Animation for 3D Printing

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Class summary

Animation can be a great design tool.

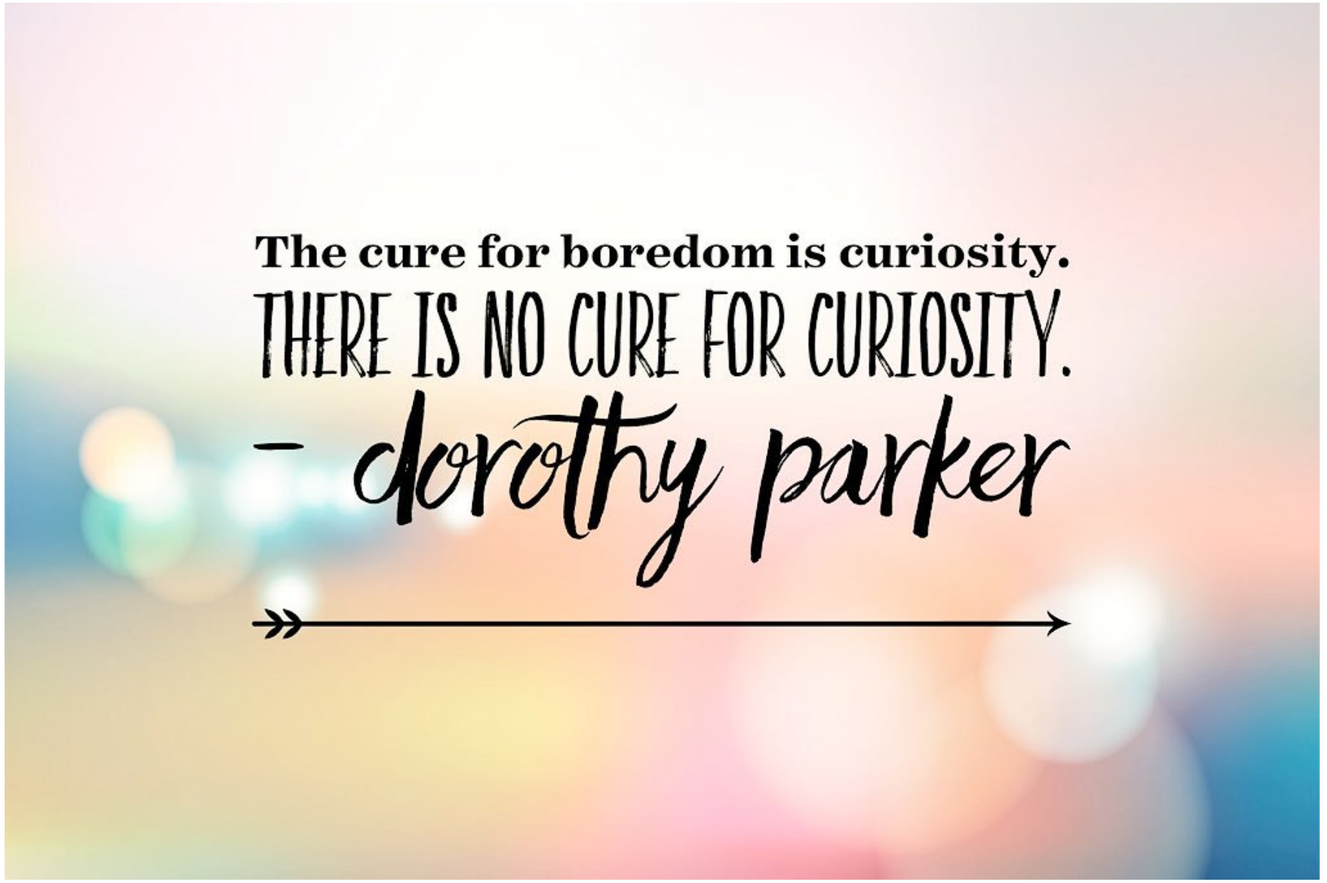
This class will look at how we can apply animation techniques to 3D printing—from laying out geometry to hiding support structures to creating interesting new models.

Key learning objectives

At the end of this class, you will be able to:

- Learn how to design for moveable 3D prints
- Learn how to optimize the position of objects in a 3D printing volume
- Learn how to hide support structures
- Learn how to use animation tools to generate interesting new surfaces

Who am I?

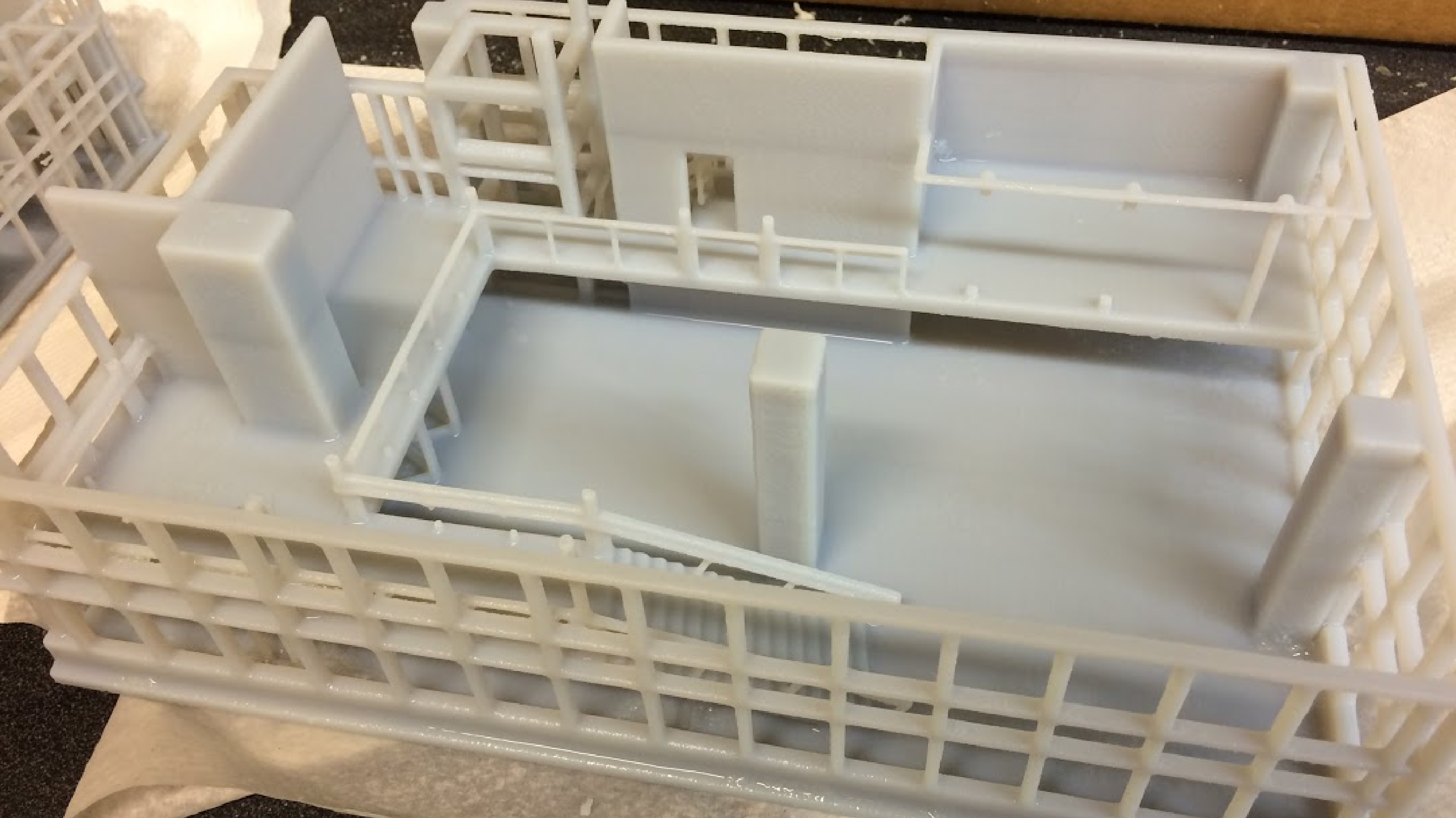

The cure for boredom is curiosity.
THERE IS NO CURE FOR CURIOSITY.
– dorothy parker

