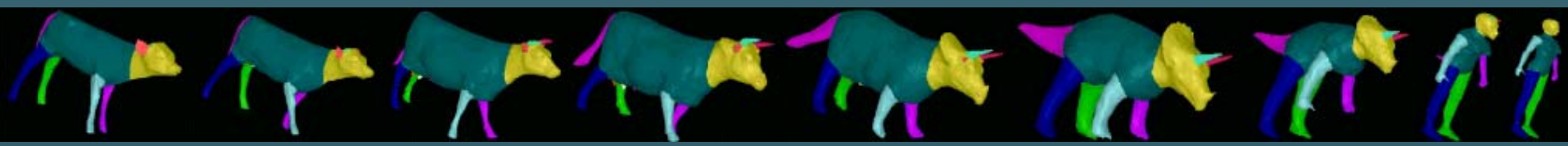
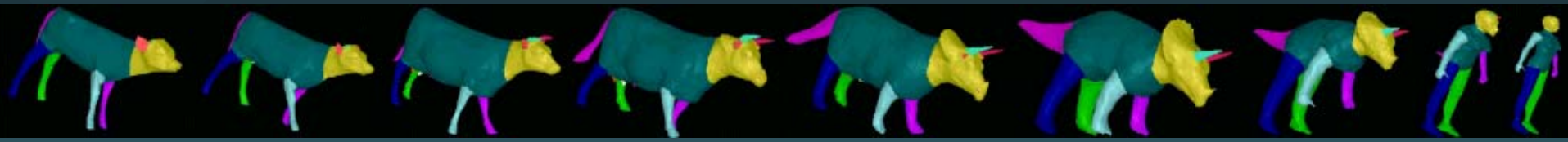
3D Object Morphing



