



# Computer Graphics Human Computer Interaction

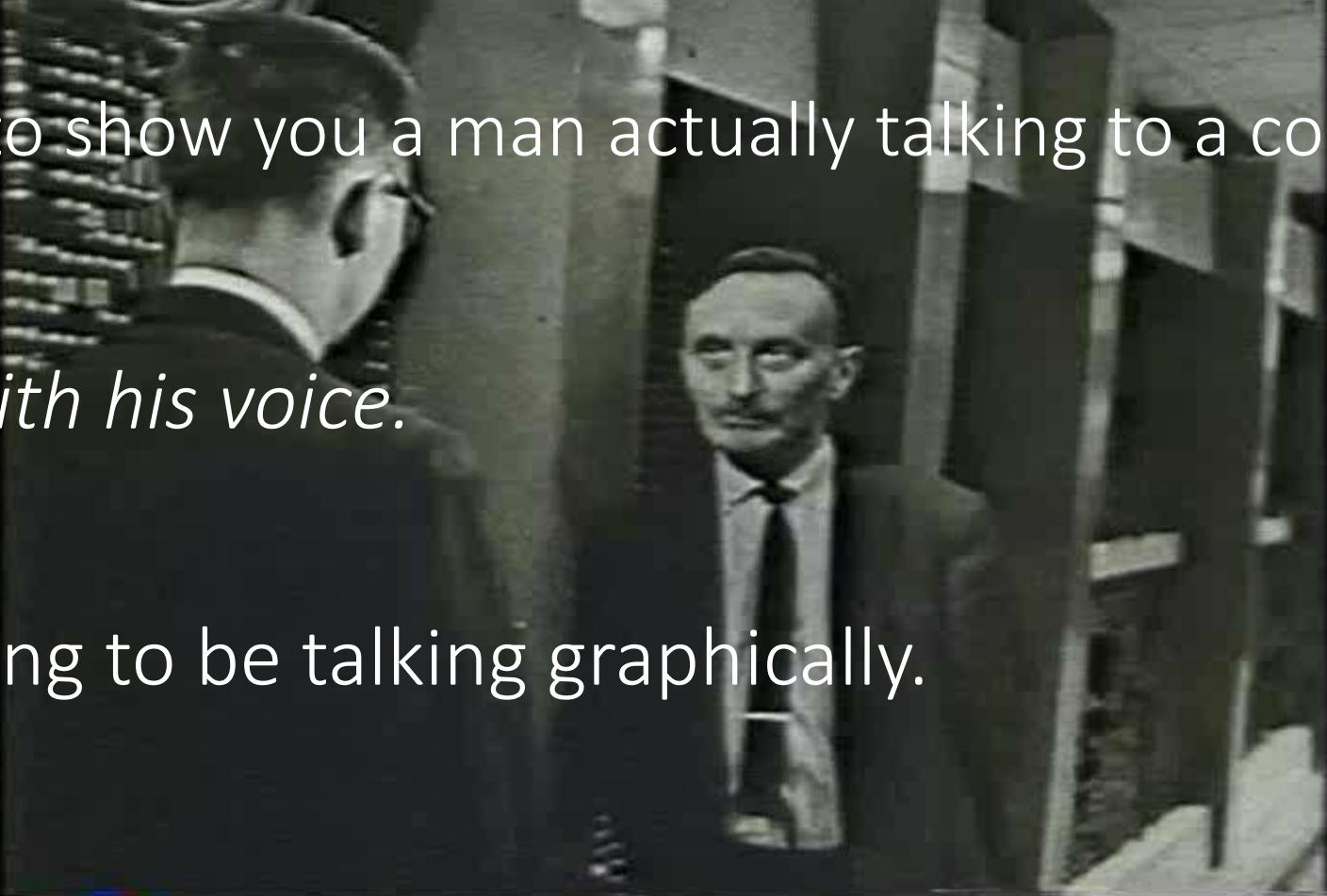
dgp



# ...On Creative Visual Communication

Karan Singh

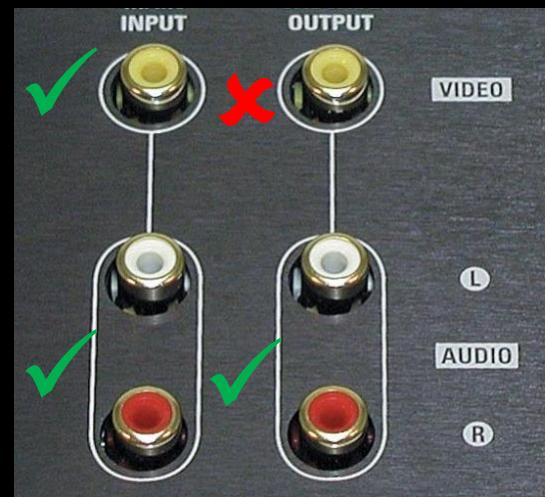
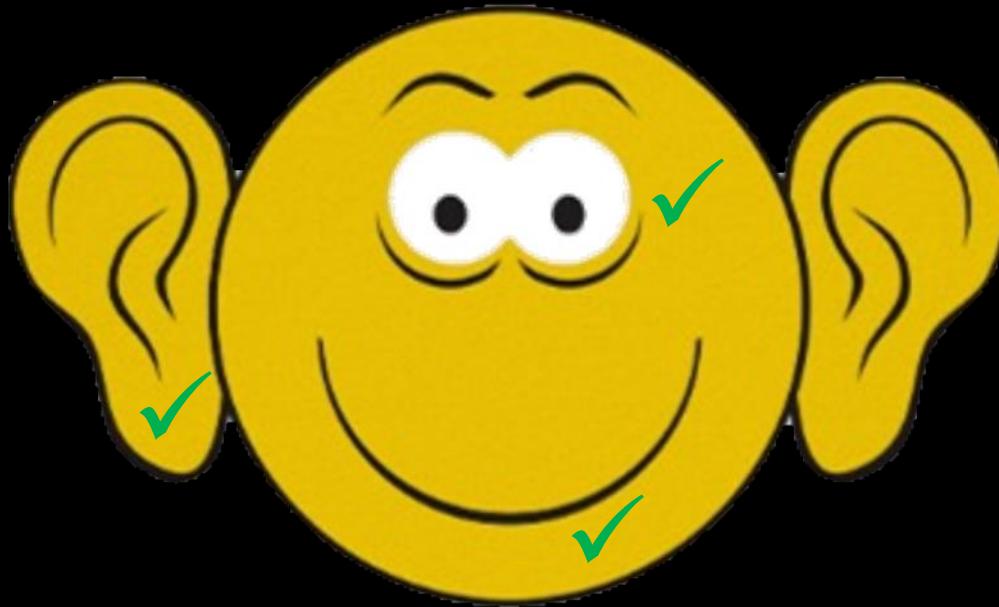




We're going to show you a man actually talking to a computer.

*Surely not with his voice.*

No! He is going to be talking graphically.



# Art + Interaction + AI

- Sketch | Sculpt | Color.
- AR | VR.
- Characters | Faces.