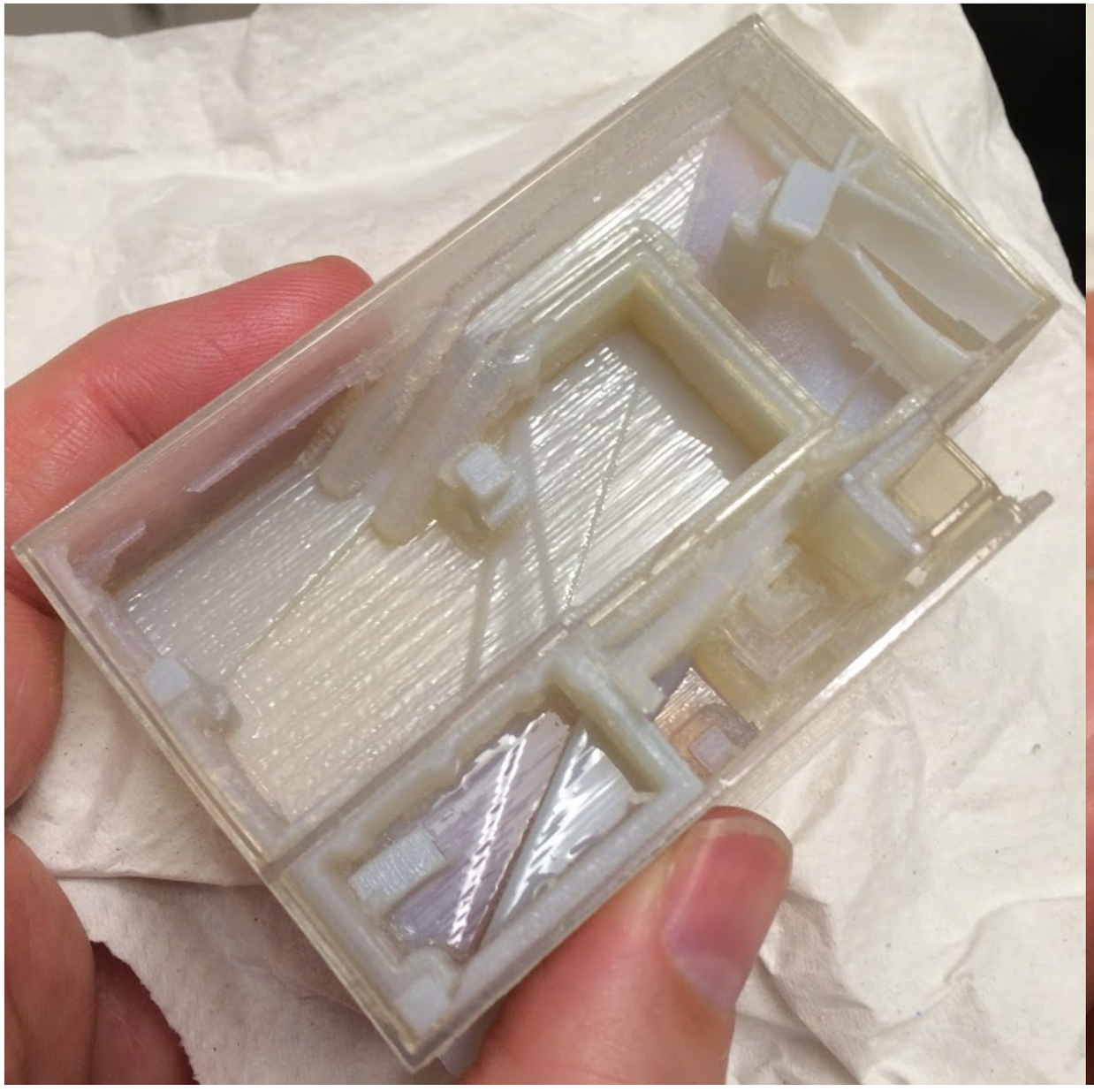
www.AutodeskResearch.com

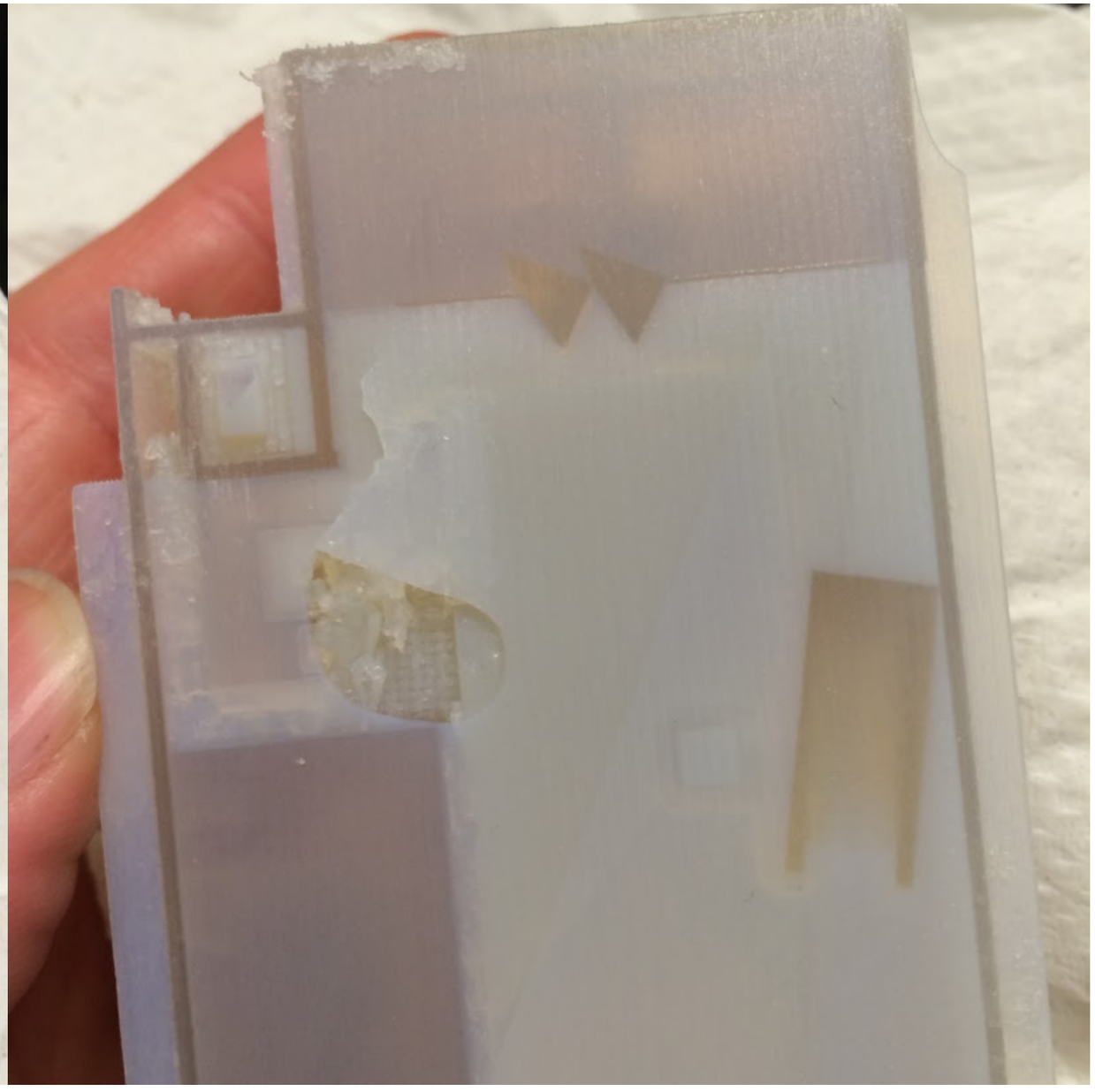
AU App Poll

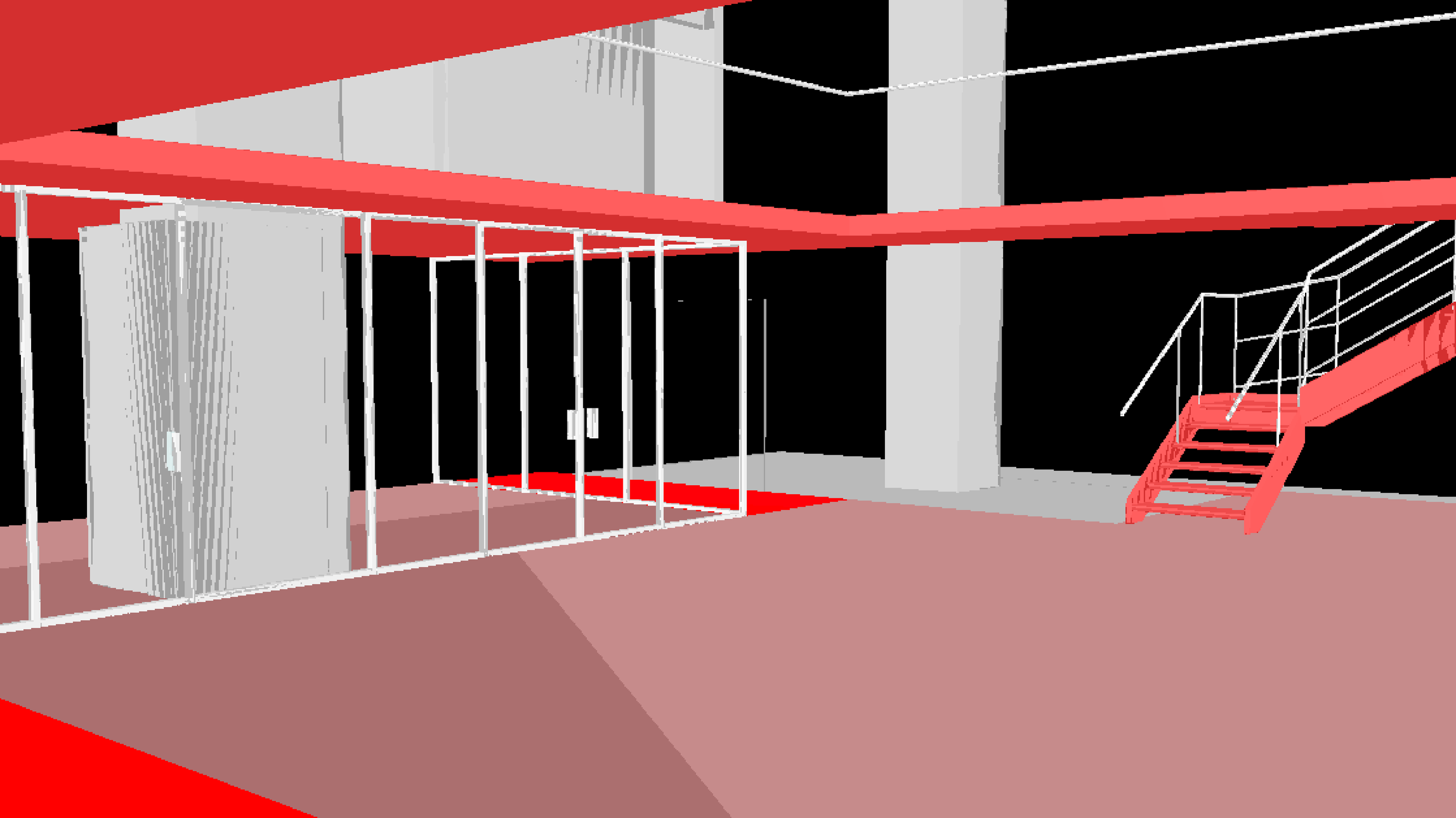
To Be or Not to Be

3D Printing vs CG Visualization

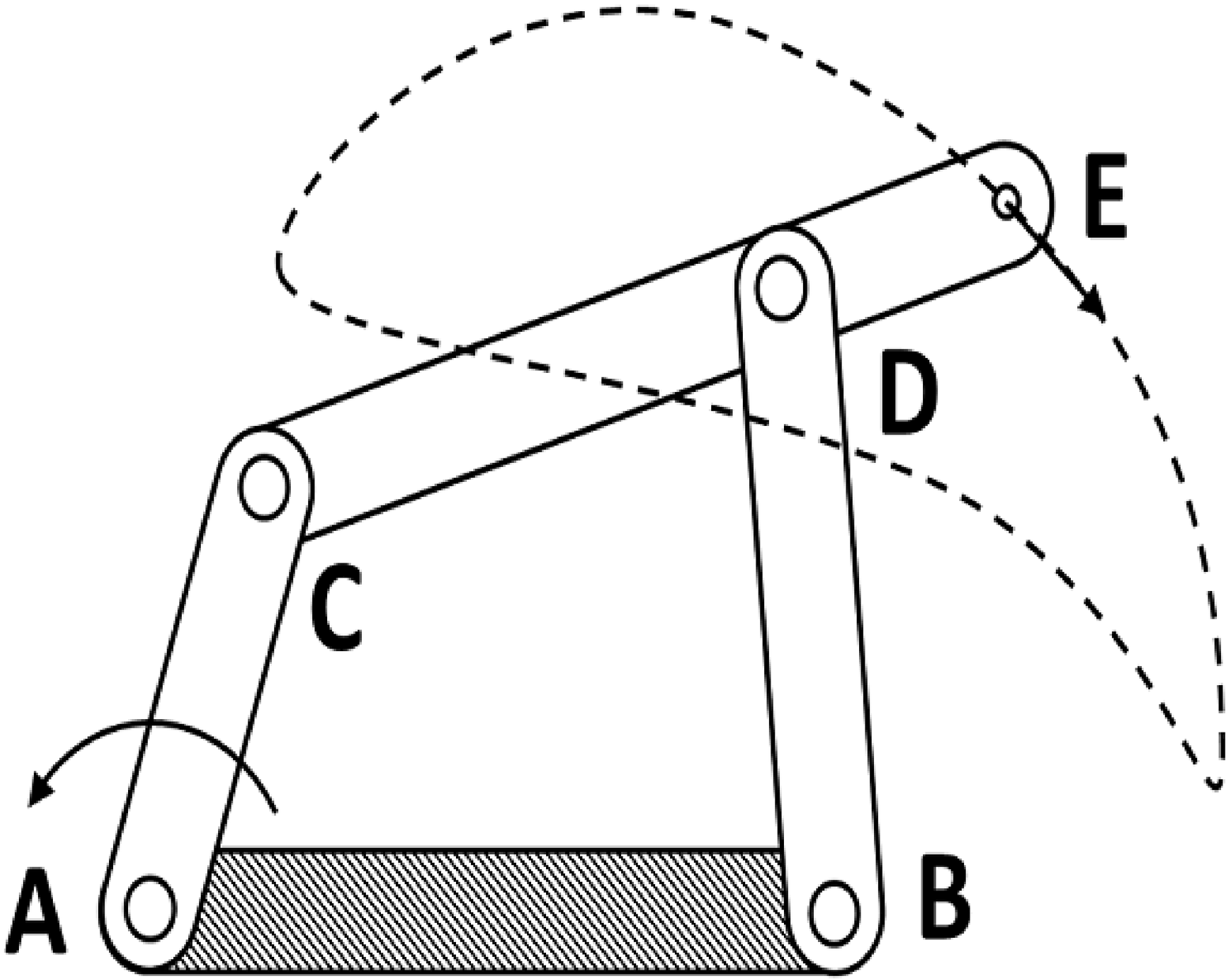




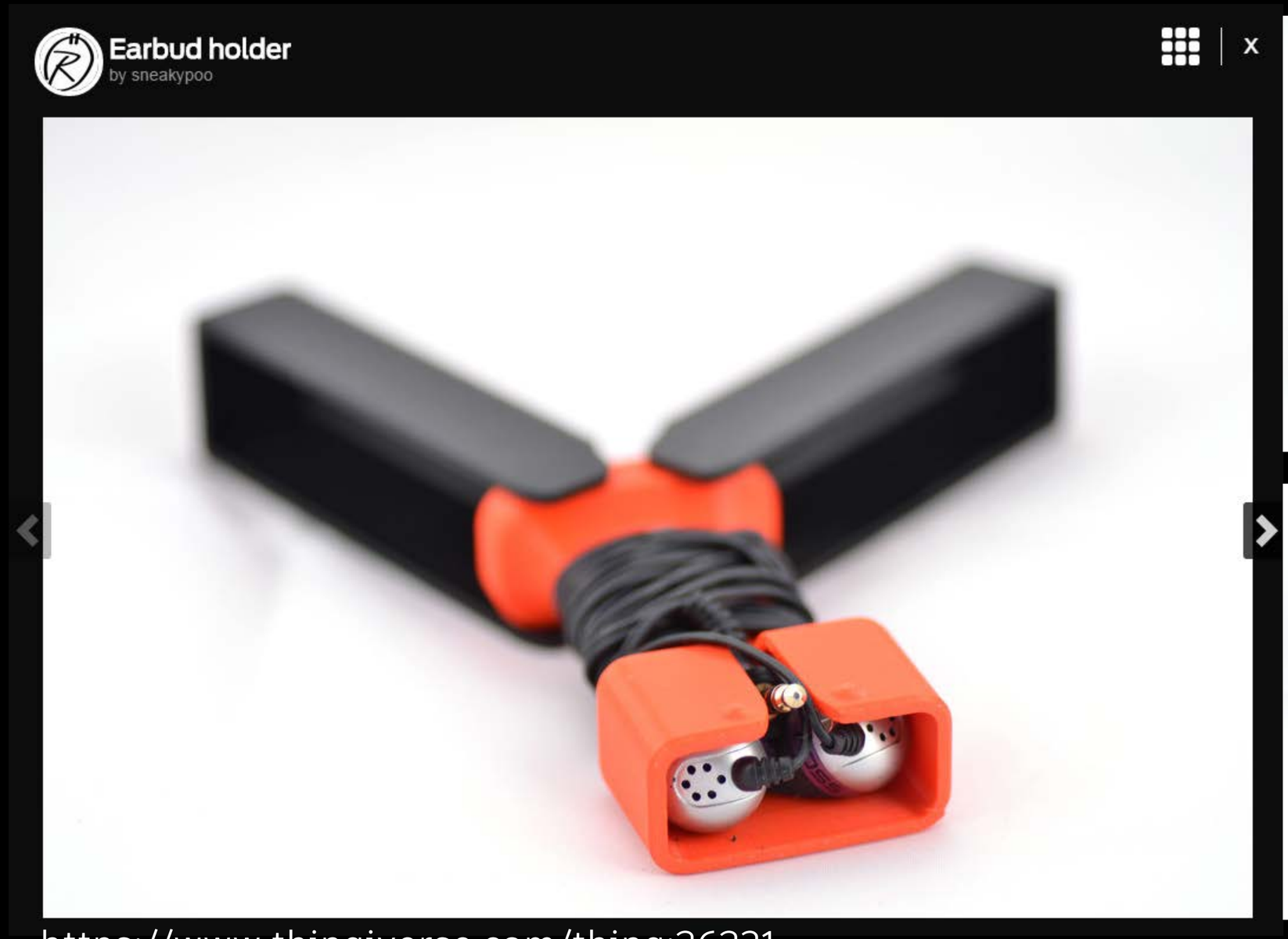




3D Printing and Moving Parts

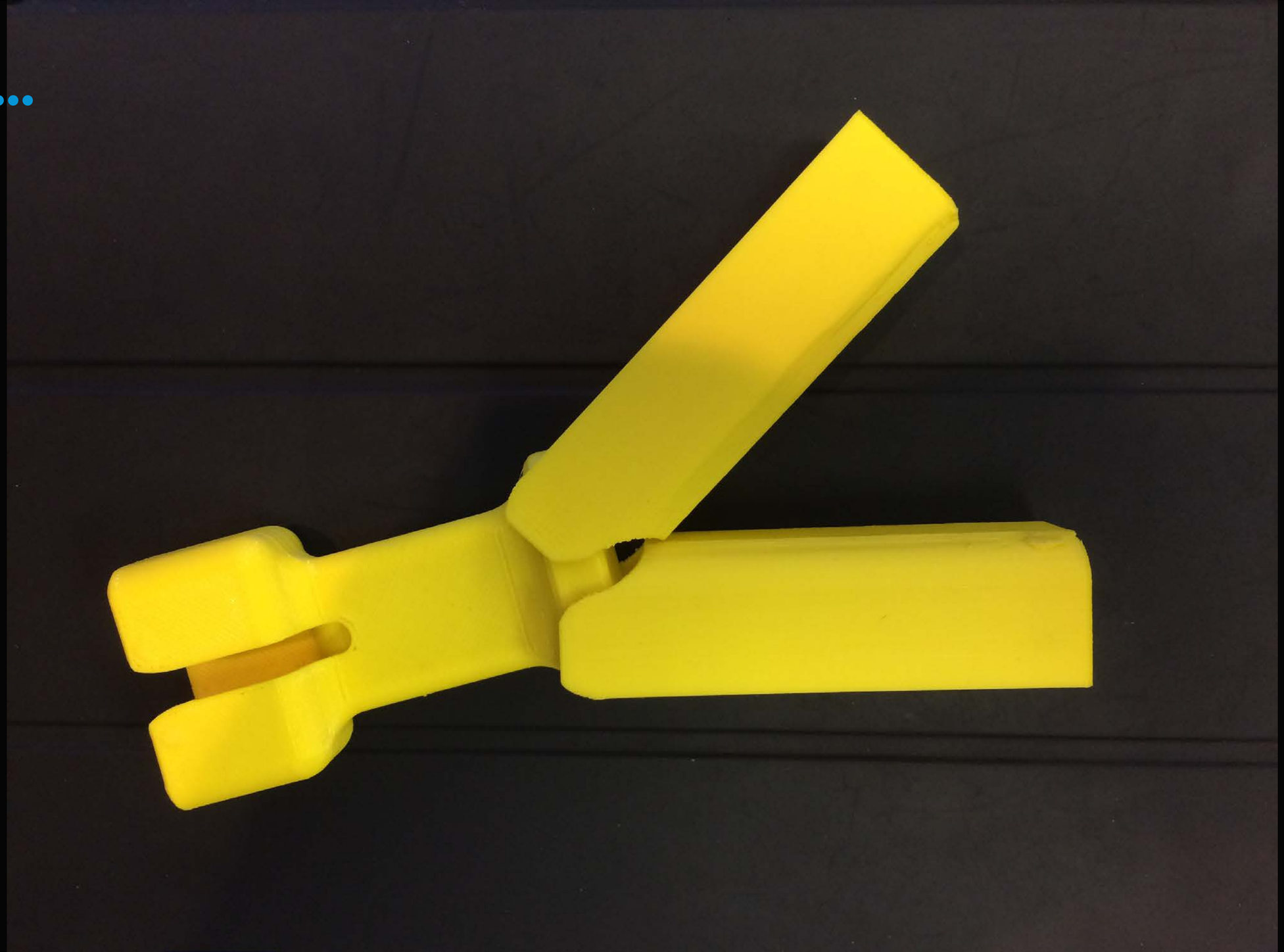

E
D
C
A
B

Where did this class come from?