CS5245 Vision and Graphics for Special Effects

3D Object Morphing



Metamorphosis

- Produce a sequence of intermediate objects that evolve from one to the other

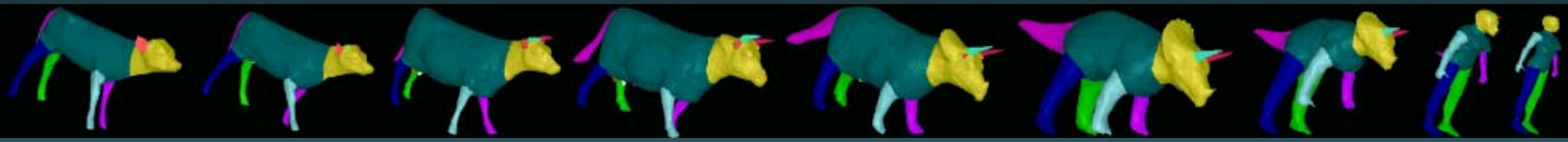
Properties

- Preserve topology, feature, & rigidity

User control

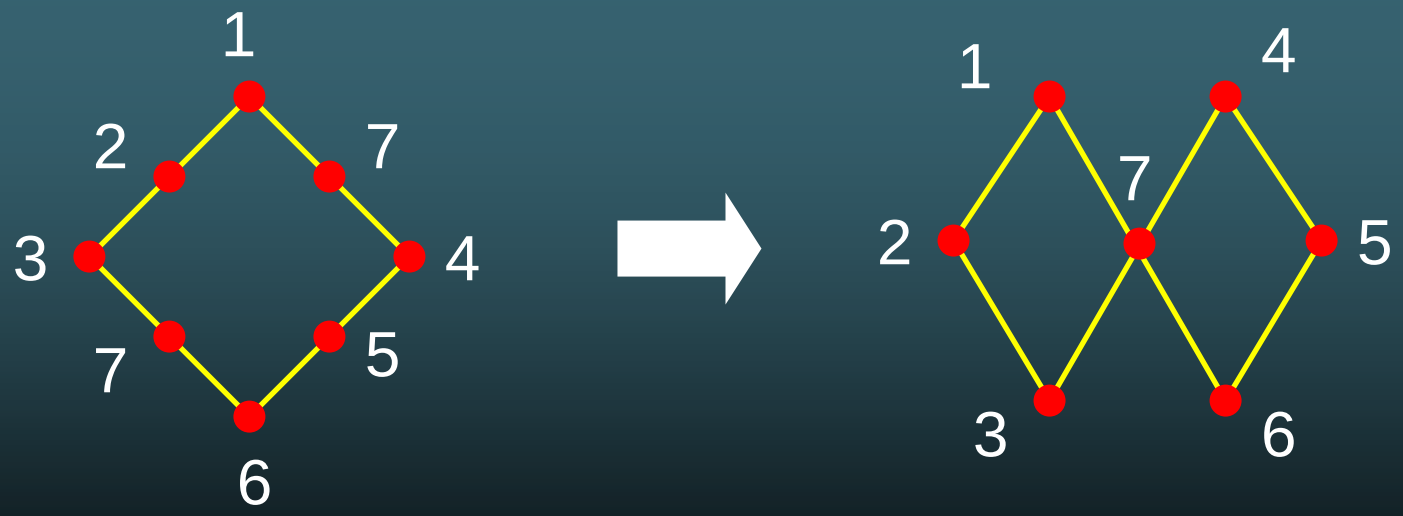
- Provide correspondence information

3D Object Morphing

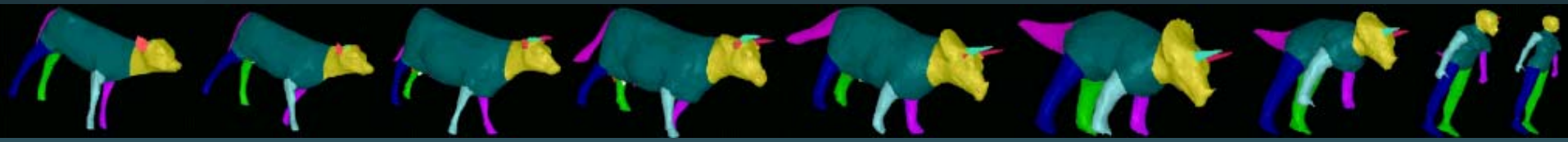


Basic Idea

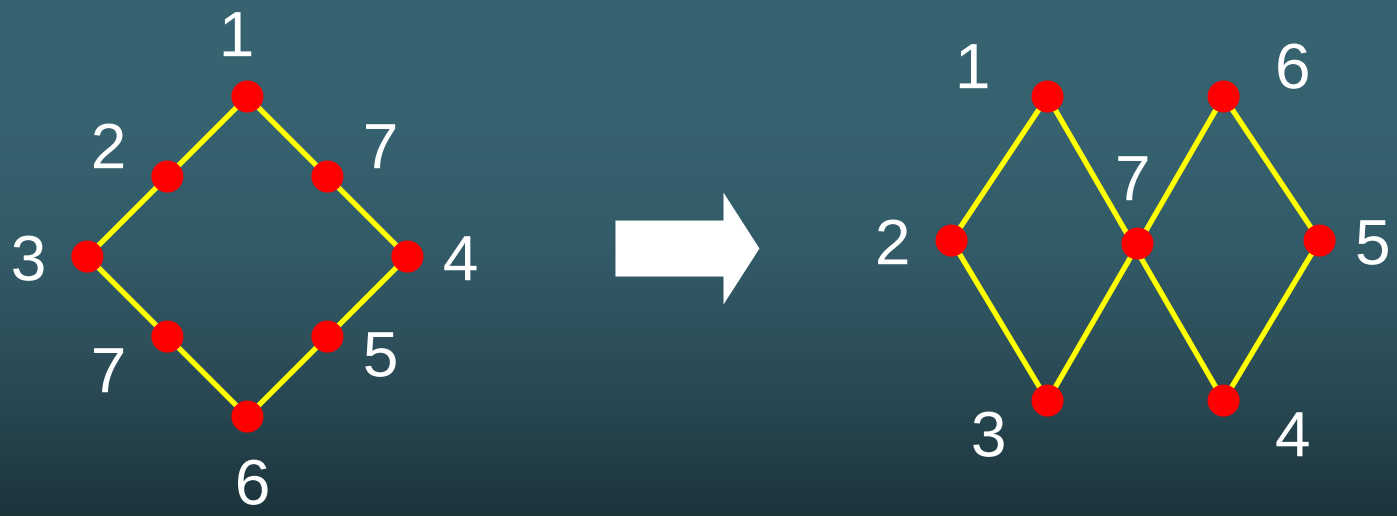
- Determine correspondence.
- Move points to corresponding position.



3D Object Morphing



- Correspondence can be arbitrarily defined.
- Want to avoid “edge crossing”.



- Intro demo: morphing planar graphs

Main Approaches

Object Representations

- Volume-base approach
- Boundary representative-based approach

Volume-based Approach

Cohen-Or, Levin, Solomovoci.

Three-dimensional distance field metamorphosis. ACM Trans. Graphics 17: 116-141.

http://www.math.tau.ac.il/~levin/

Two main stages:

- Warp: deform the 3D space to make the two objects coincide as much as possible

- Interpolation: Linear interpolate distance fields deformed by the warp

Volume-based Approach

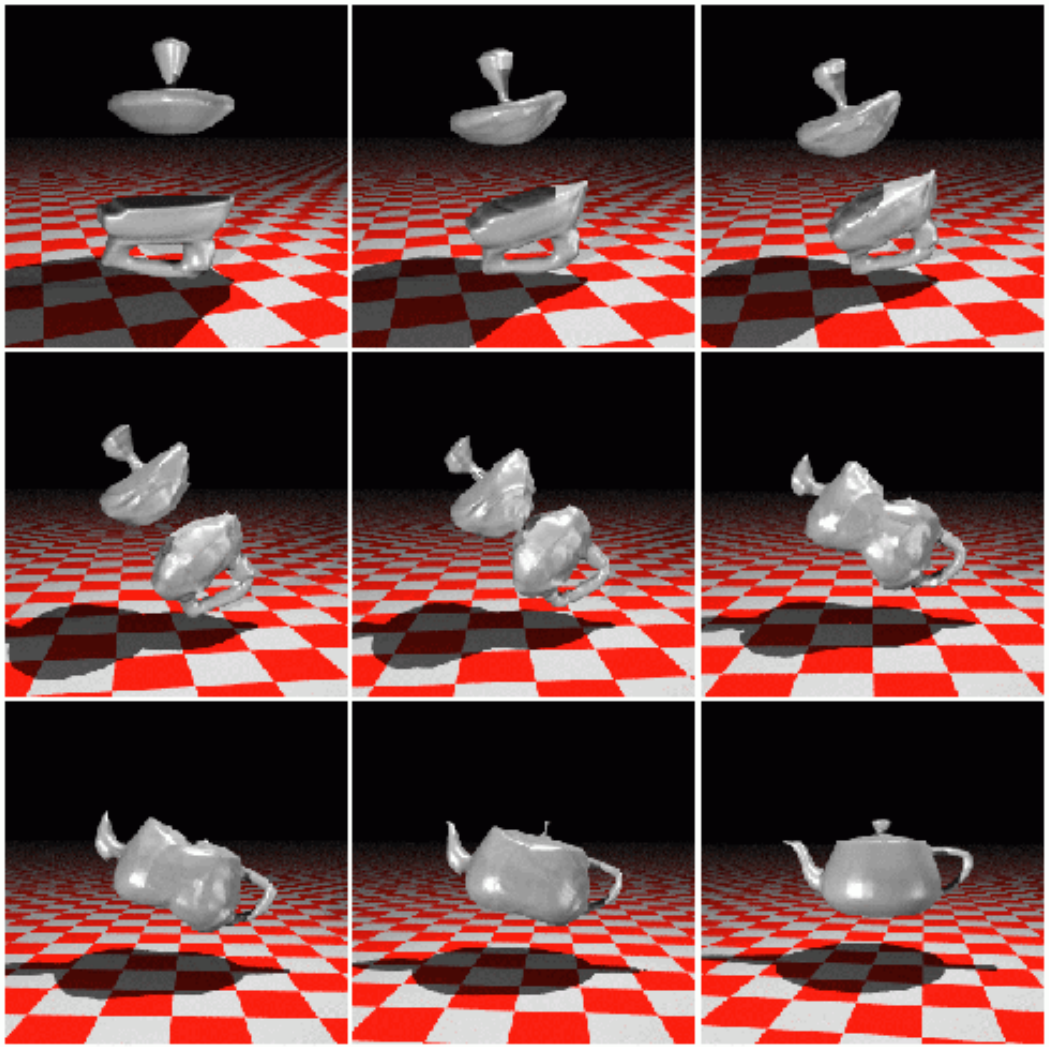


Figure 13: *3D morphing between a mushroom, an iron and a teapot. Note that the source and the target objects have a different topological genus.*

