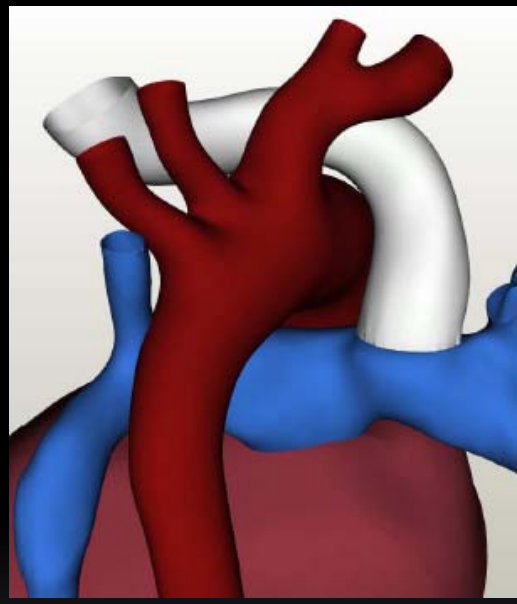
- Used for cardiovascular surgery simulation



input models



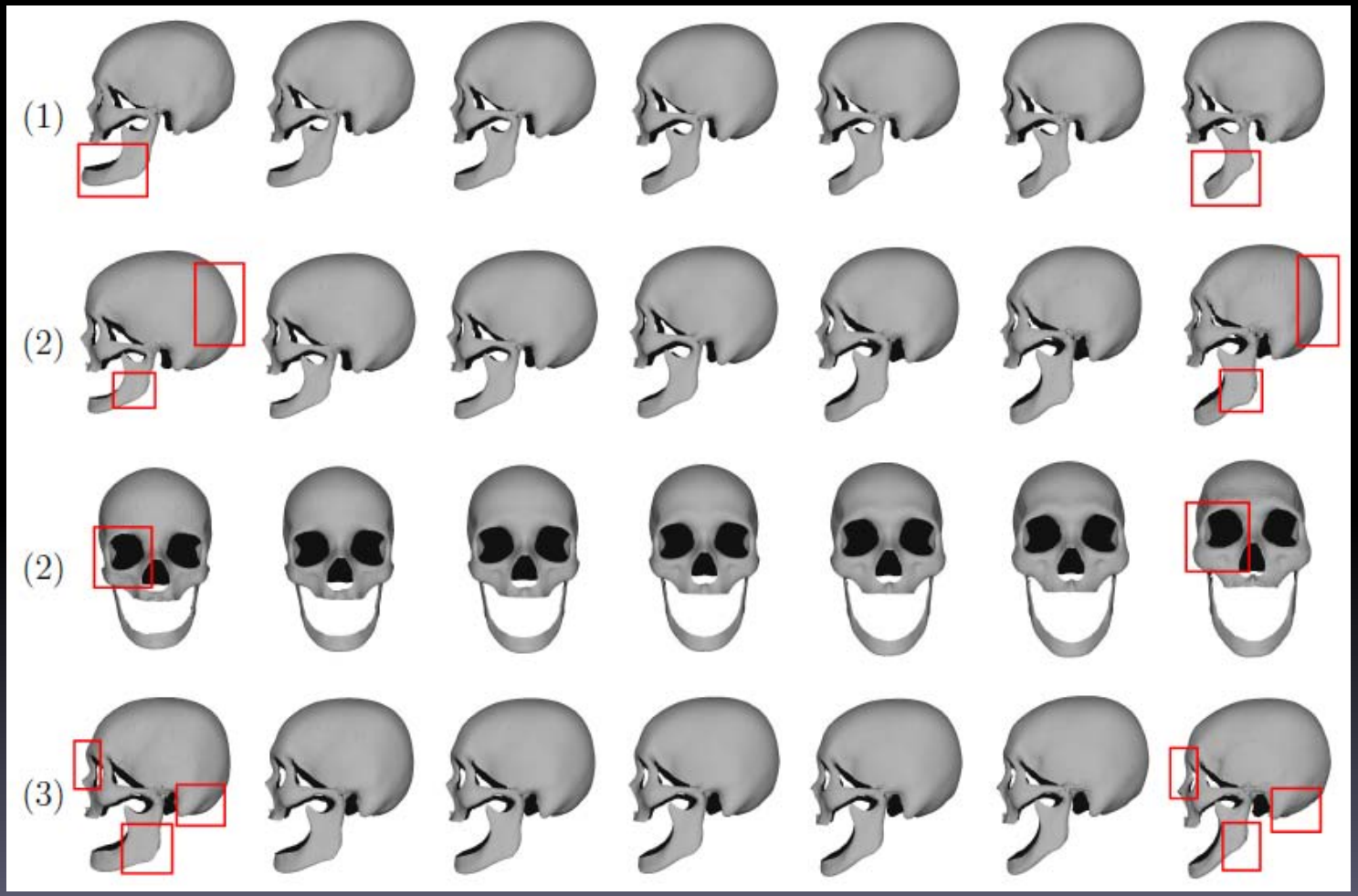
cut points



joint result

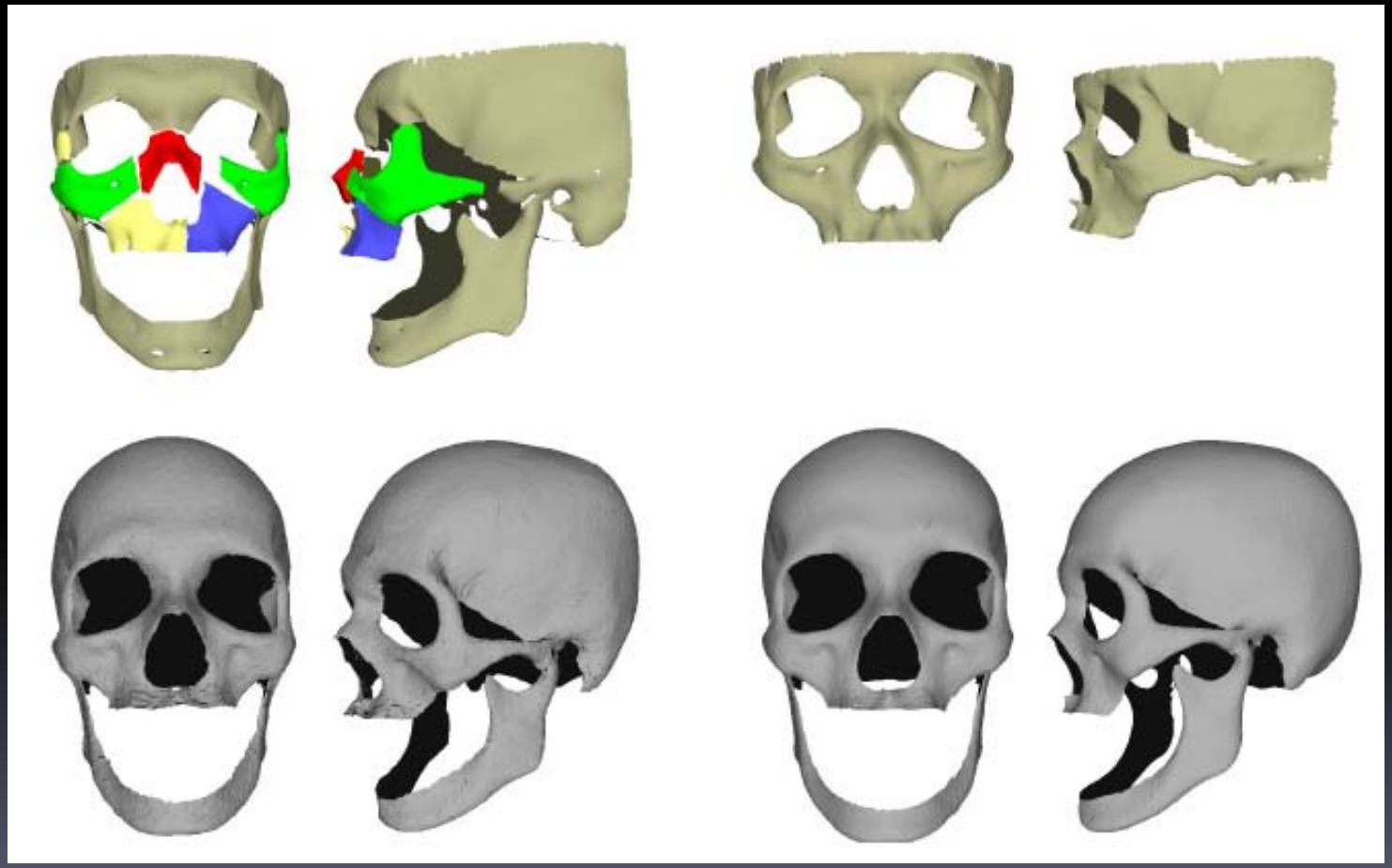
Shape Deformation

- Statistical Model: Active Shape Model



Model Completion / Reconstruction

- Reconstruct from incomplete model



Model Completion / Reconstruction

- Reconstruct from related model

Visual Substitution

- Translate visual info to tactile / audio info

Have fun with shapes!