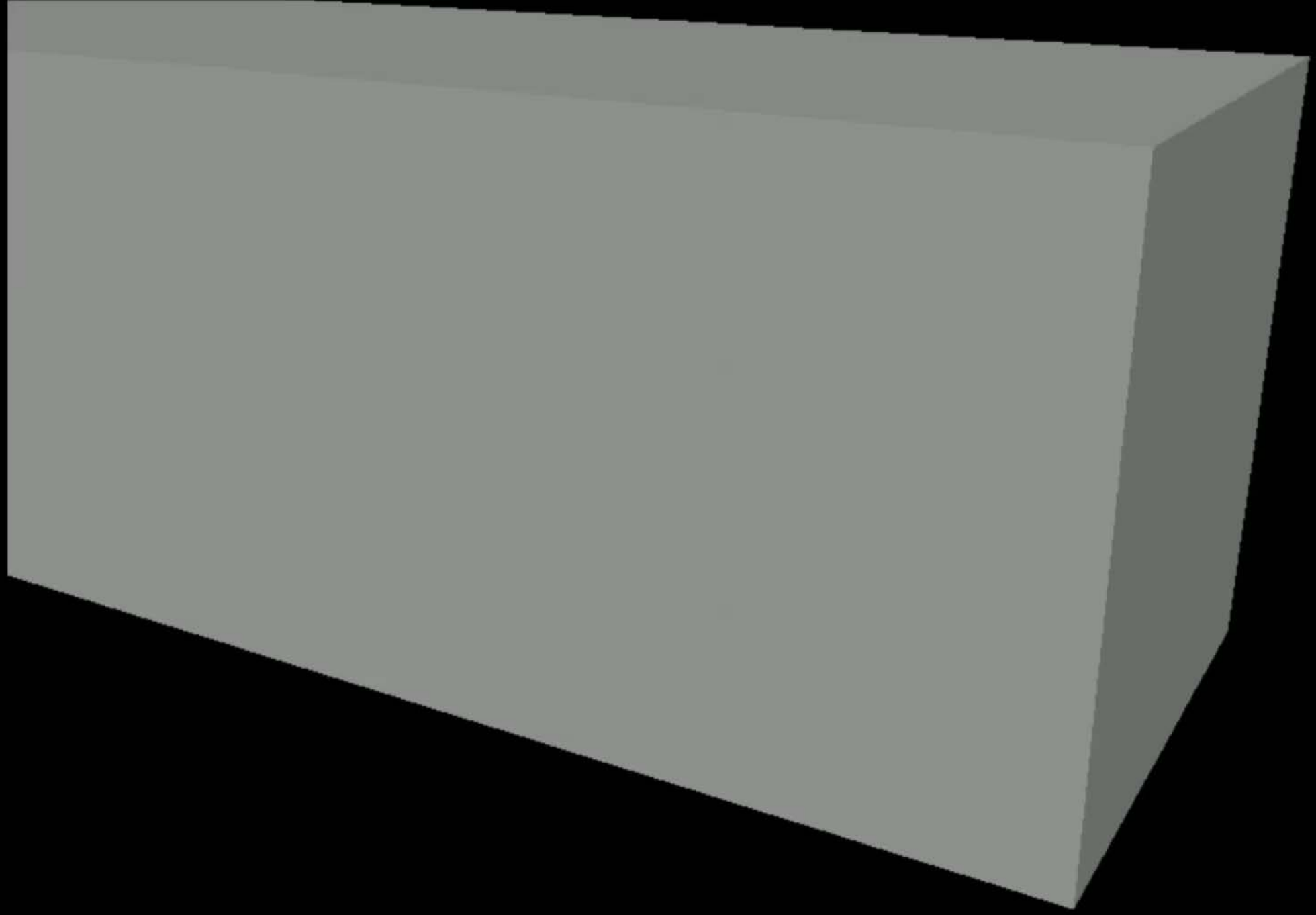
https://www.thingiverse.com/thing:36321

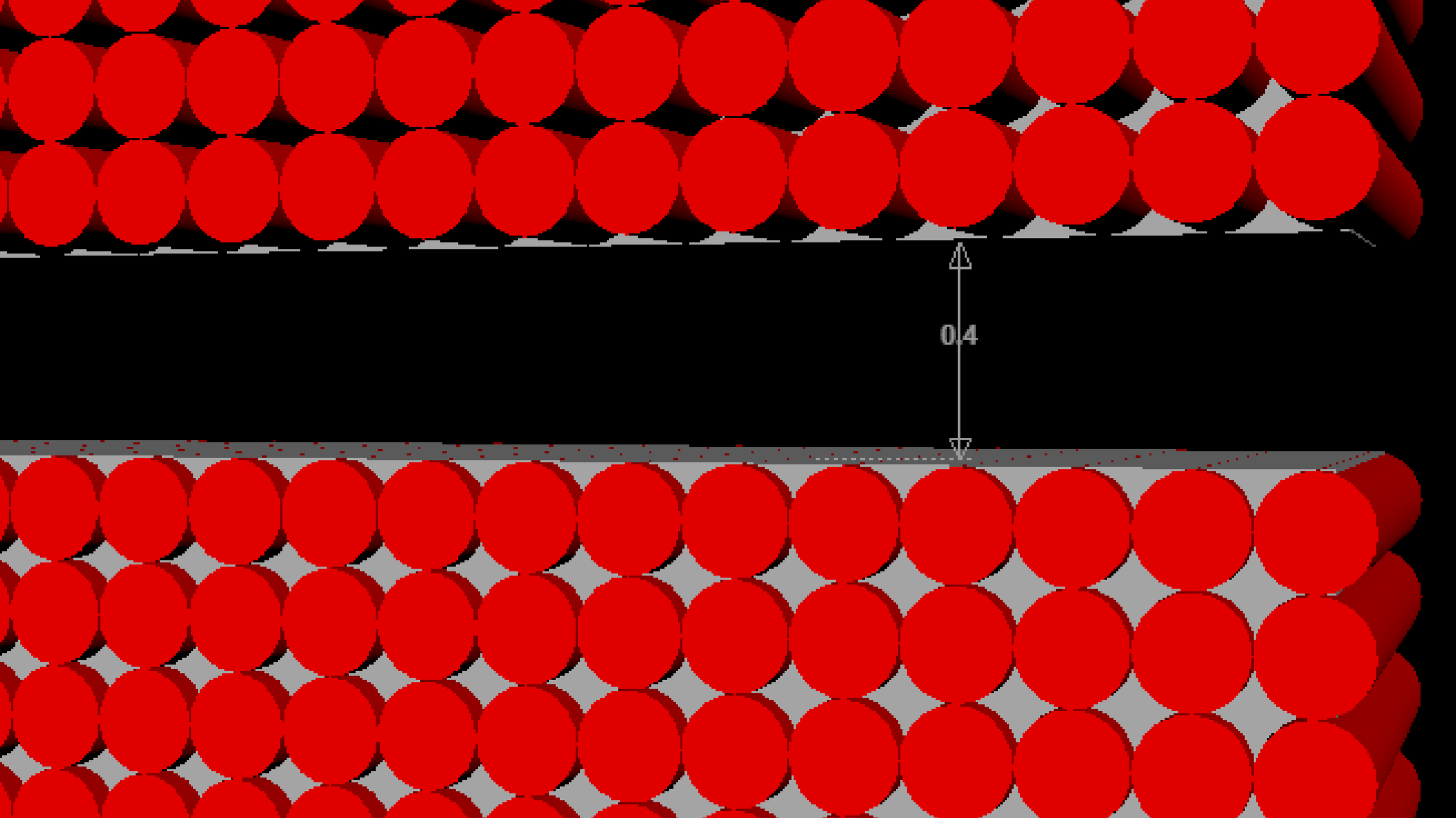
But…

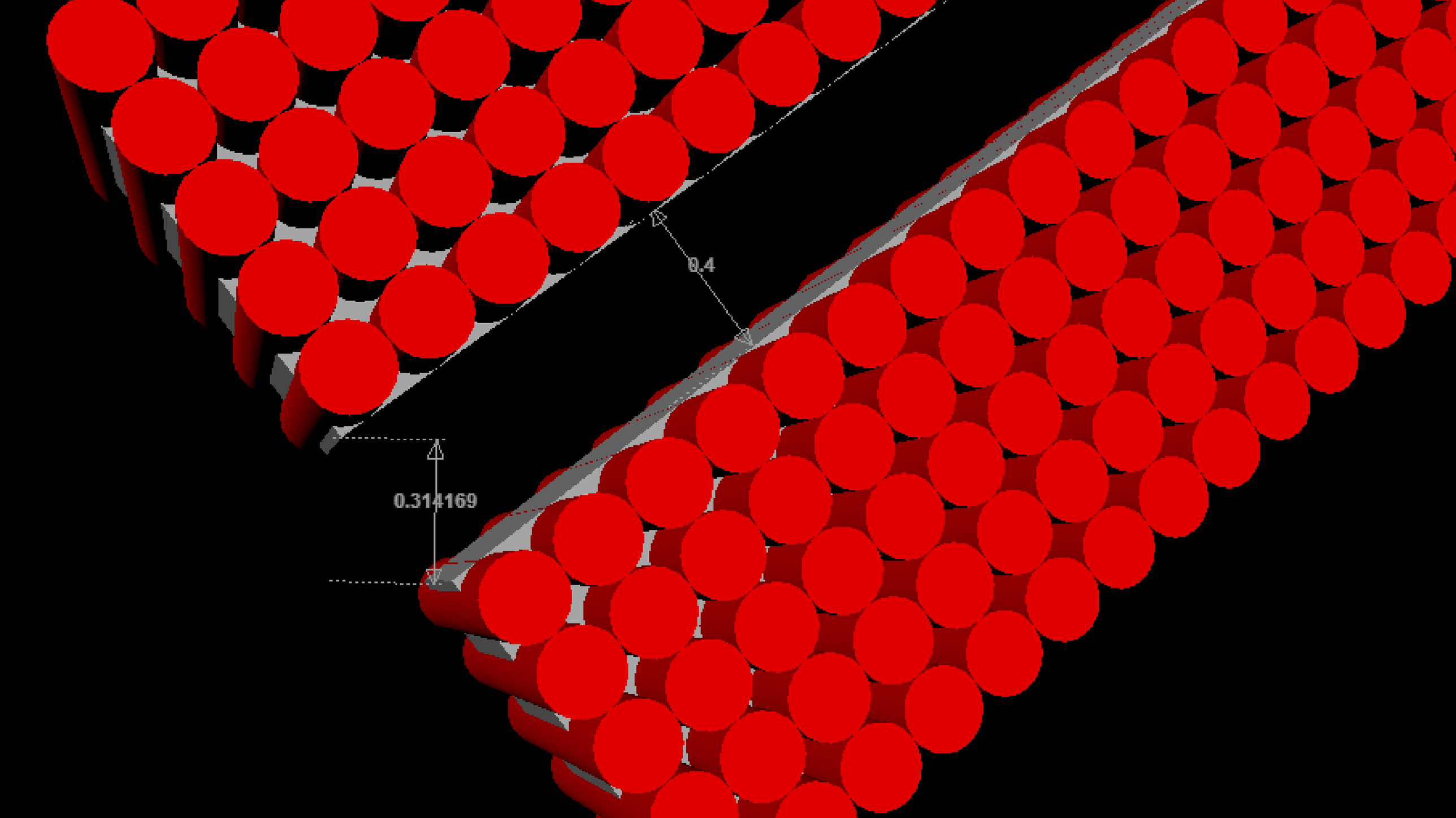


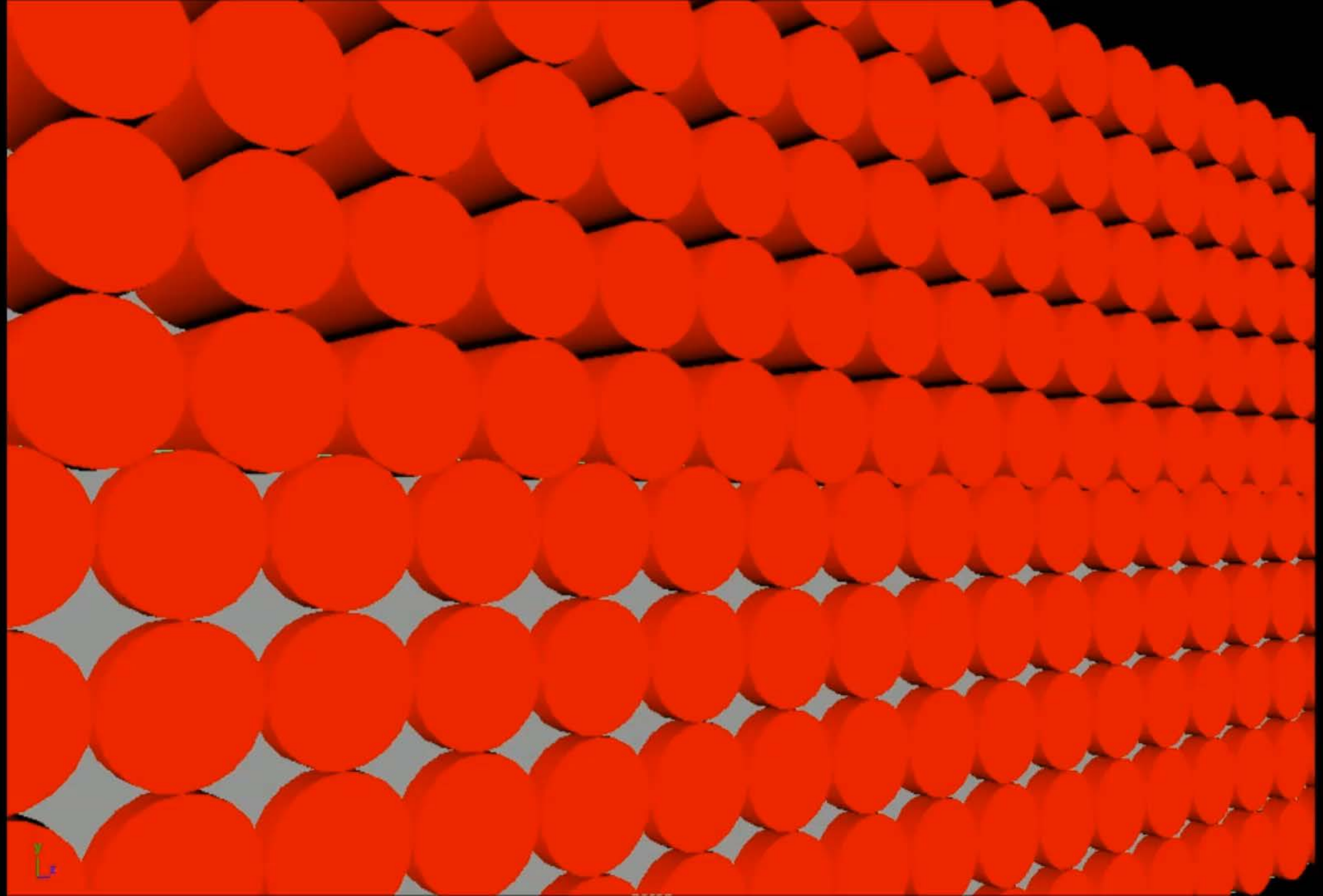
Designing for Moving Parts

When does 0.4mm ≠ 0.4mm?