Volume-based Approach

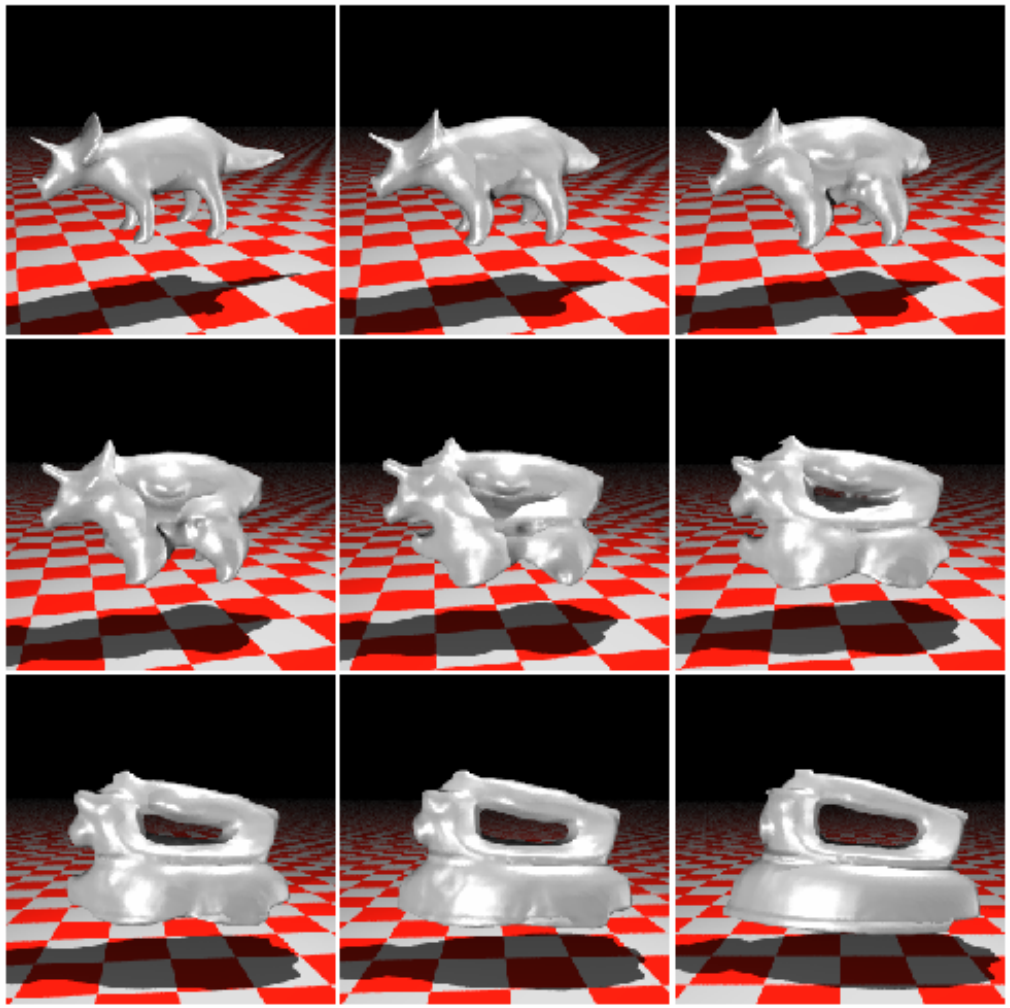


Figure 12: *3D morphing between a Triceratops and an iron. Note that only the iron object has a hole.*

B-rep-based Approach

Gregory, State, Lin, Manocha and Livingston.
Interactive surface decomposition for polyhedral morphing. The Visual Computer, 15, 1999, 453-470.
http://www.cs.unc.edu/~geom/3Dmorphing/

Two main stages:

- Correspondence: map each vertex in source to a vertex in target
- Interpolation: move a vertex to its corresponding vertex