Sketch | Sculpt | Color

# I ❤ SKETCH: multi-view sketching

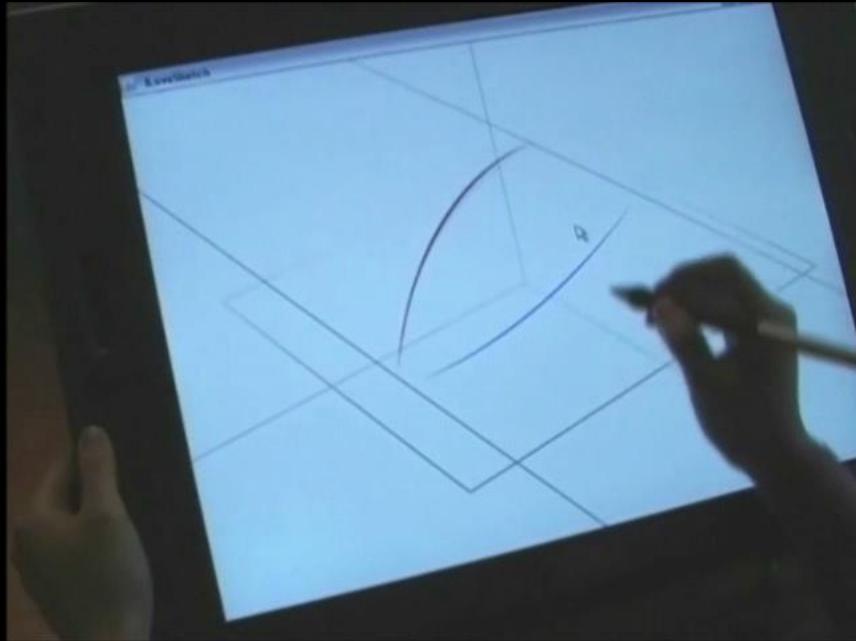


[ILoveSketch: As-natural-as-possible sketching system for creating 3D curve models. Bae, Balakrishnan & Singh, ACM UIST 2008]

[EverybodyLovesSketch: 3D Sketching for a Broader Audience. Bae, Balakrishnan & Singh, ACM UIST 2009]

[www.ilovesketch.com](http://www.ilovesketch.com)