0.4


0.4
0.314169



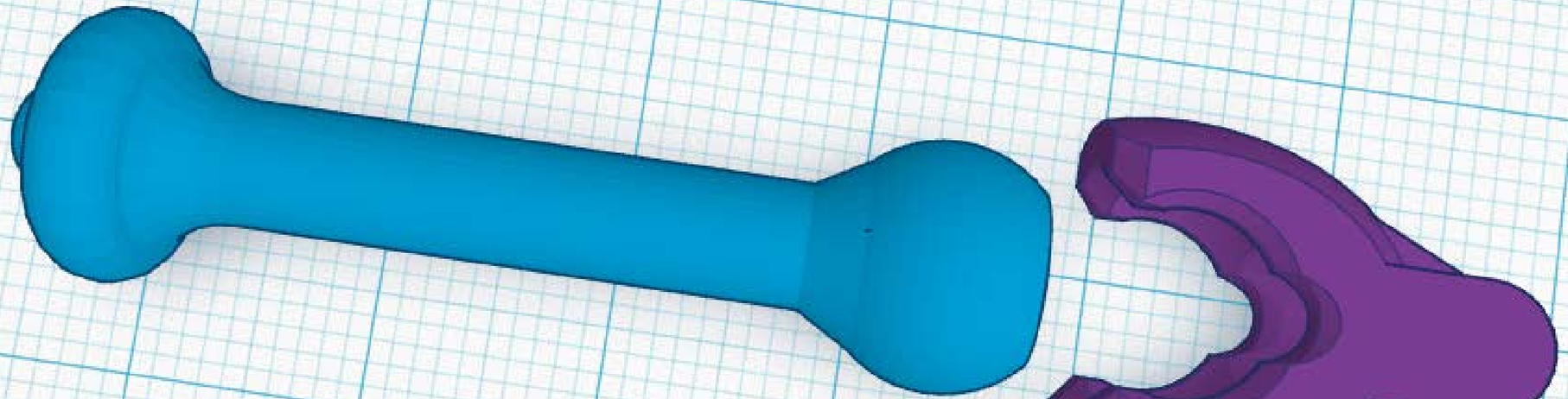
Designing for Moving Parts

3D Printing ≠ Machining

Moving Parts

Don’t Reinvent the Wheel

Spectacular Sango



Edit grid

Components

Connectors

Ball Angled
by team tinkercad

Ball Free
by team tinkercad

Ball Handle Seated
by team tinkercad

Ball Seated Vert
by team tinkercad

Ball Seated
by team tinkercad

Hand Grip Cut O...
by team tinkercad

Handle Seated

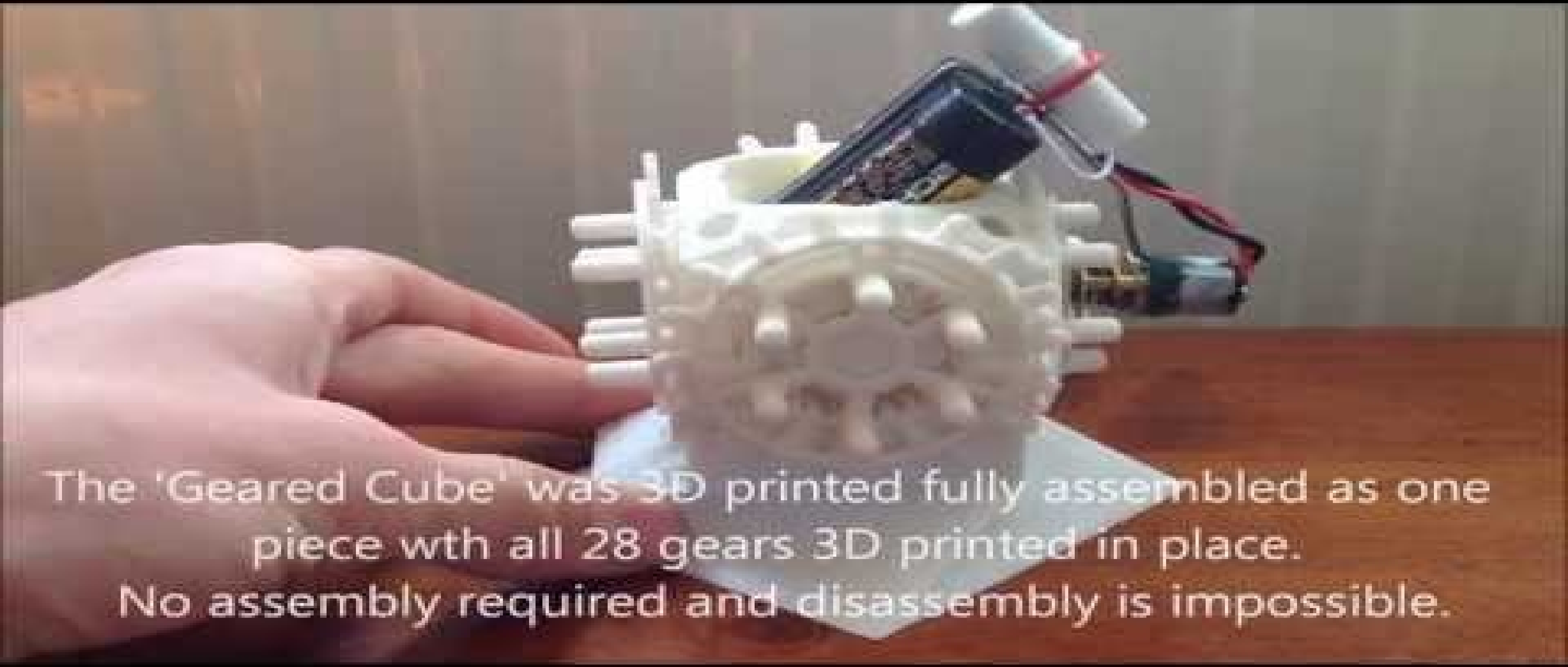
Socket Angled

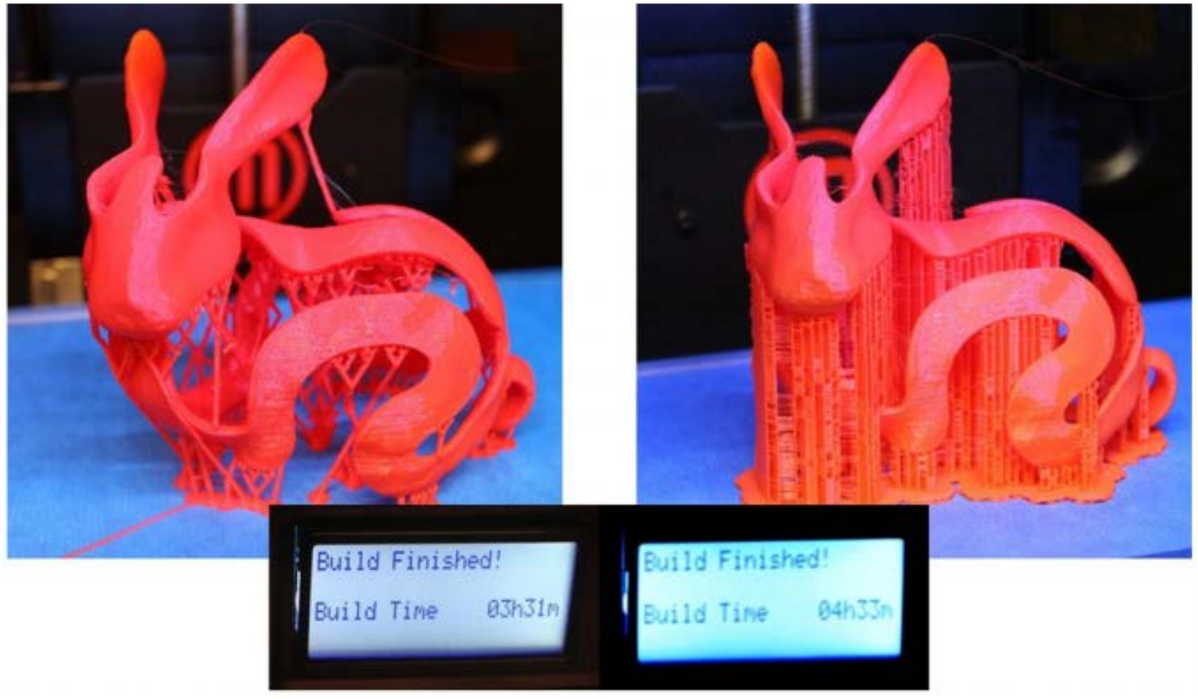

Robot woman "Robotica"
by Shira
X
ROBOTICA
Ball Jointed Doll
https://www.thingiverse.com/thing:614366

Integrated Assemblies

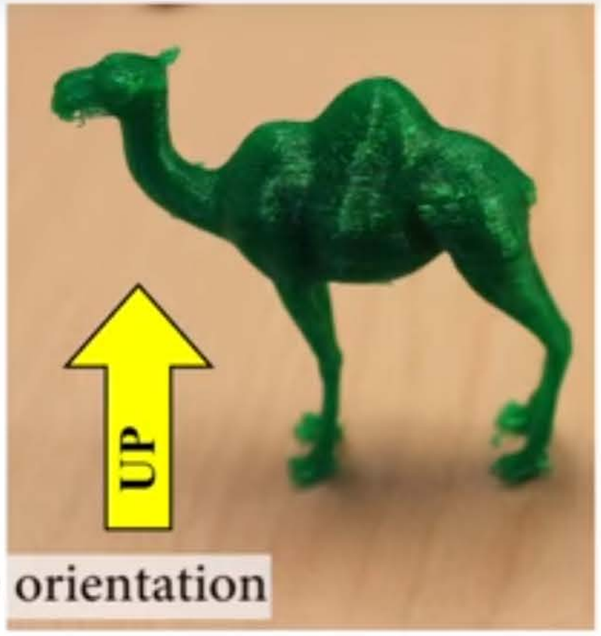
Gear Bearing
by emmett

https://www.thingiverse.com/thing:53451


The 'Geared Cube' was 3D printed fully assembled as one
piece wth all 28 gears 3D printed in place.
No assembly required and disassembly is impossible.


Build Finished!
Build Time 03h31m
Build Finished!
Build Time 04h33m


Escali
418
Escali
1855



naïve orientation

optimal orientation

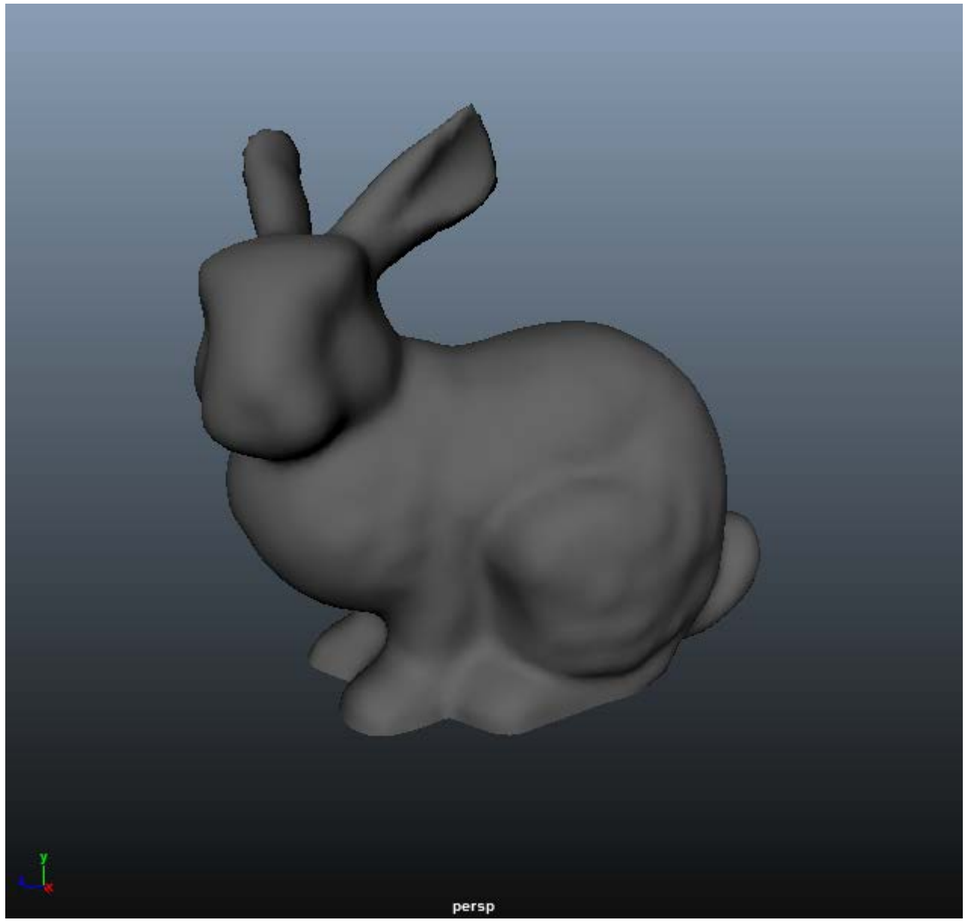
https://www.n-e-r-v-o-u-s.com

Kinematics Fold
reduced the size of
the dress by 85%
making it printable
as a single piece


Meltables: Fabrication of Complex 3D Curves by Melting
32x
Hot Air soldering tool at 300F/150C
0:11 / 2:14