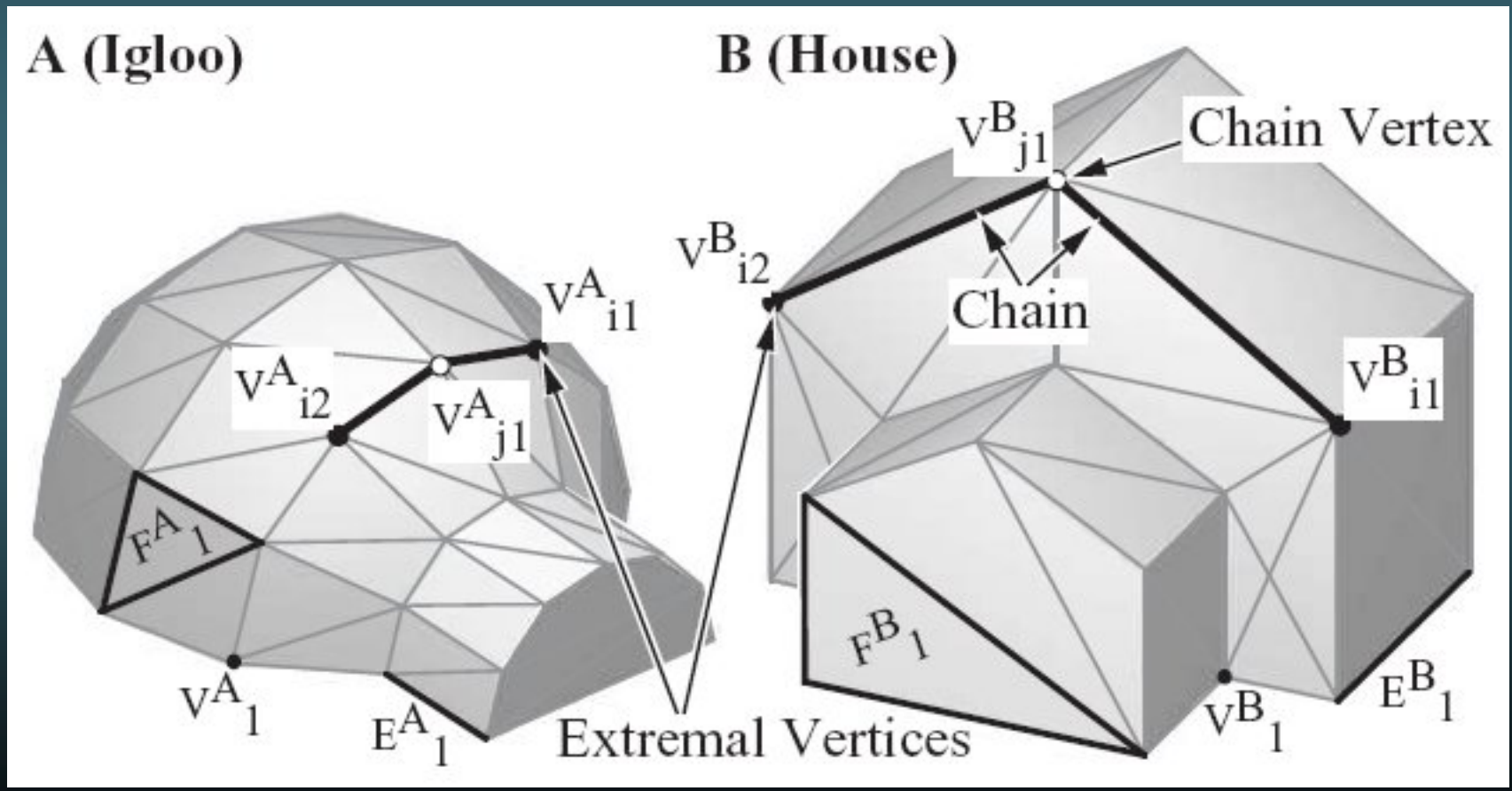
B-rep-based Approach

Main Steps:

- User specify corresponding features.
- Determine corresponding feature nets.
- Decompose objects into morphing patches.
- Map morphing patches to regular 2D polygons.
- Merge corresponding morphing patches.
- Reconstruct objects.
- Interpolate objects.

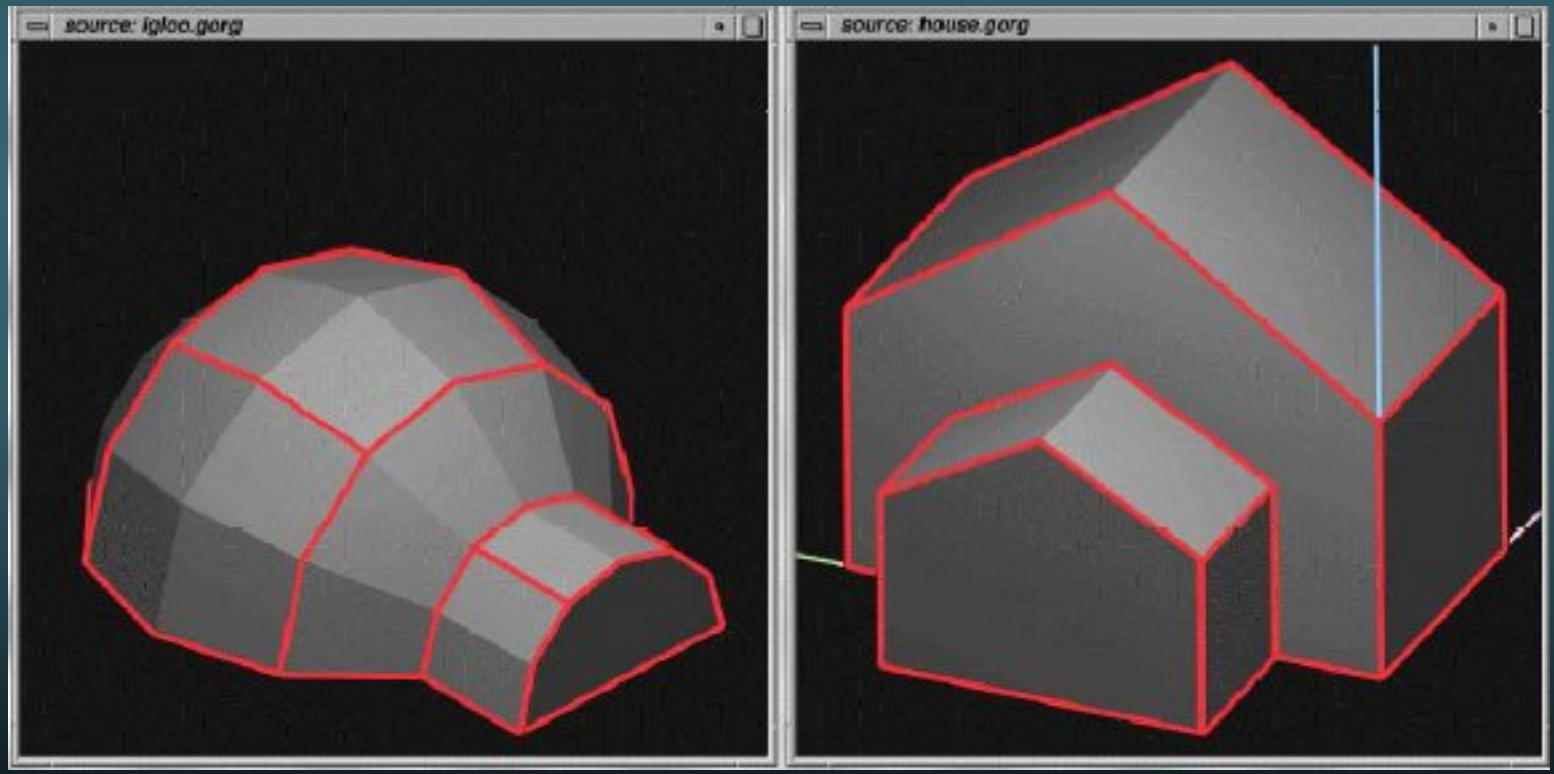
B-rep-based Approach

User specify corresponding features.



