RigMesh: Automatic Rigging for Part-Based Shape Modeling and Deformation

Péter Borosán
Ming Jin
Doug DeCarlo
Yotam Gingold
Andrew Nealen
Problem
Problem

- Creating ready-to-animate 3D models is hard
Problem

• Creating ready-to-animate 3D models is hard

Modeling

[youtube user: MasahiroUshiyama]
Problem

- Creating ready-to-animate 3D models is hard

Modeling

[webpage: MasahiroUshiyama]

Rigging

[Weber et al. 07]
Problem

• Creating ready-to-animate 3D models is **hard**
Problem

• Creating ready-to-animate 3D models is hard
Problem

- Creating ready-to-animate 3D models is hard
Problem

- Creating ready-to-animate 3D models is hard
Problem

• Creating ready-to-animate 3D models is hard
Problem

- Creating ready-to-animate 3D models is hard
Problem

• Creating ready-to-animate 3D models is hard
Problem

• Creating ready-to-animate 3D models is **hard**

• Fundamental problem: static sequential pipeline
Sketch-based Modeling
Sketch-based Modeling

• Teddy [Igarashi et al. 99]
Sketch-based Modeling

- Teddy [Igarashi et al. 99]
- ShapeShop [Schmidt et al. 05]
Sketch-based Modeling

- Teddy [Igarashi et al. 99]
- ShapeShop [Schmidt et al. 05]
- FiberMesh [Nealen et al. 07]
Sketch-based Modeling

- Teddy [Igarashi et al. 99]
- ShapeShop [Schmidt et al. 05]
- FiberMesh [Nealen et al. 07]
- SurfaceTrees [Schmidt and Singh 08]
Automatic Rigging
Automatic Rigging

- Skeleton extraction
  [Sharf et al. 07] [Pan et al. 09] [Ju et al. 11]
Automatic Rigging

- Skeleton extraction

[Sharf et al. 07] [Pan et al. 09] [Ju et al. 11]

[Cornea et al. 07]
Automatic Rigging

• Skeleton extraction
  [Sharf et al. 07] [Pan et al. 09] [Ju et al. 11]
  [Cornea et al. 07]

• Automatic skinning
  Pinocchio [Baran and Popović 07]
Solution?
Solution?
Solution?
Solution?

rig

deform
Solution?

rig

deform
Solution

Models rigged at all times
Solution

Models rigged at all times

• Non-linear editing
Solution

Models rigged at all times

- Non-linear editing
- Modeling by parts
Solution

Models rigged at all times

- Non-linear editing
- Modeling by parts
Solution

Models rigged at all times
- Non-linear editing
- Modeling by parts
Solution

Models rigged at all times
- Non-linear editing
- Modeling by parts
Solution

Models rigged at all times
• Non-linear editing
• Modeling by parts
Solution

Models rigged at all times

- Non-linear editing
- Modeling by parts
RigMesh
Contributions

Models rigged at all times
• Non-linear editing
• Modeling by parts
RigMesh

Contributions

Models rigged at all times

• Non-linear editing
• Modeling by parts: Sketch, Cut & Merge
RigMesh
Contributions

Models rigged at all times

• Non-linear editing
• Modeling by parts: Sketch, Cut & Merge
• Automatically determining skeletal structure from sketch
**RigMesh**

**Contributions**

**Models rigged at all times**

- Non-linear editing
- Modeling by parts: Sketch, Cut & Merge
- Automatically determining skeletal structure from sketch
- Efficient local skin weights computation
Demo
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Shape creation
Skeletonization
Skeletonization
Skeletonization
Skeletonization
Skeletonization
Skeletonization

chordal axis
Skeletonization

chord
Skeletonization
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
Douglas-Peucker algorithm
What happens if…
...the chordal axis is almost straight
Result of Douglas-Peucker
Result of Douglas-Peucker
Result of Douglas-Peucker
Use thickness (chords)
Fit line segment
Fit trapezoid
Fit trapezoid
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Cylindrical Douglas-Peucker error
Add new point
Fit trapezoids
Error below threshold
Bones
Shape creation
Shape creation
Results
Results (reusing existing models)
Results (1\textsuperscript{st} time users)
Limitations
Limitations

Only acyclic skeletons
Limitations

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations

Only acyclic skeletons
Objects without strong, stable axial symmetry
Limitations

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations & Future work

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations & Future work

Only acyclic skeletons
Objects without strong, stable axial symmetry
Limitations & Future work

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations & Future work

Only acyclic skeletons

Objects without strong, stable axial symmetry
Limitations & Future work

Only acyclic skeletons
Objects without strong, stable axial symmetry

Adapt for improved skinning methods
Limitations & Future work

Only acyclic skeletons
Objects without strong, stable axial symmetry

Adapt for improved skinning methods
Include animation in the unified pipeline
Thank you!