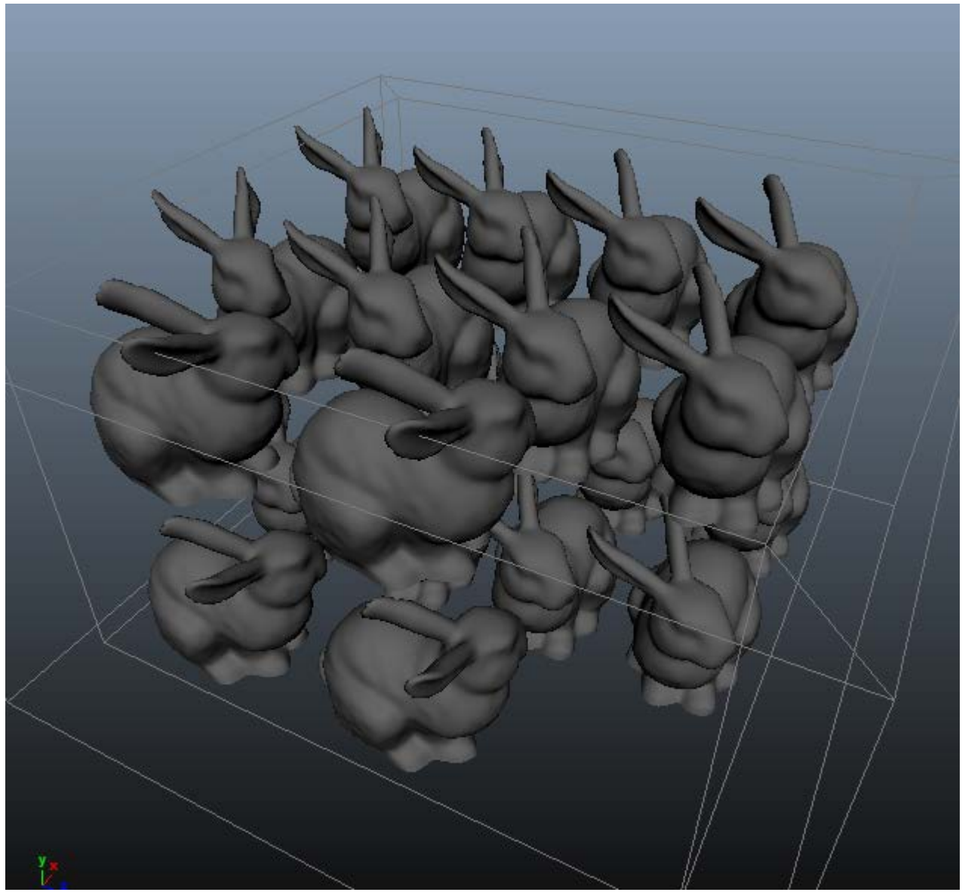
Dynamic Packing

Bunny Multiplication



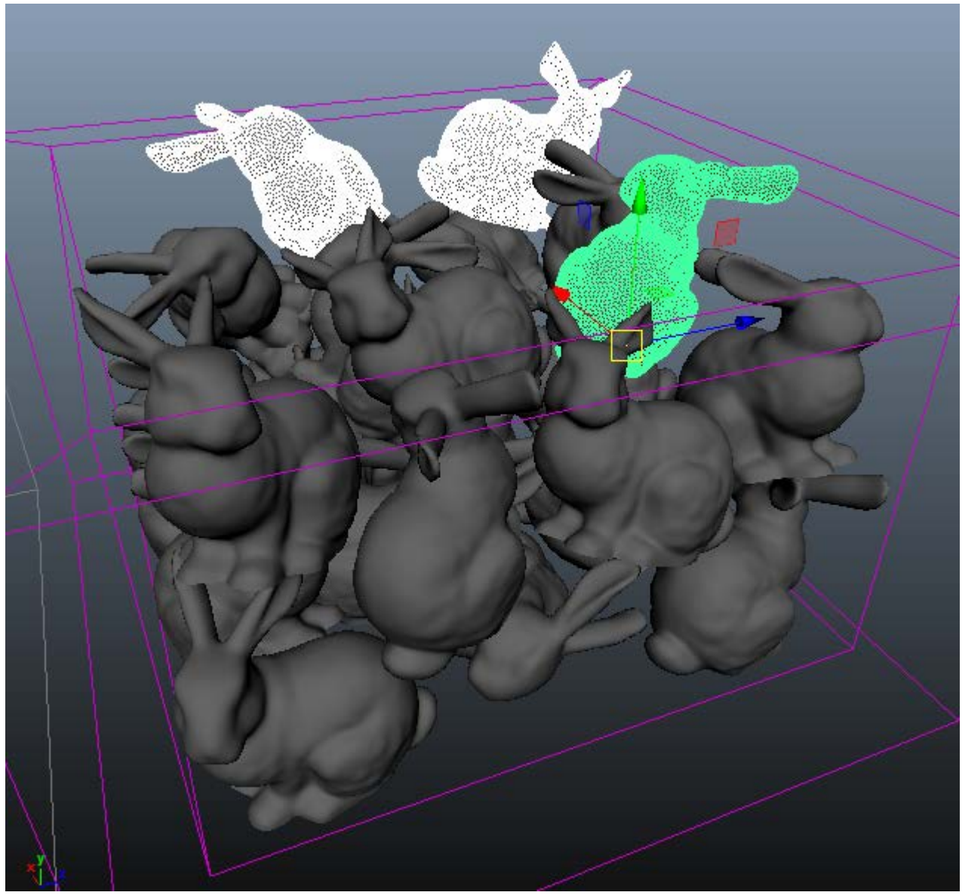
Print Time: 20 min
Operator Time: 2 min

Bunny Multiplication



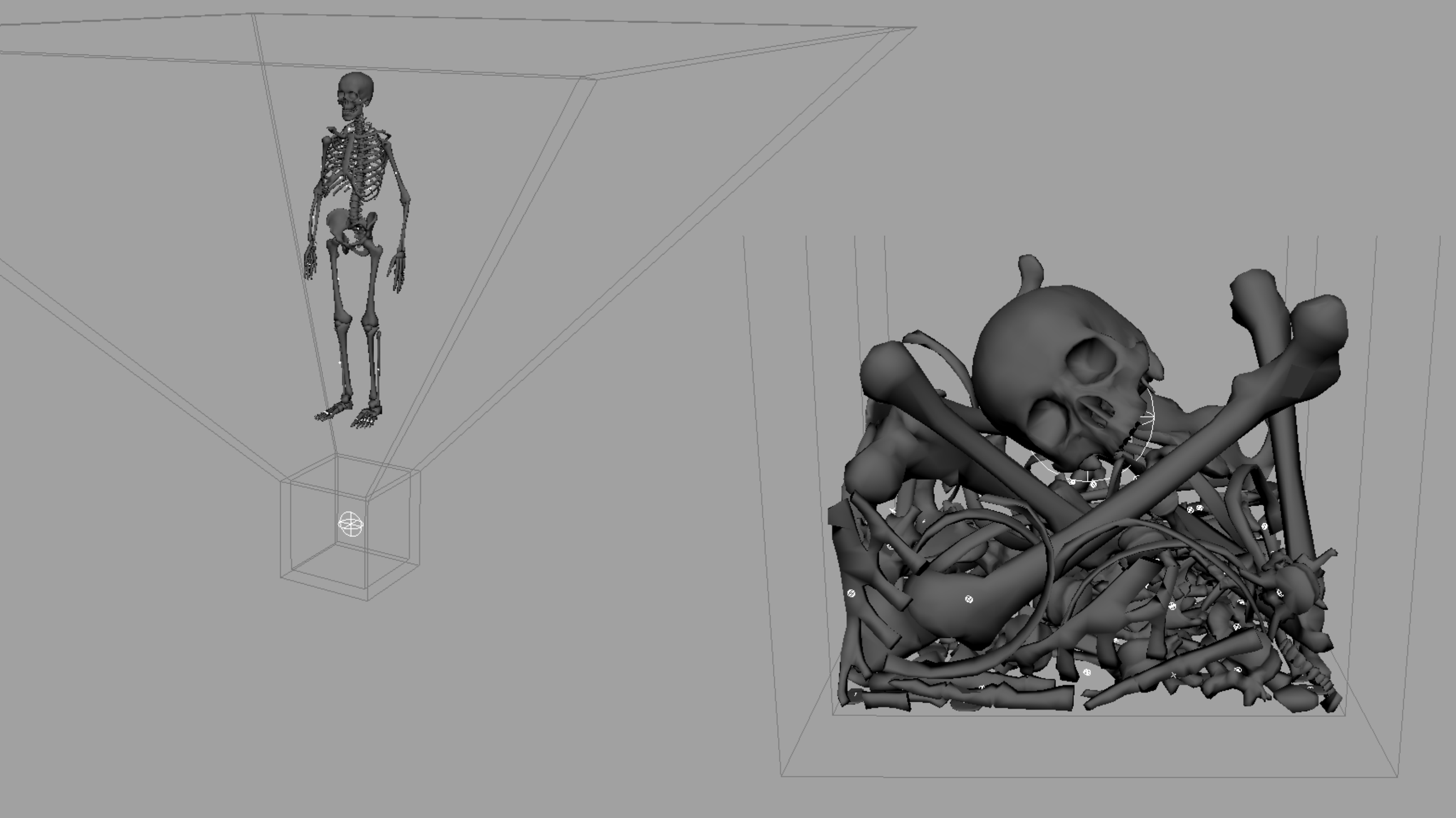
16 Bunnies
Print Time: 5.5 hours
Operator Time: 30 min

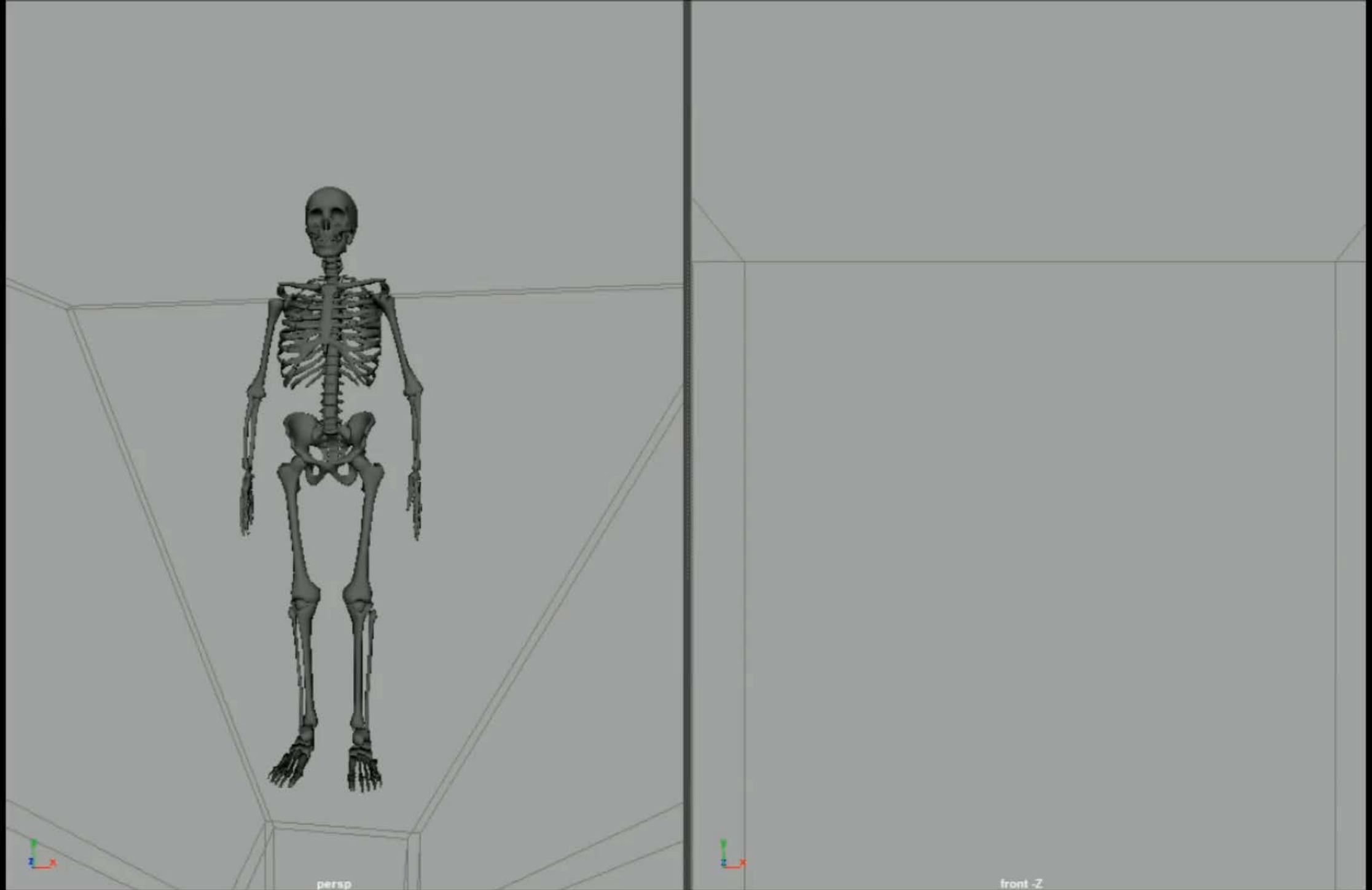
Bunny Multiplication

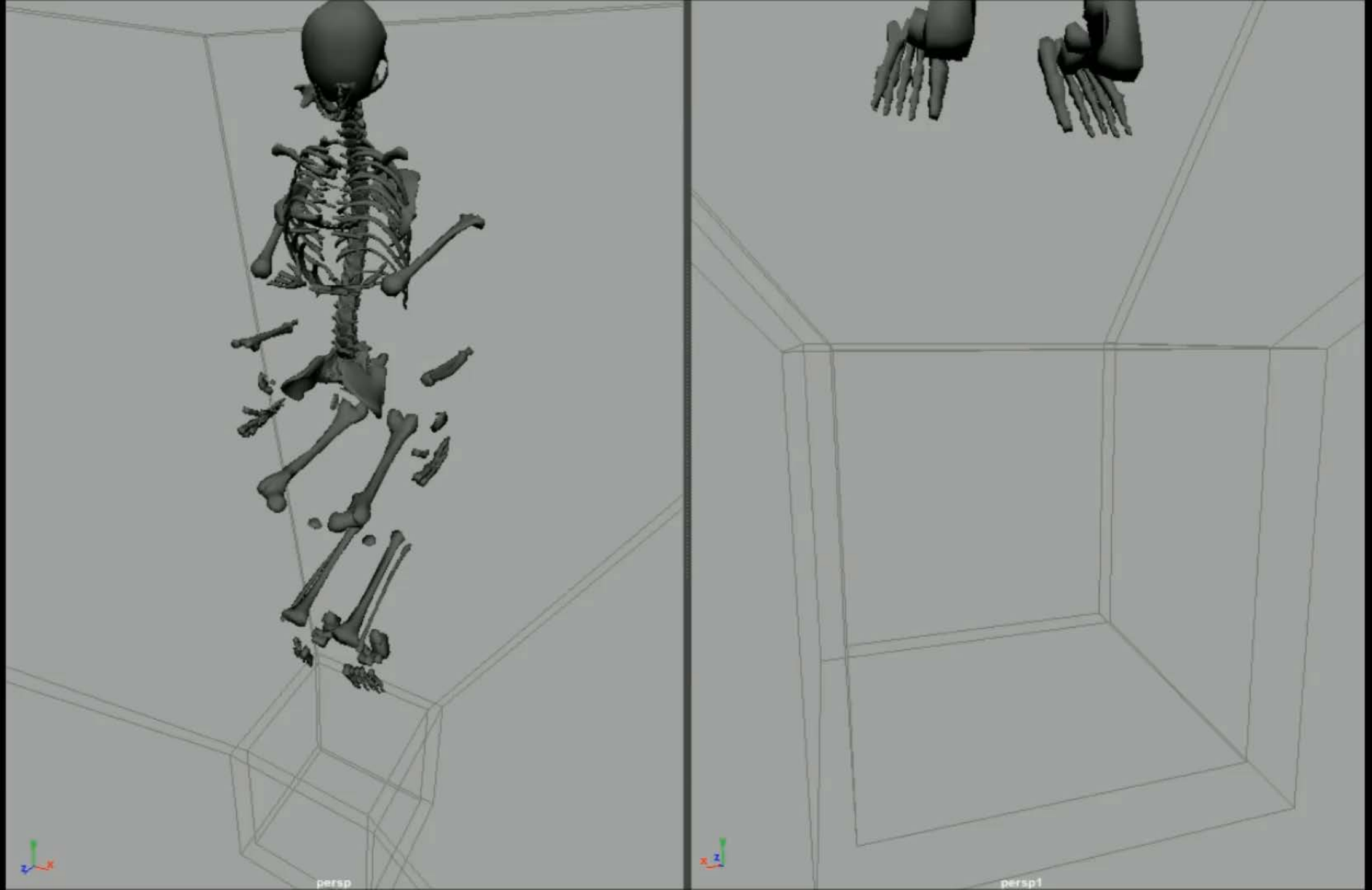


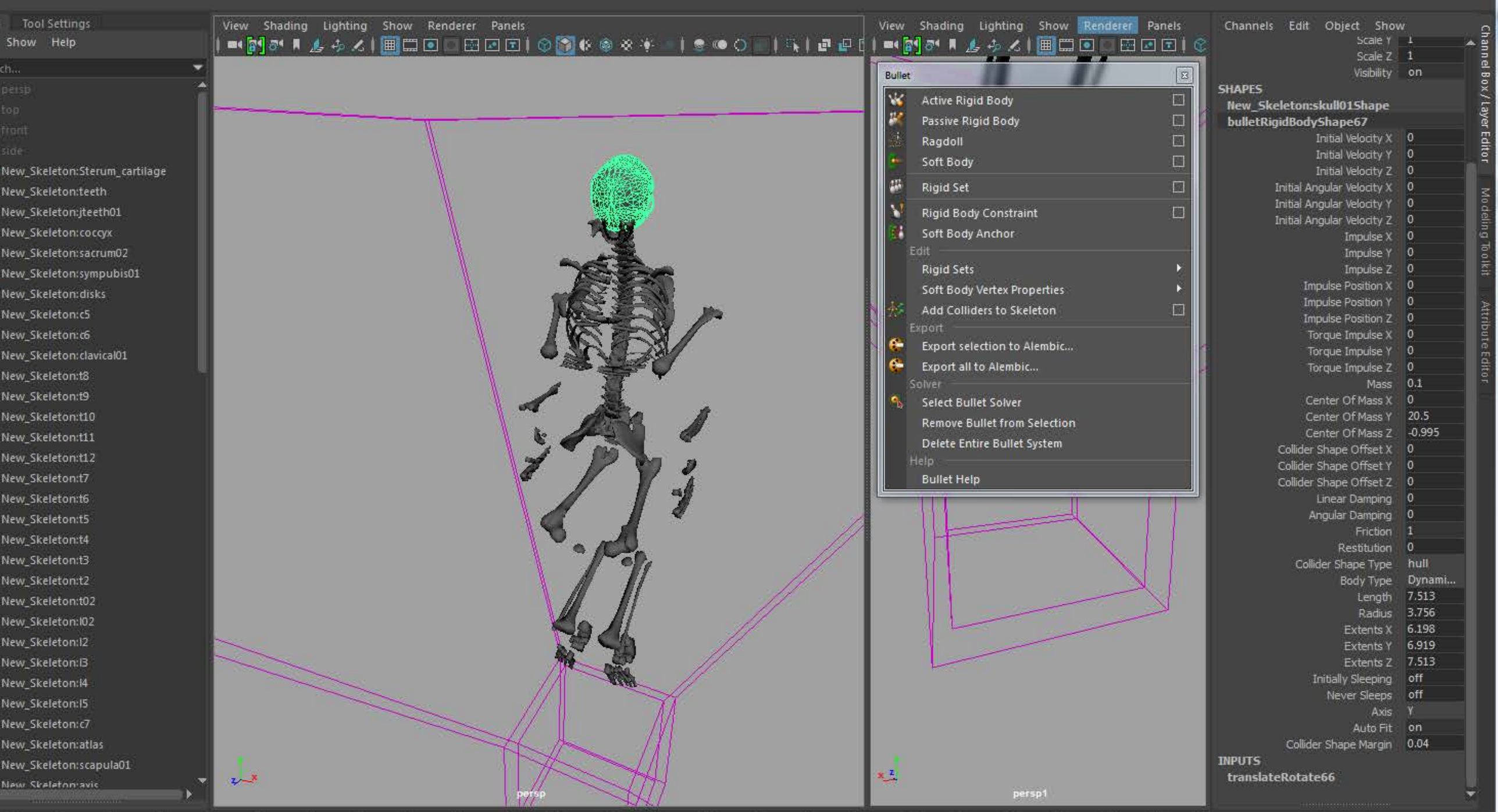
27 Bunnies
Print Time: 9 hours
Operator Time: 40 min