# I ❤ SKETCH: multi-view sketching

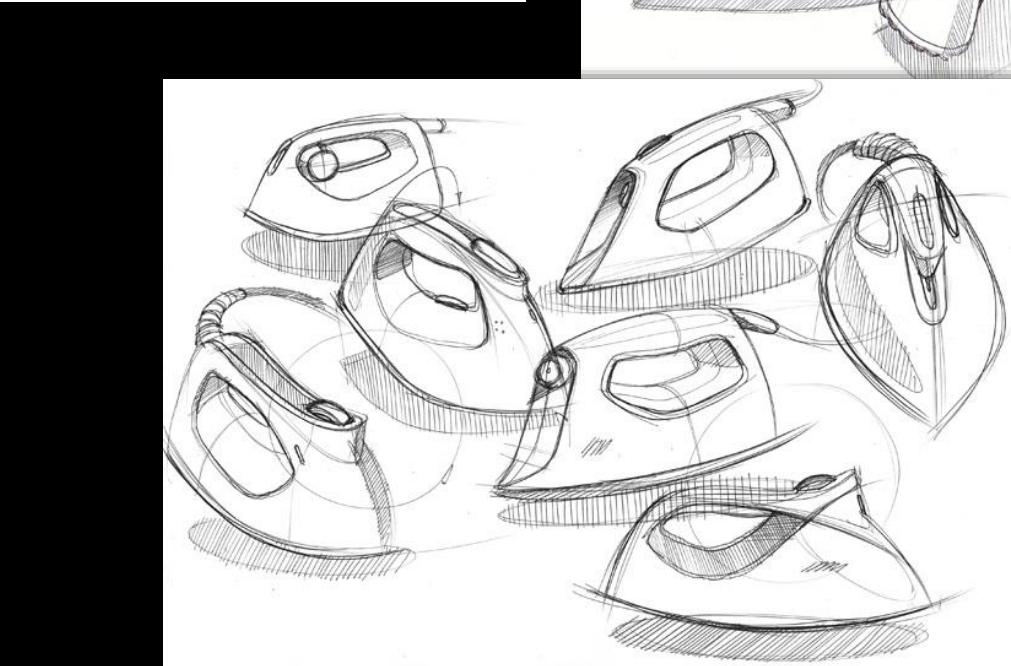
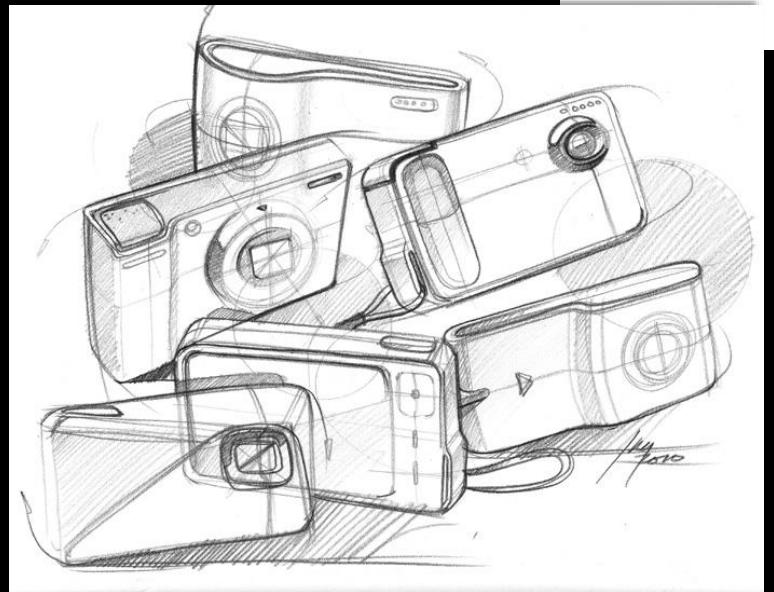
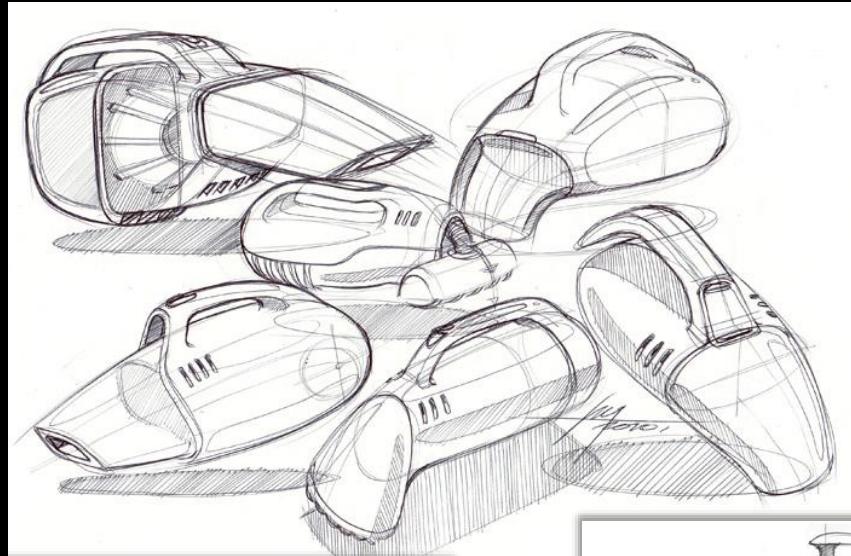
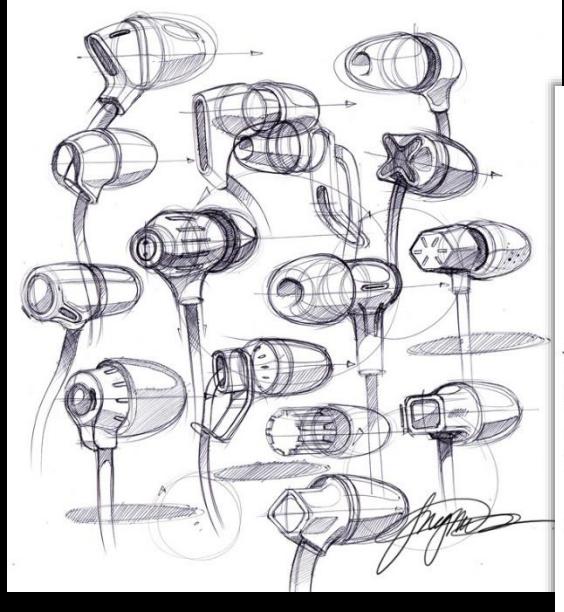


[ILoveSketch: As-natural-as-possible sketching system for creating 3D curve models. Bae, Balakrishnan & Singh, ACM UIST 2008]