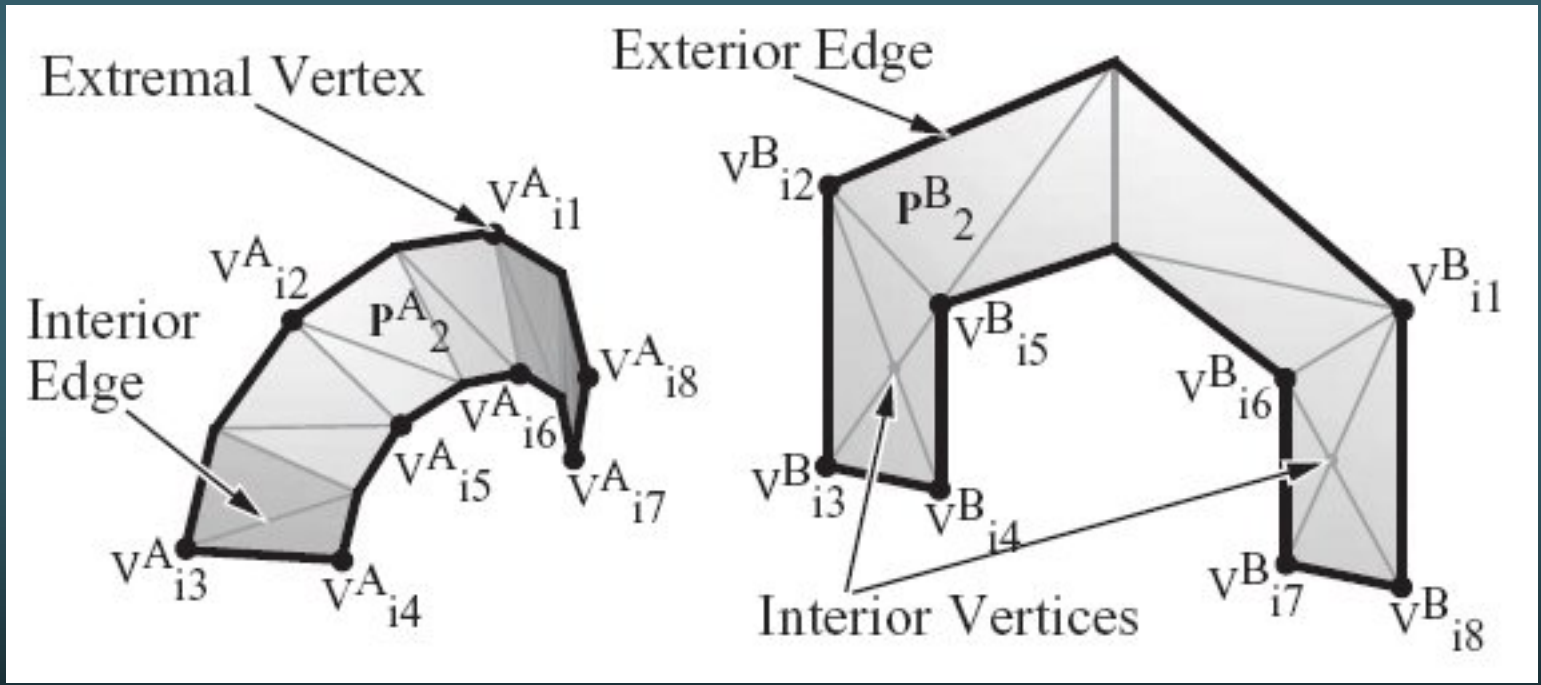
B-rep-based Approach

Determine corresponding feature nets.



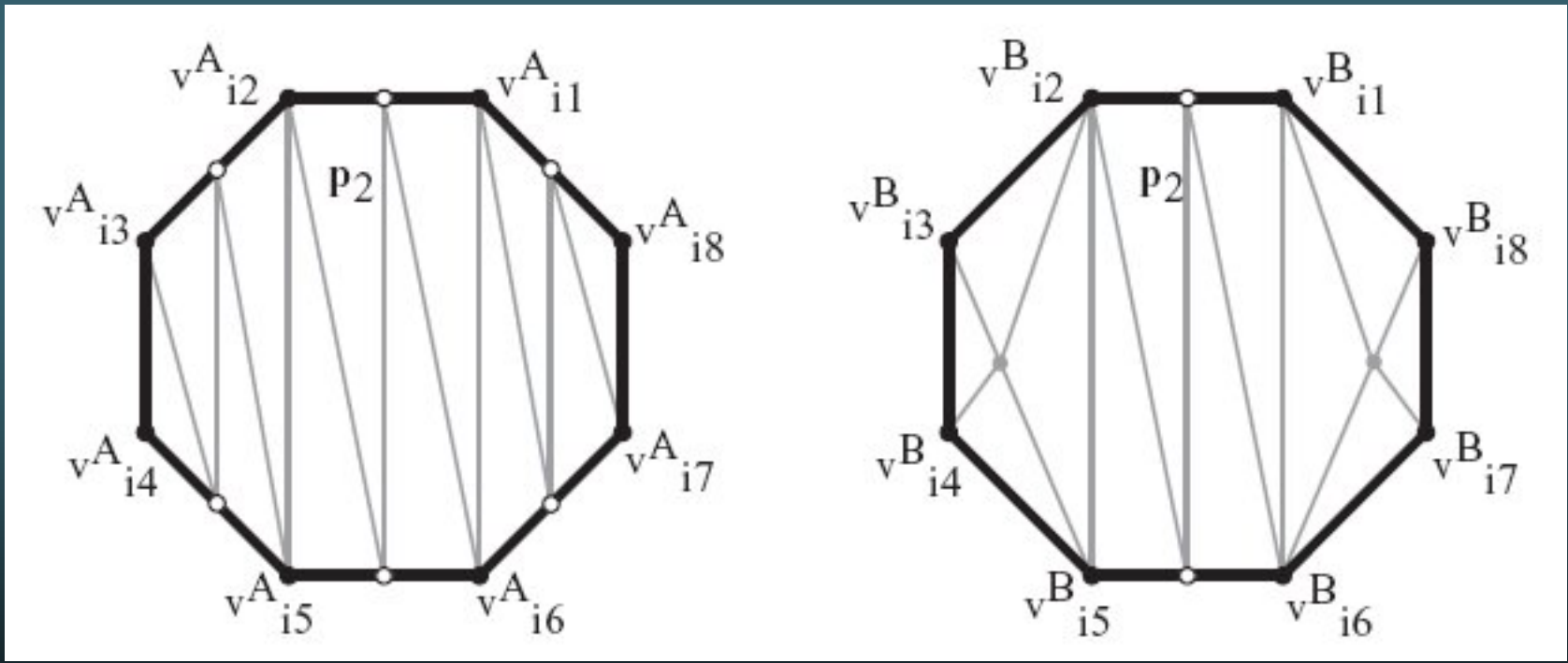
B-rep-based Approach

Decompose objects into morphing patches.