Bunnies	Print	Operator
1	20 min	2 min
16	5.5 hours	30 min
27	9 hours	40 min



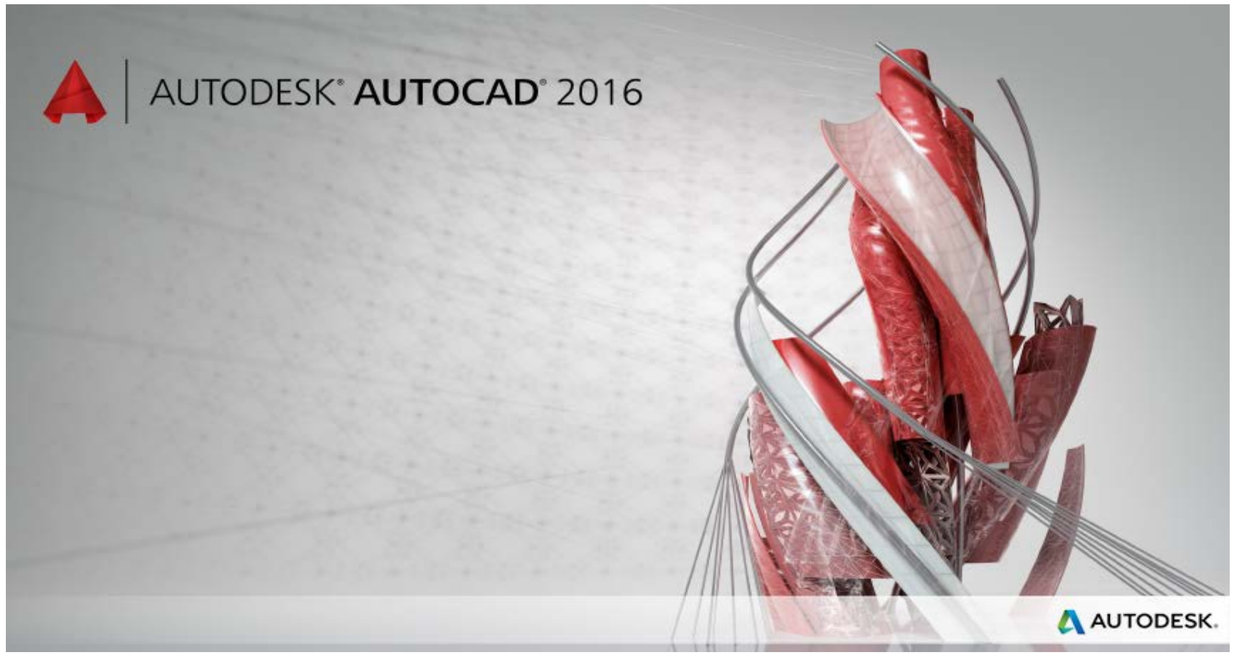

persp
front -Z


persp
persp1

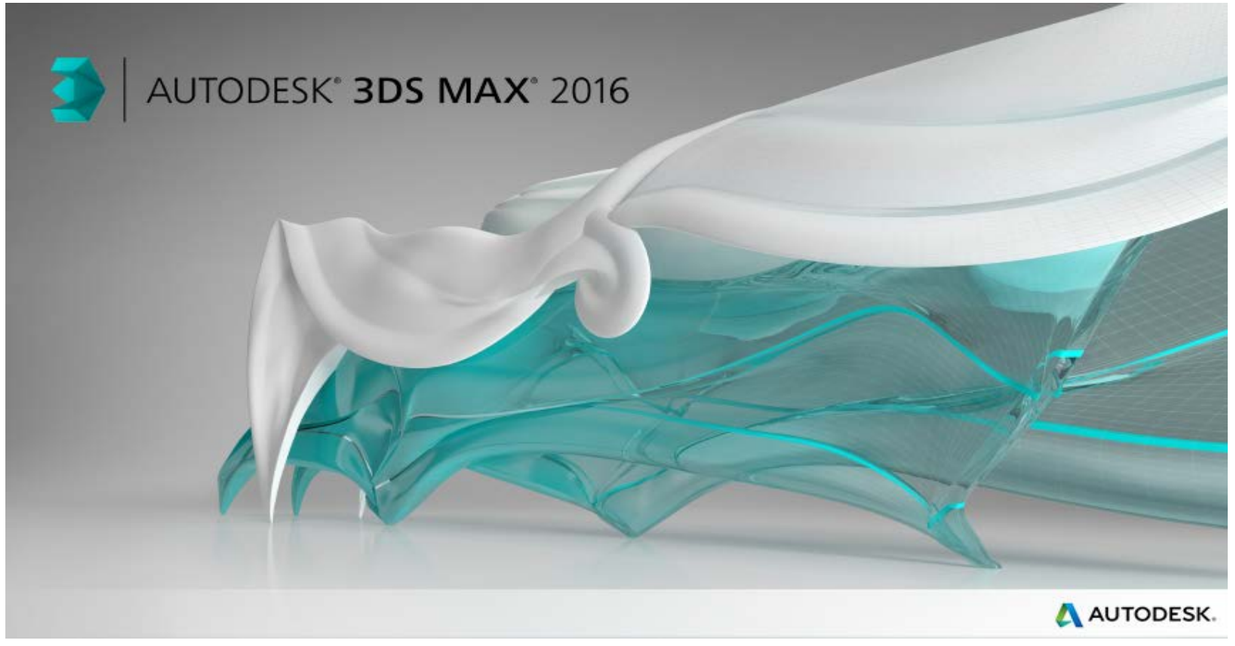

Tool Settings
Show Help
persp
top
front
side
New_Skeleton:Sterum_cartilage
New_Skeleton:teeth
New_Skeleton:jteeth01
New_Skeleton:coccyx
New_Skeleton:sacrum02
New_Skeleton:sympubis01
New_Skeleton:disks
New_Skeleton:c5
New_Skeleton:c6
New_Skeleton:clavical01
New_Skeleton:t8
New_Skeleton:t9
New_Skeleton:t10
New_Skeleton:t11
New_Skeleton:t12
New_Skeleton:t7
New_Skeleton:t6
New_Skeleton:t5
New_Skeleton:t4
New_Skeleton:t3
New_Skeleton:t2
New_Skeleton:t02
New_Skeleton:l02
New_Skeleton:l2
New_Skeleton:l3
New_Skeleton:l4
New_Skeleton:l5
New_Skeleton:c7
New_Skeleton:atlas
New_Skeleton:scapula01
View Shading Lighting Show Renderer Panels
persp
View Shading Lighting Show Renderer Panels
Bullet
Active Rigid Body
Passive Rigid Body
Ragdoll
Soft Body
Rigid Set
Rigid Body Constraint
Soft Body Anchor
Edit
Rigid Sets
Soft Body Vertex Properties
Add Colliders to Skeleton
Export
Export selection to Alembic...
Export all to Alembic...
Solver
Select Bullet Solver
Remove Bullet from Selection
Delete Entire Bullet System
Help
Bullet Help
persp1
Channels Edit Object Show
Scale Y 1
Scale Z 1
Visibility on
SHAPES
New_Skeleton:skull01Shape
bulletRigidBodyShape67
Initial Velocity X 0
Initial Velocity Y 0
Initial Velocity Z 0
Initial Angular Velocity X 0
Initial Angular Velocity Y 0
Initial Angular Velocity Z 0
Impulse X 0
Impulse Y 0
Impulse Z 0
Impulse Position X 0
Impulse Position Y 0
Impulse Position Z 0
Torque Impulse X 0
Torque Impulse Y 0
Torque Impulse Z 0
Mass 0.1
Center Of Mass X 0
Center Of Mass Y 20.5
Center Of Mass Z -0.995
Collider Shape Offset X 0
Collider Shape Offset Y 0
Collider Shape Offset Z 0
Linear Damping 0
Angular Damping 0
Friction 1
Restitution 0
Collider Shape Type hull
Body Type Dynami...
Length 7.513
Radius 3.756
Extents X 6.198
Extents Y 6.919
Extents Z 7.513
Initially Sleeping off
Never Sleeps off
Axis Y
Auto Fit on
Collider Shape Margin 0.04
INPUTS
translateRotate66
Channel Box / Layer Editor
Modeling Toolkit
Attribute Editor
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130
1

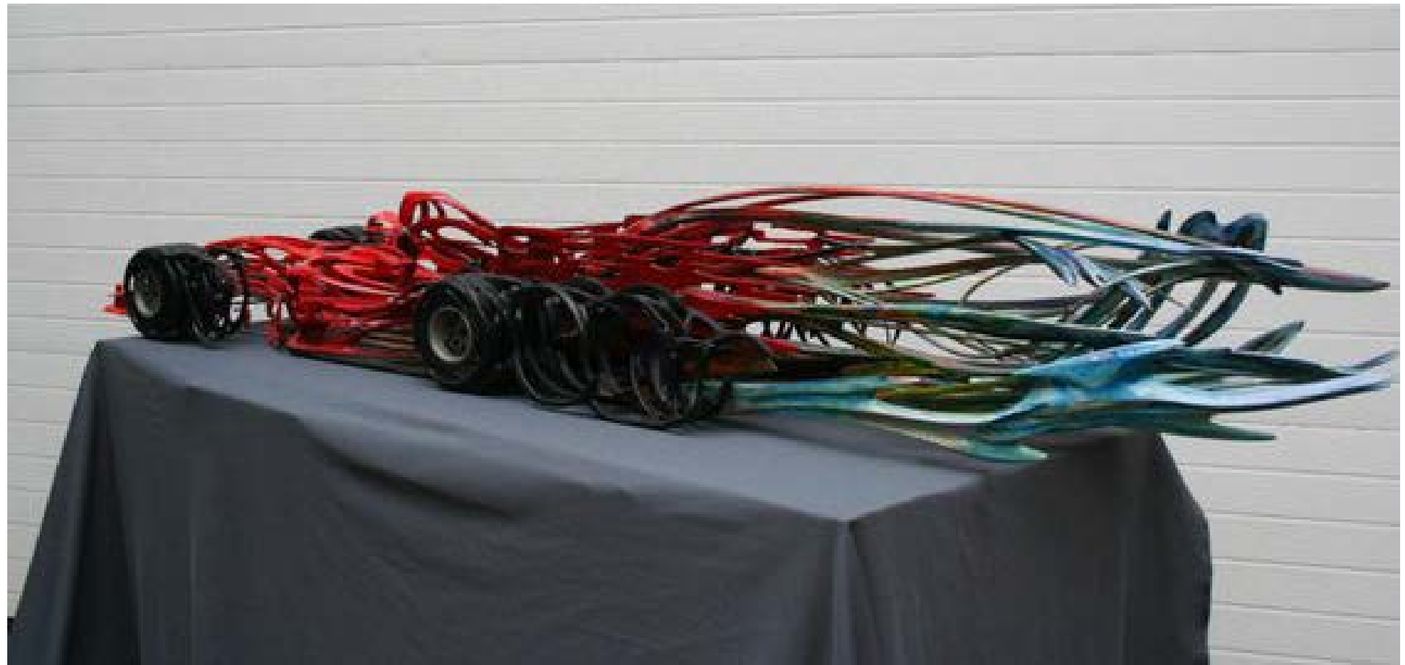
3D Printing Motion


AUTODESK® MAYA® 2014
AUTODESK.


AUTODESK® AUTOCAD® 2016
AUTODESK.


AUTODESK® ALIAS® AUTOMOTIVE 2014
AUTODESK.


AUTODESK® 3DS MAX® 2016
AUTODESK.