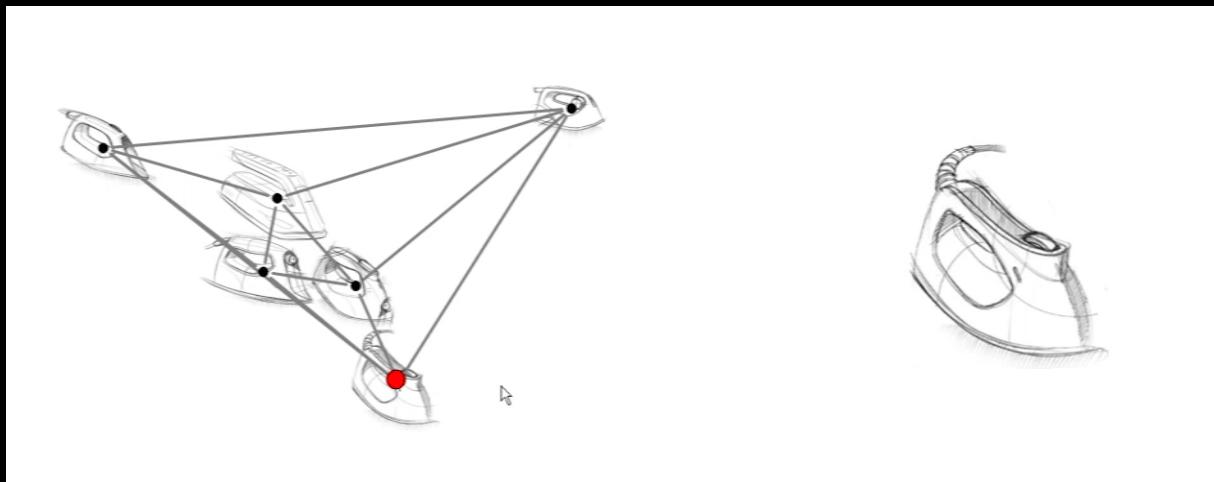
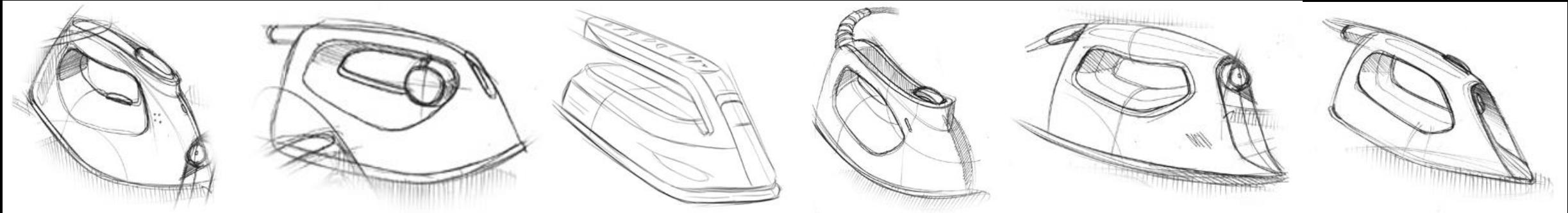
[EverybodyLovesSketch: 3D Sketching for a Broader Audience. Bae, Balakrishnan & Singh, ACM UIST 2009]

[www.ilovesketch.com](http://www.ilovesketch.com)