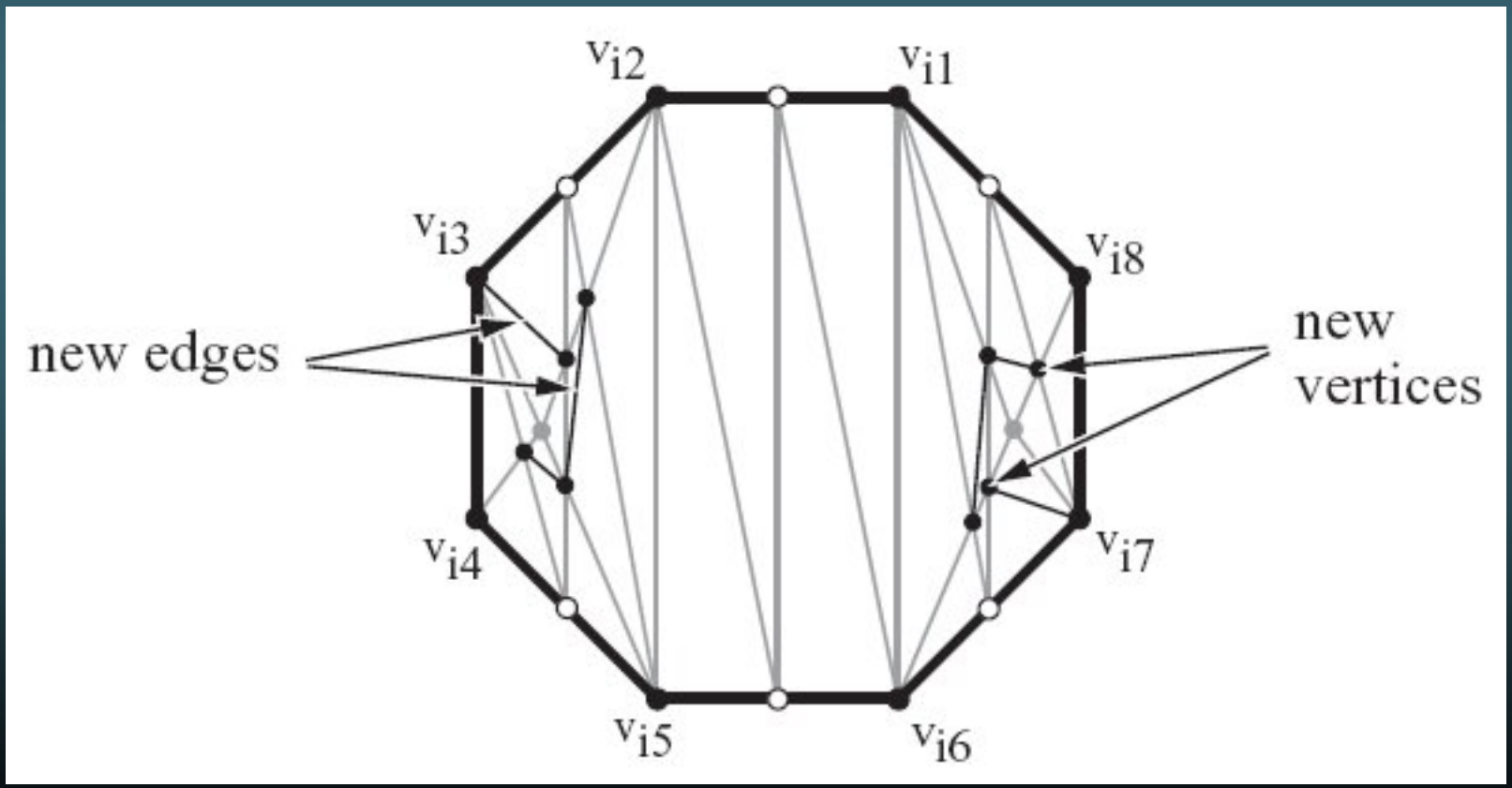
B-rep-based Approach

Map morphing patches to regular 2D polygons.



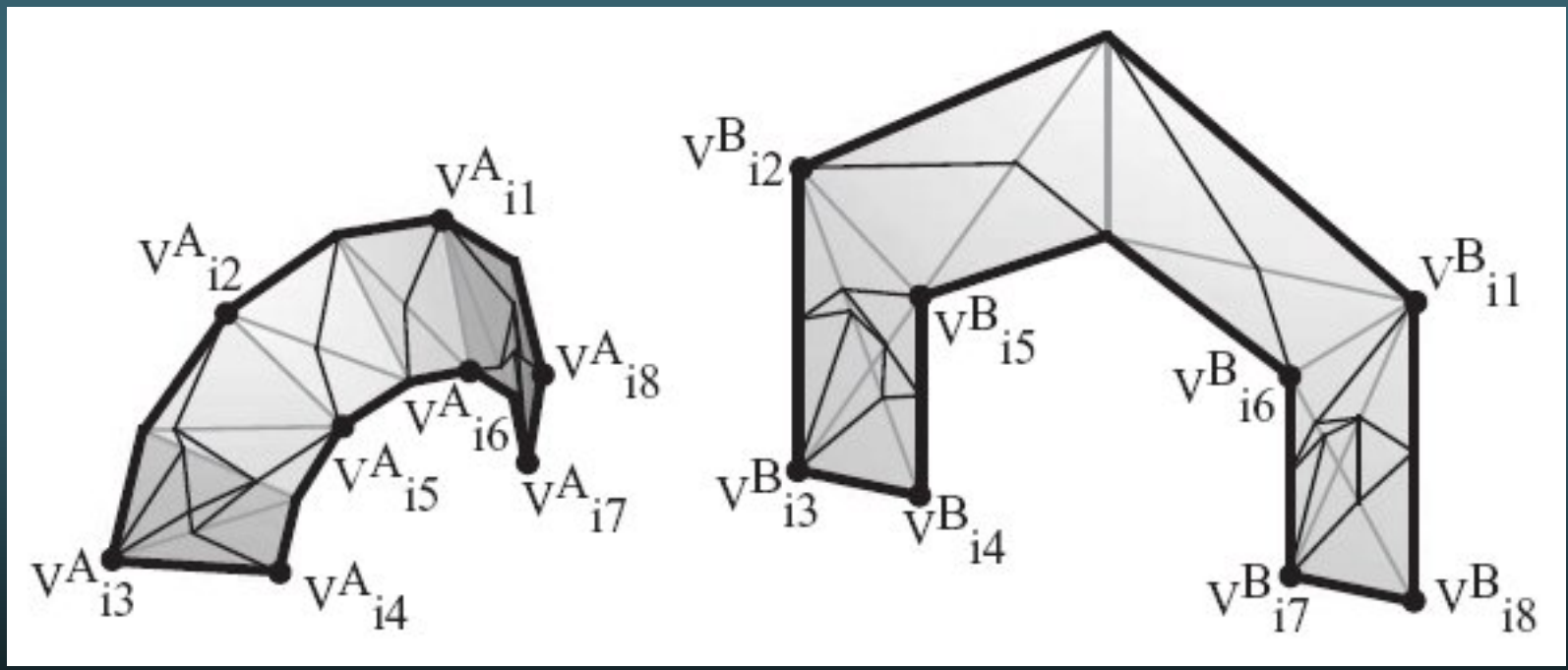
B-rep-based Approach

Merge corresponding morphing patches represented by 2D regular polygons.