Types of 3D Printable Animation

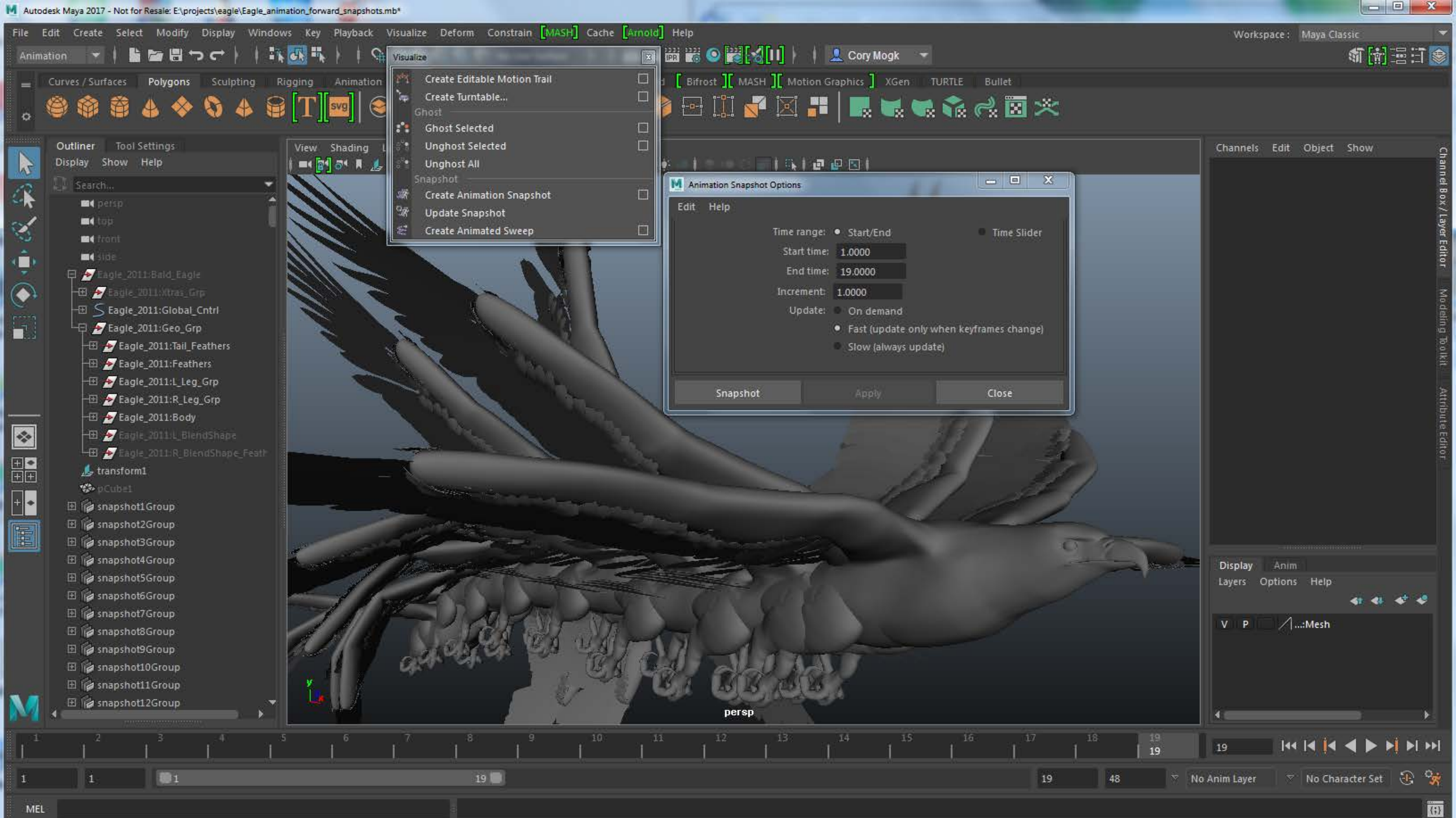
Stamps

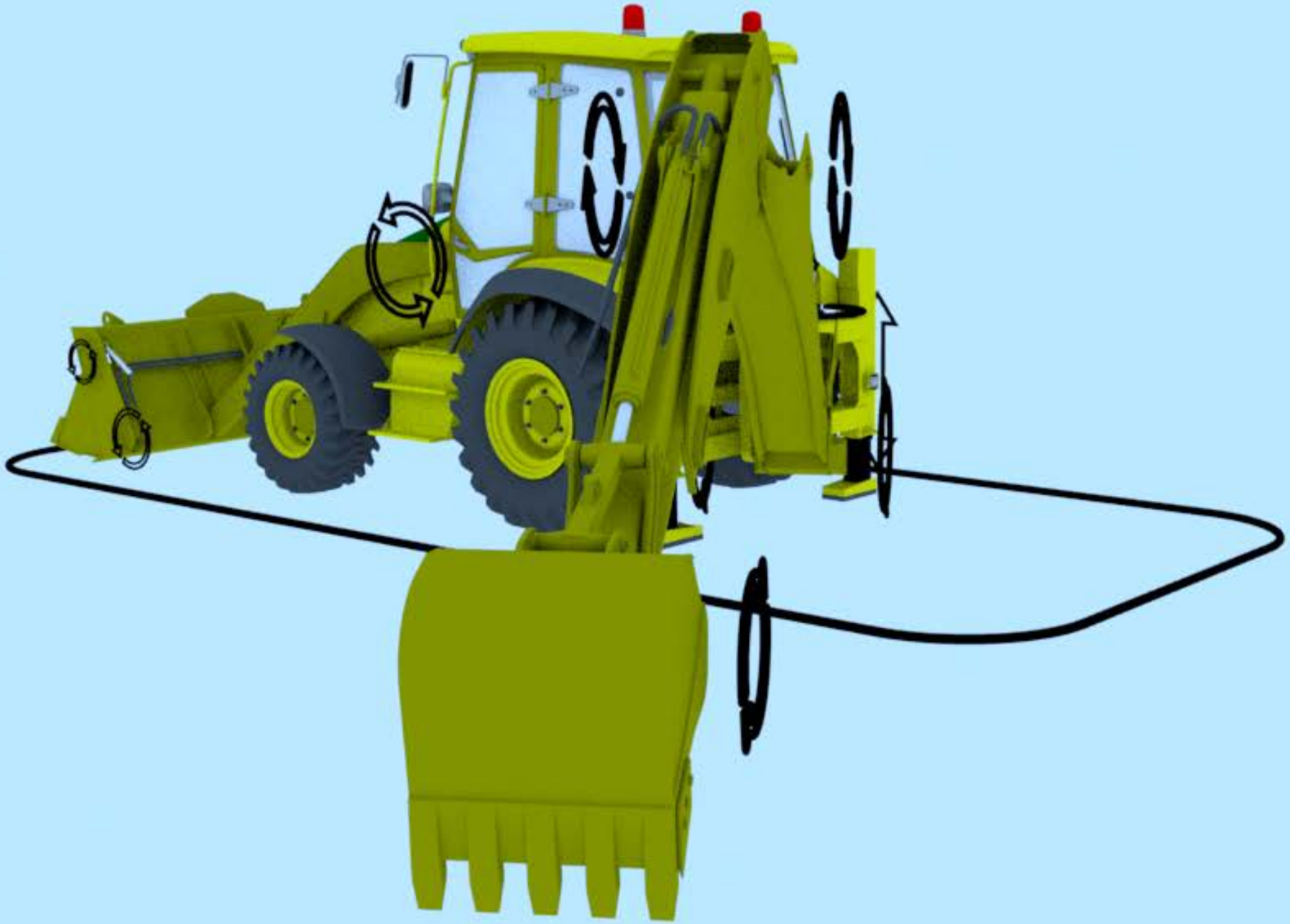
Motion Trails
& Sweeps

Particles

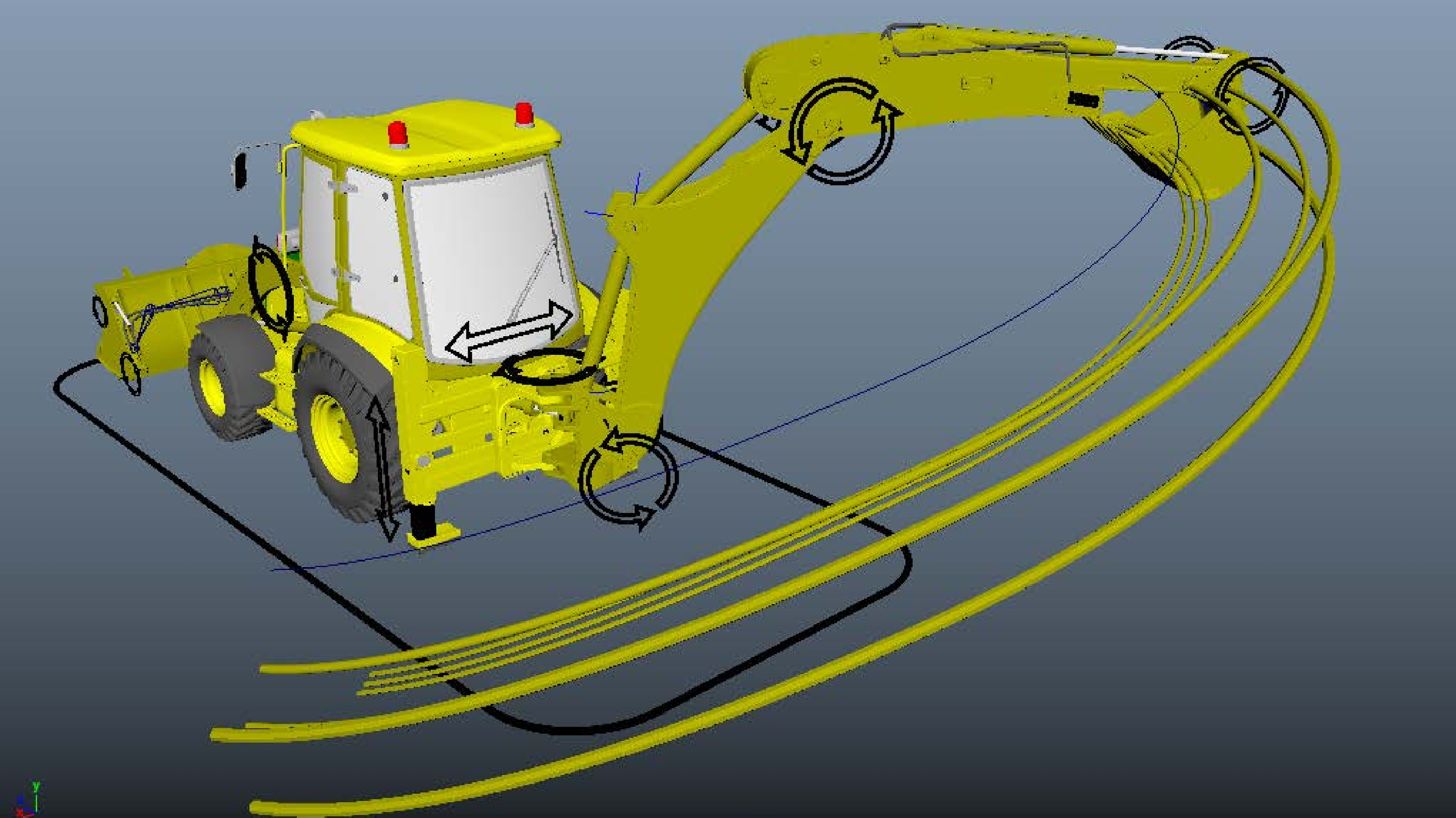
Stamps

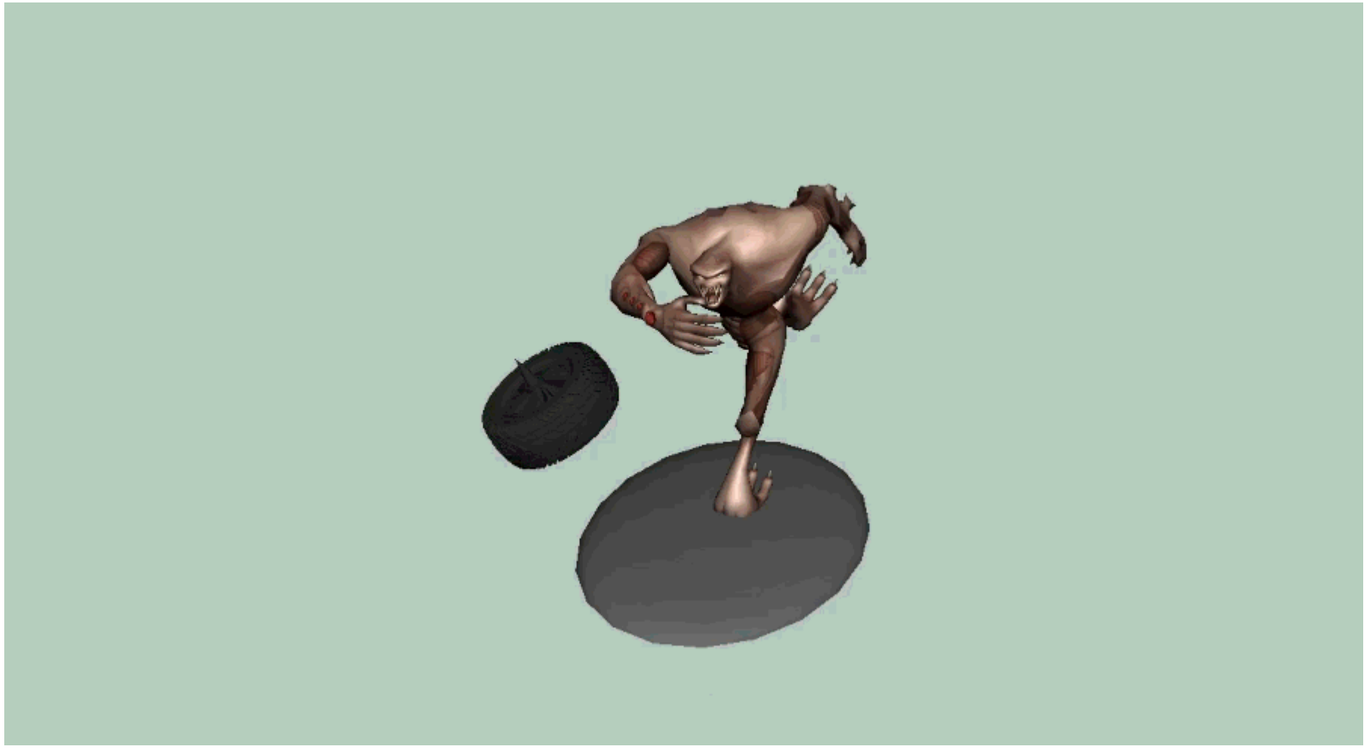

CHRONO-TAB

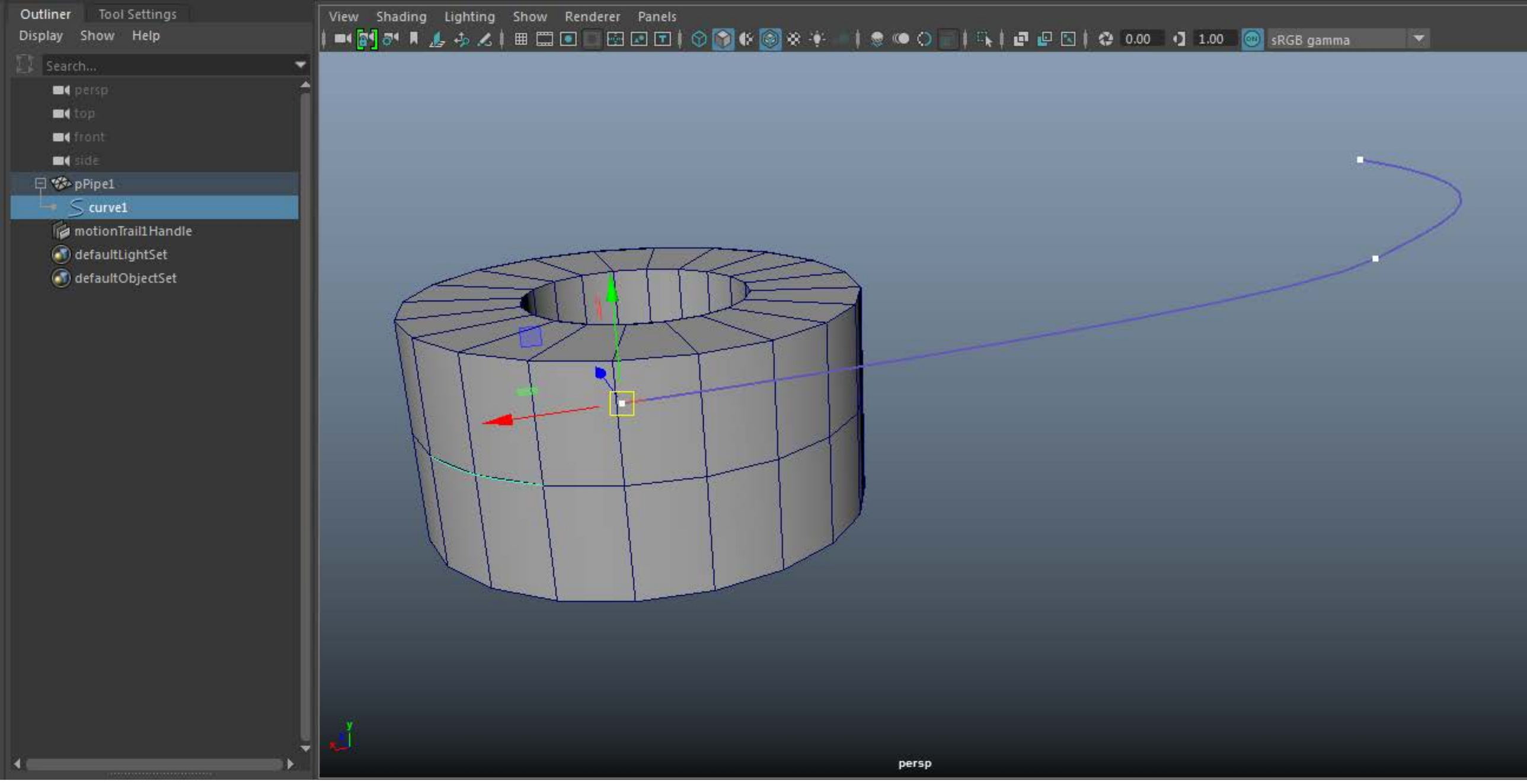

Autodesk Maya 2017 - Not for Resale: E:\projects\eagle\Eagle_animation_forward_snapshots.mb*
File Edit Create Select Modify Display Windows Key Playback Visualize Deform Constrain [MASH] Cache [Arnold] Help
Workspace : Maya Classic
Animation
Cory Mogk
Curves / Surfaces Polygons Sculpting Rigging Animation
Bifrost MASH Motion Graphics XGen TURTLE Bullet
Visualize
Create Editable Motion Trail
Create Turntable...
Ghost
Ghost Selected
Unghost Selected
Unghost All
Snapshot
Create Animation Snapshot
Update Snapshot
Create Animated Sweep
Outliner Tool Settings
Display Show Help
Search...
persp
top
front
side
Eagle_2011:Bald_Eagle
Eagle_2011:Xtras_Grp
Eagle_2011:Global_Cntrl
Eagle_2011:Geo_Grp
Eagle_2011:Tail_Feathers
Eagle_2011:Feathers
Eagle_2011:L_Leg_Grp
Eagle_2011:R_Leg_Grp
Eagle_2011:Body
Eagle_2011:L_BlendShape
Eagle_2011:R_BlendShape_Feath
transform1
pCube1
snapshot1Group
snapshot2Group
snapshot3Group
snapshot4Group
snapshot5Group
snapshot6Group
snapshot7Group
snapshot8Group
snapshot9Group
snapshot10Group
snapshot11Group
snapshot12Group
View Shading
Animation Snapshot Options
Edit Help
Time range: Start/End
Time Slider
Start time: 1.0000
End time: 19.0000
Increment: 1.0000
Update: On demand
Fast (update only when keyframes change)
Slow (always update)
Snapshot
Apply
Close
persp
Channels Edit Object Show
Display Anim
Layers Options Help
V P ...:Mesh
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
19
1 1 1 19 19 48 No Anim Layer No Character Set
MEL

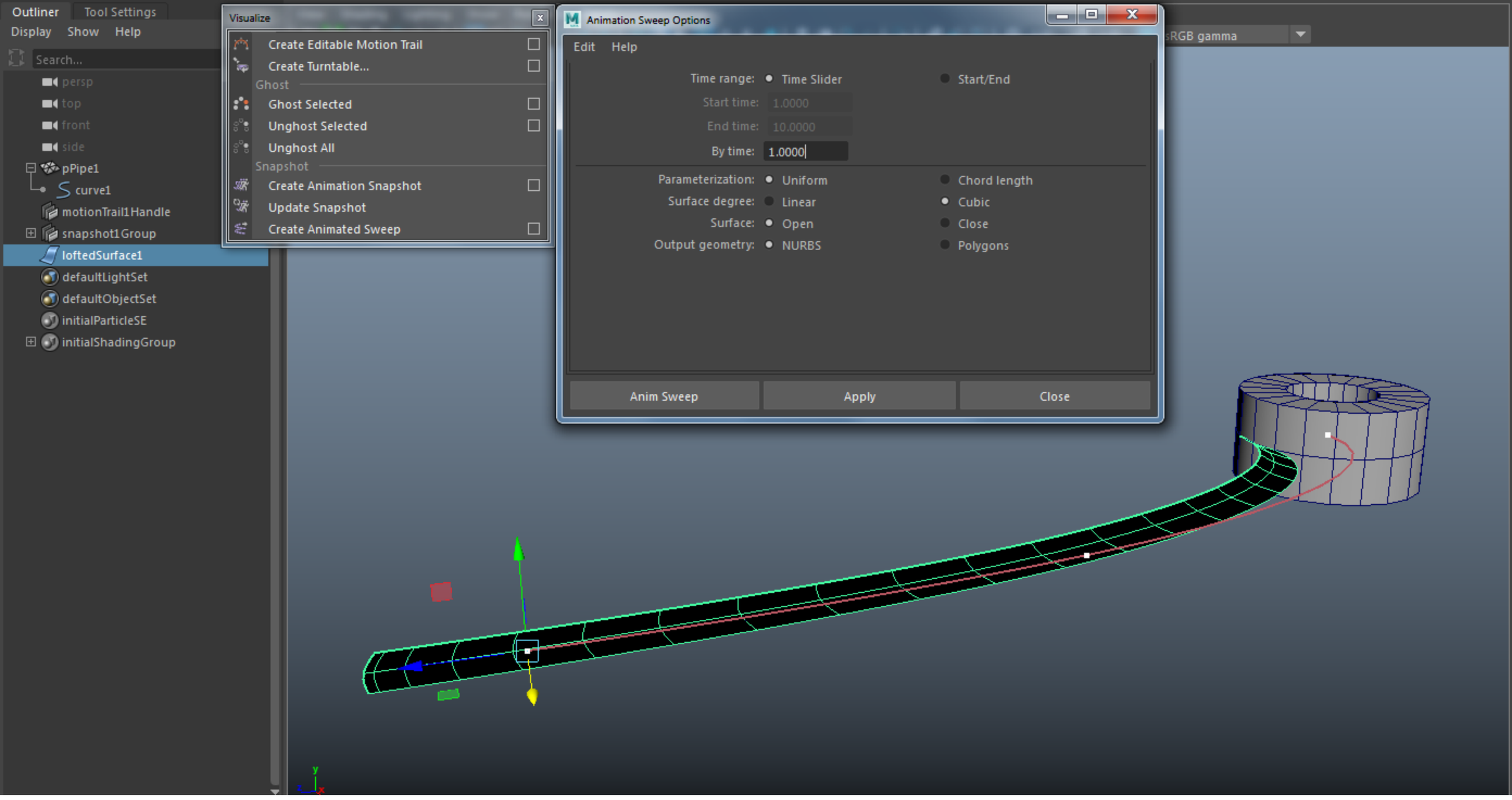


Motion Trails & Sweeps






Outliner
Tool Settings
Display
Show
Help
Search...
persp
top
front
side
pPipe1
curve1
motionTrail1Handle
defaultLightSet
defaultObjectSet
View
Shading
Lighting
Show
Renderer
Panels
0.00
1.00
sRGB gamma
persp


Outliner
Tool Settings
Display
Show
Help
Search...
persp
top
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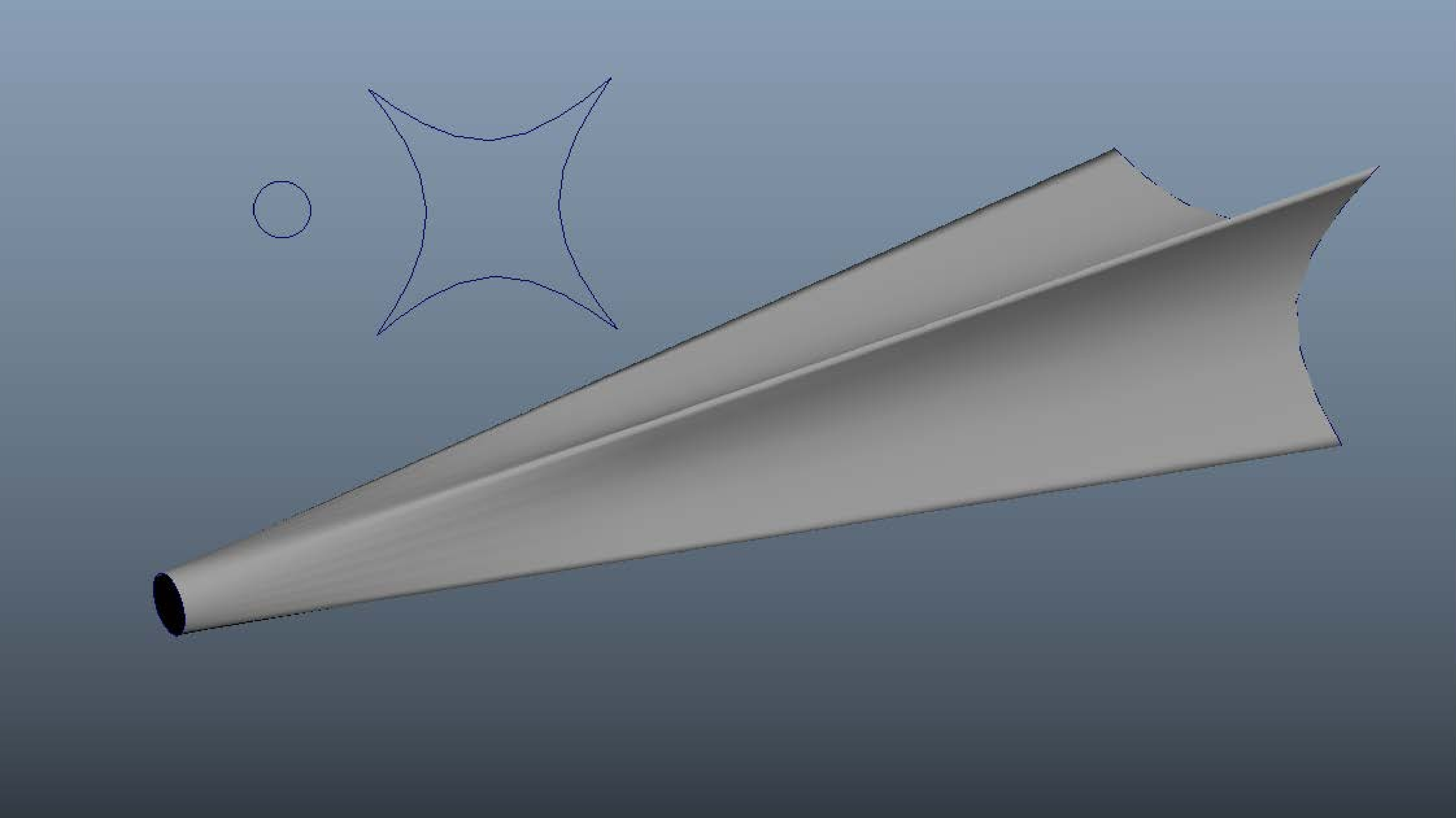
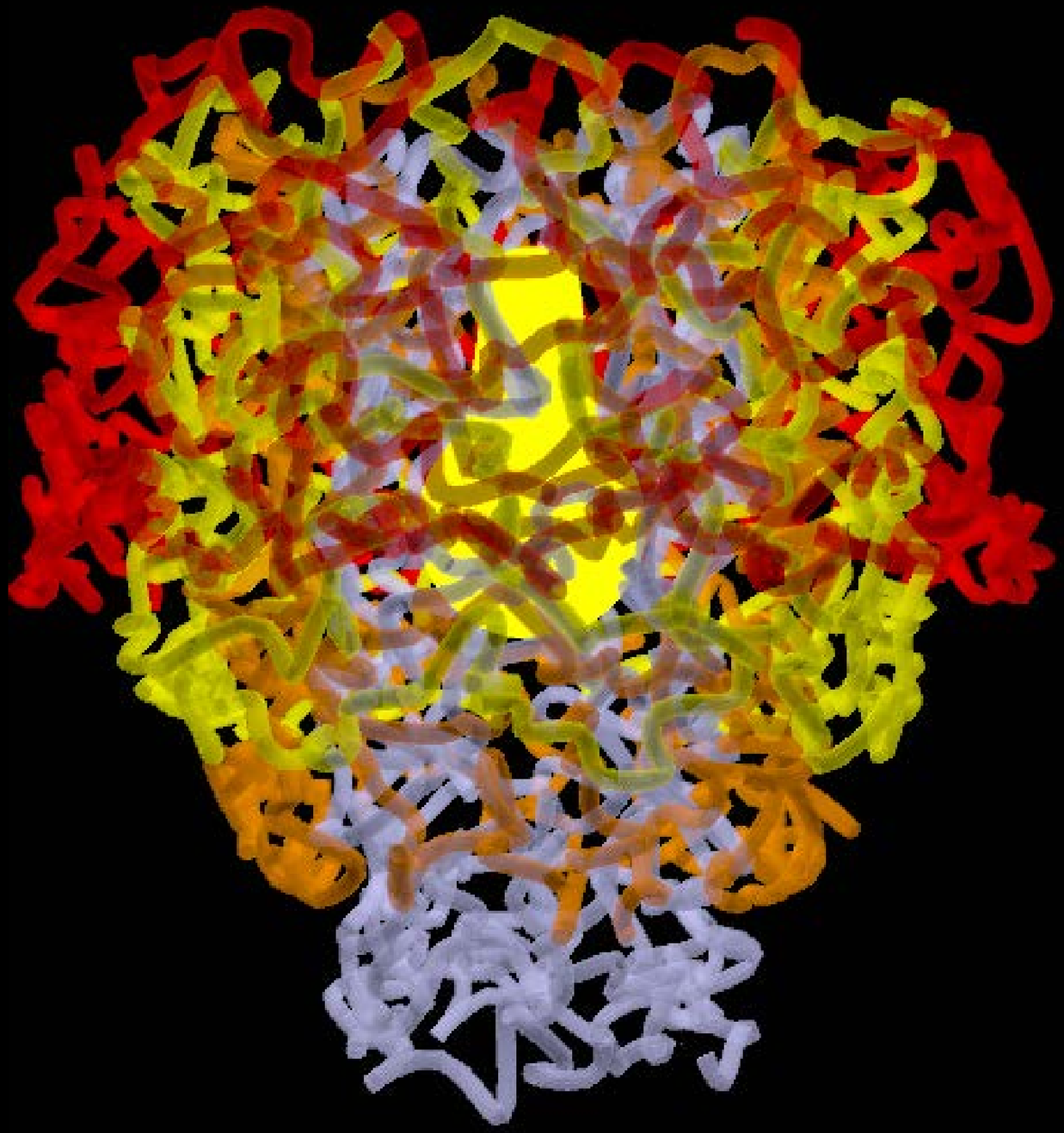
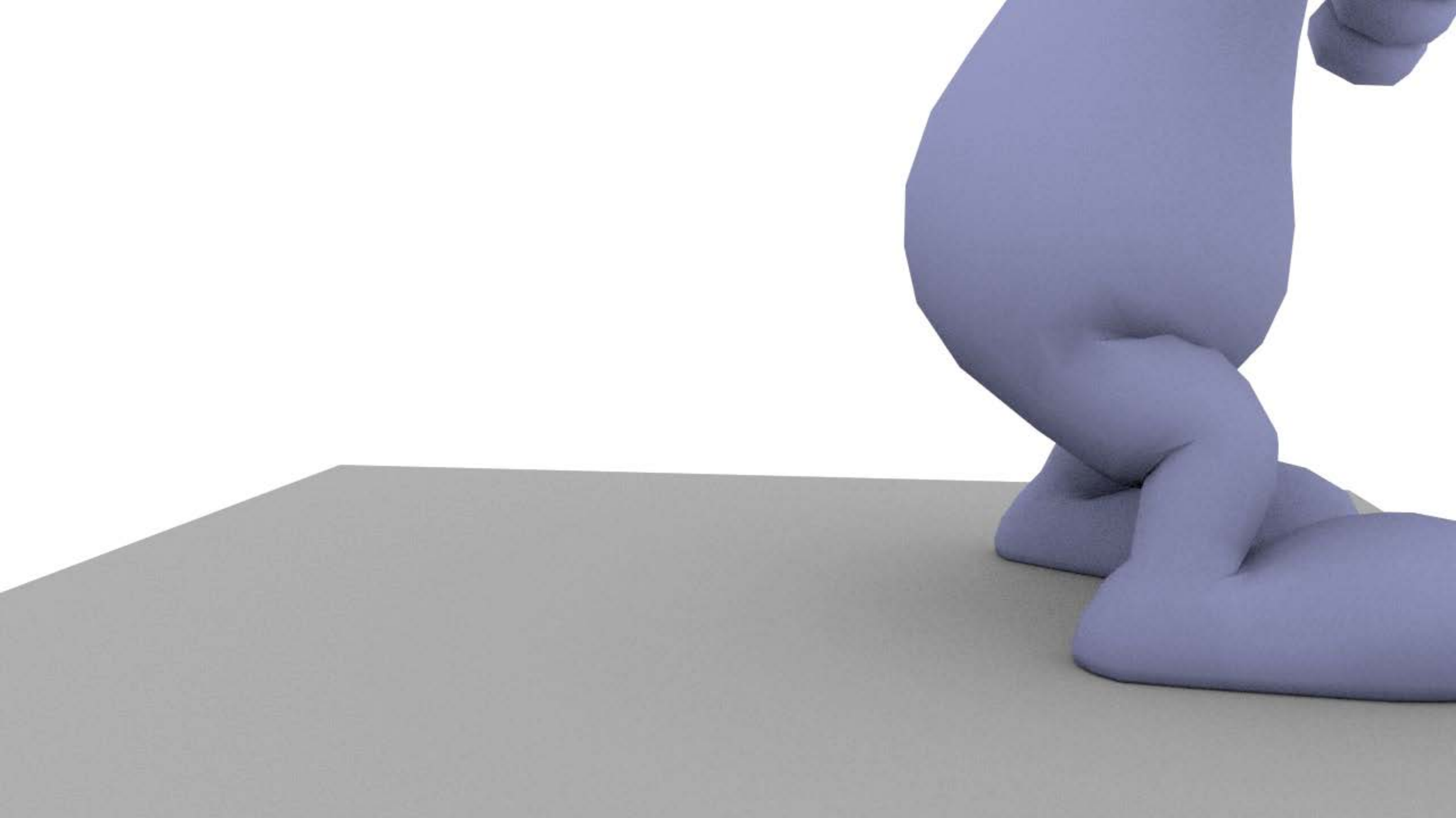
curve1
motionTrail1Handle
snapshot1Group
loftedSurface1
defaultLightSet
defaultObjectSet
initialParticleSE
initialShadingGroup
Visualize
Create Editable Motion Trail
Create Turntable...
Ghost
Ghost Selected
Unghost Selected
Unghost All
Snapshot
Create Animation Snapshot
Update Snapshot
Create Animated Sweep
Animation Sweep Options
Edit
Help
Time range:
Time Slider
Start/End
Start time:
1.0000
End time:
10.0000
By time:
1.0000
Parameterization:
Uniform
Chord length
Surface degree:
Linear
Cubic
Surface:
Open
Close
Output geometry:
NURBS
Polygons
Anim Sweep
Apply
Close
RGB gamma






Share
Download
LEFT
FRONT

Particles



What did we talk about?

- 3D Printing vs CG Visualization
- Designing for Moving Parts
- Dynamic packing
- Representing motion in 3D Prints

@CoryMogk Cory.Mogk@Autodesk.com

How did I do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**