B-rep-based Approach

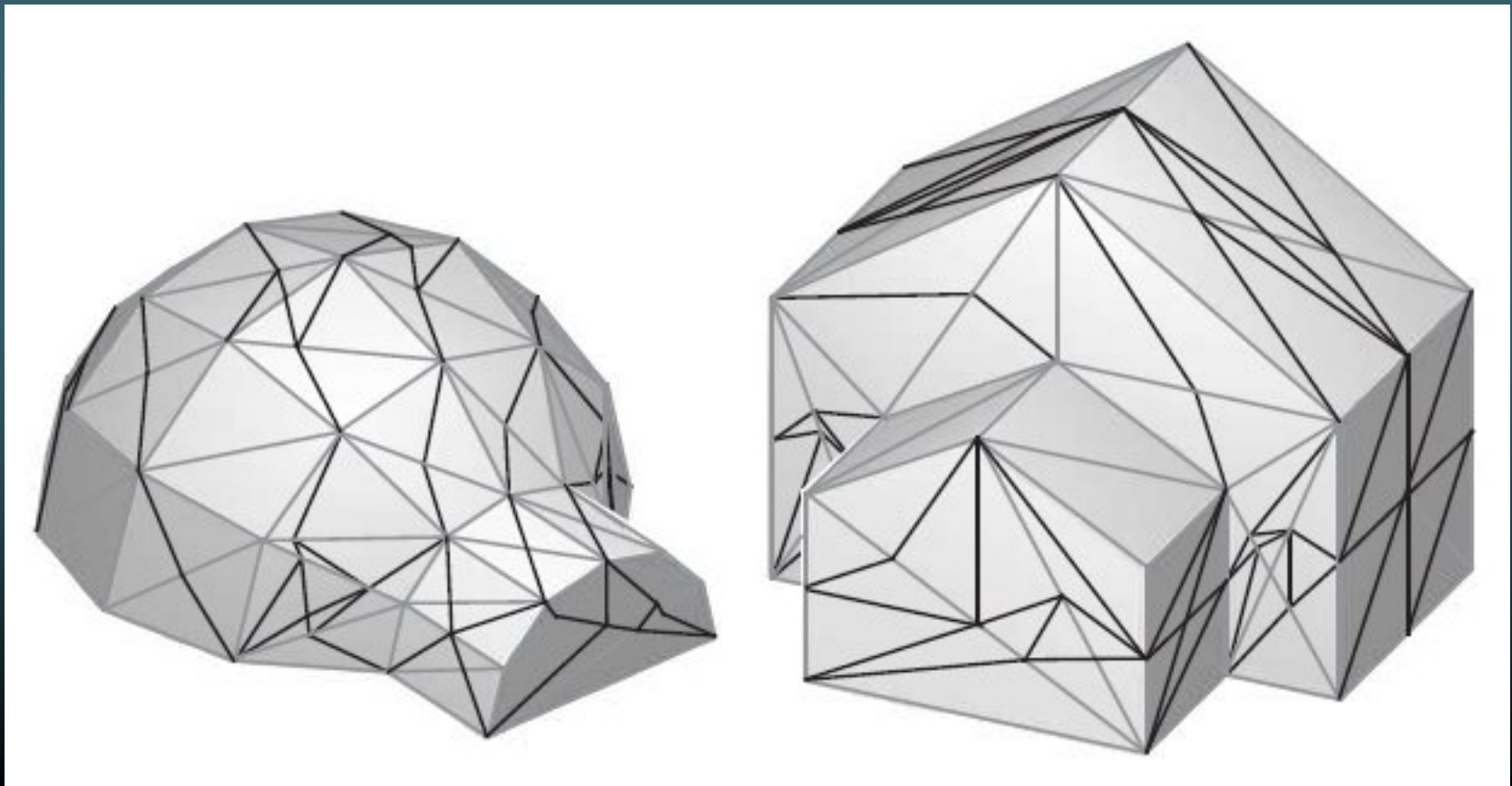
Triangulate merged patches and reconstruct objects.



B-rep-based Approach

Reconstructed objects:

Has one-to-one correspondence between vertices



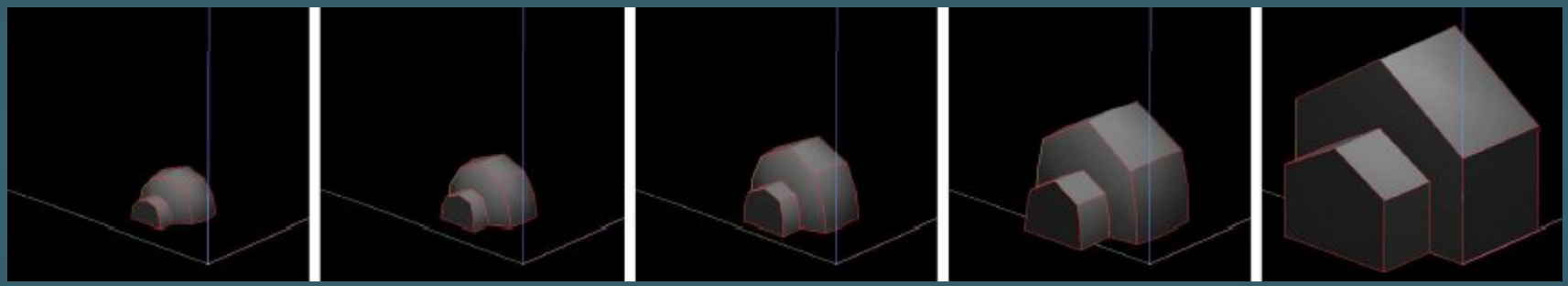
B-rep-based Approach

Interpolate objects:

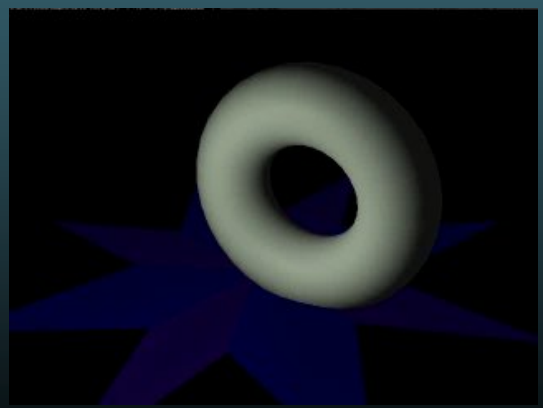
compute morphing trajectories.

B-rep-based Approach

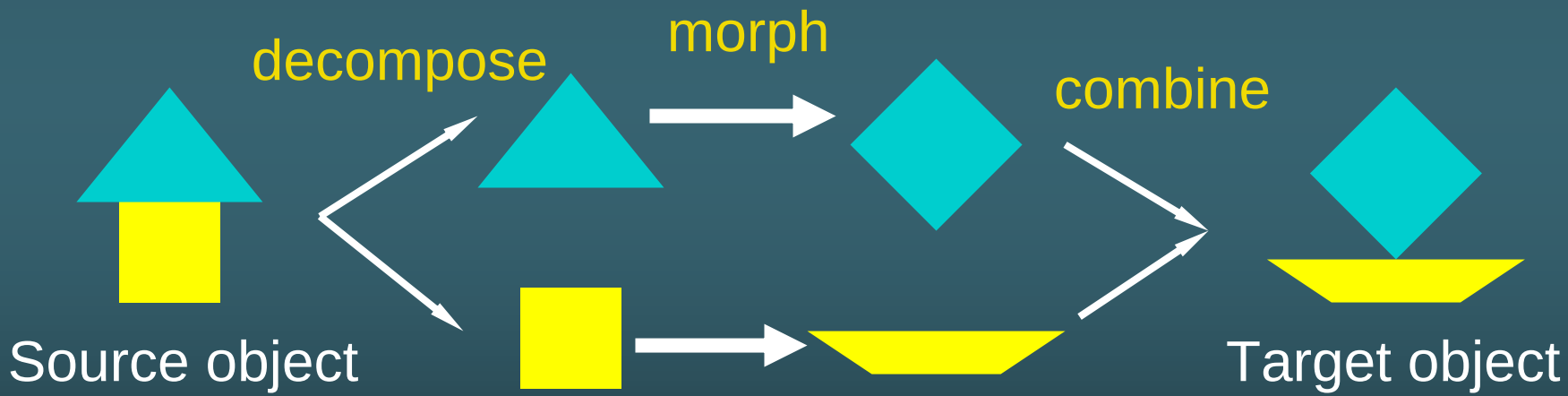
Interpolate objects: interpolate vertex colors, lighting coefficients, normal vectors, etc.



Demo:



Component-based Approach



Object = a collection of meaningful simpler parts (boundary representation), or components

Component-based Approach

Zhao, Ong, Tan and Xiao. Interactive control of component-based morphing. Proc. Symp. Computer Animation, 2003.

Decomposition

- decompose objects into parts

Correspondence

- map each vertex in source to a vertex in target

Interpolation

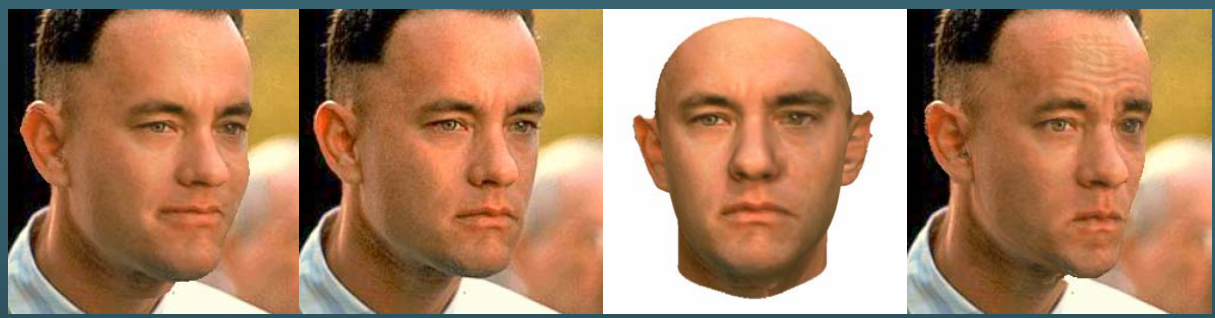
- move a vertex to its corresponding vertex

Component-based Approach

Demo:

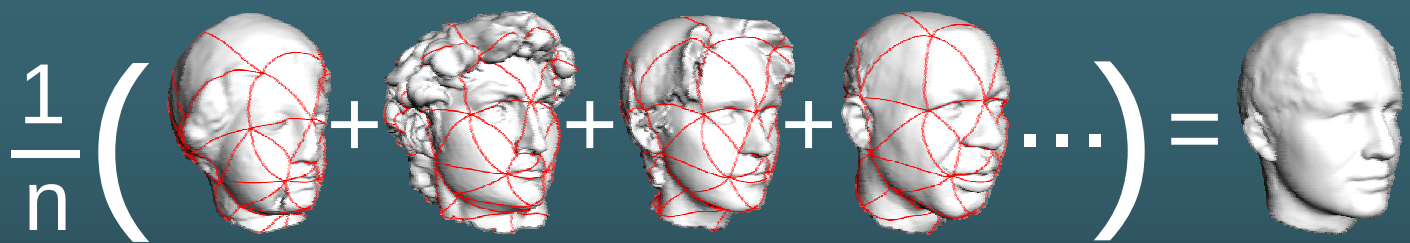
Related Topics

- A Morphable Model for the Synthesis of 3D Faces
  By Blanz and Vetter, SIGGRAPH 1999



Related Topics

- Consistent Mesh Parameterizations
  Praun, Sweldens and Schrode, SIGGRAPH 2001



Related Topics

- Cross-parameterizaion and Compatible Remeshing of 3D Models
  Kraevoy and Sheffer, SIGGRAPH 2004