# Ideation

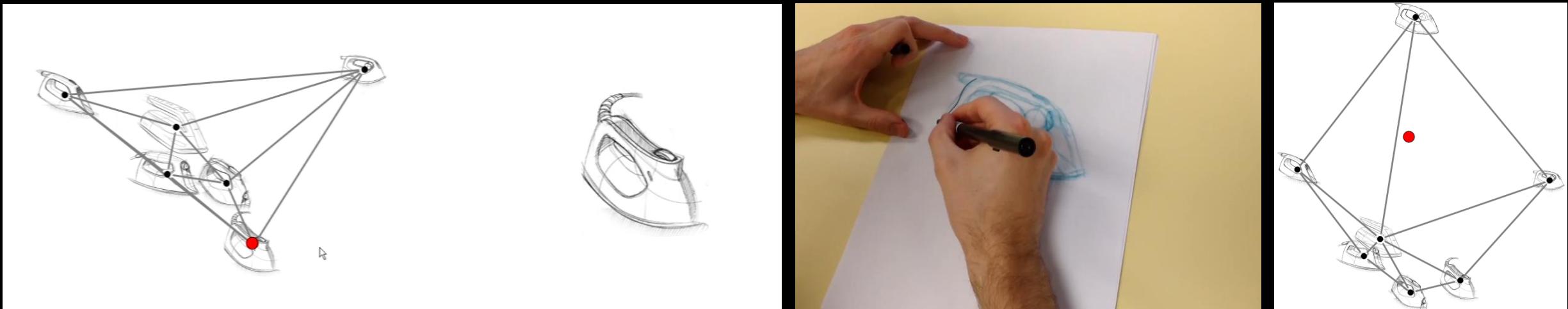
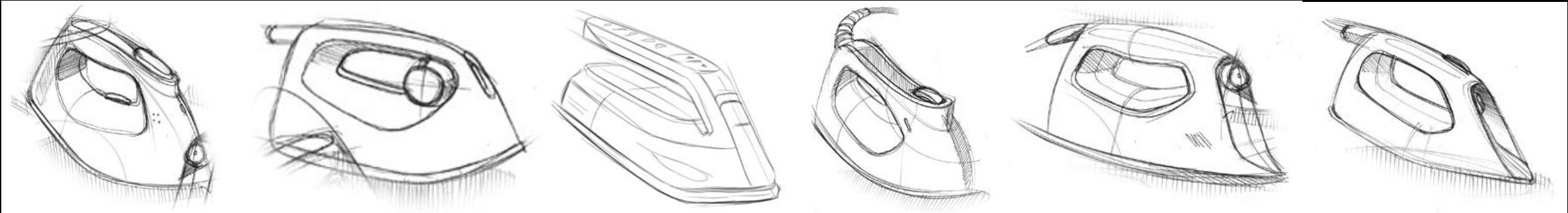


# SketchSoup

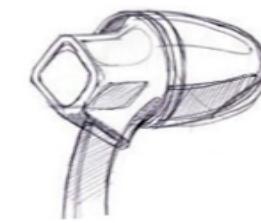
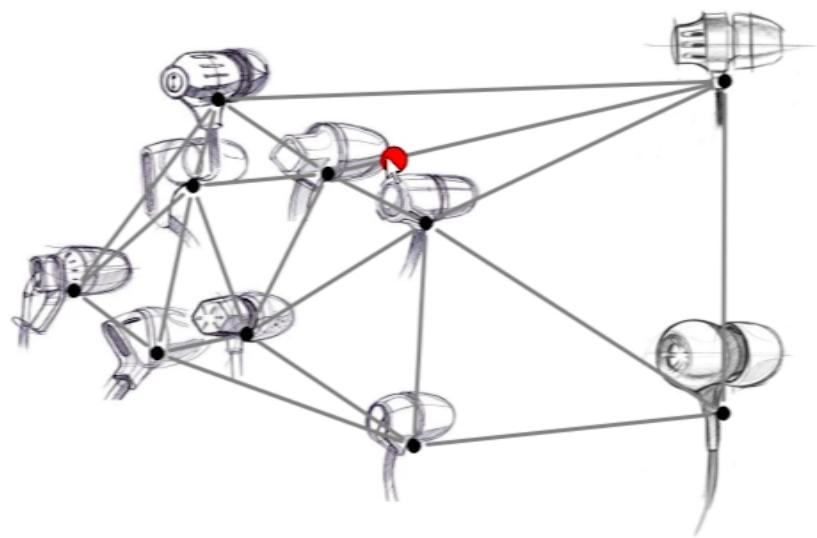


[SketchSoup: Exploratory Ideation using Design Sketches. Arora, Darolia, Namboodiri, Singh, Bousseau, *CGF 2017*]

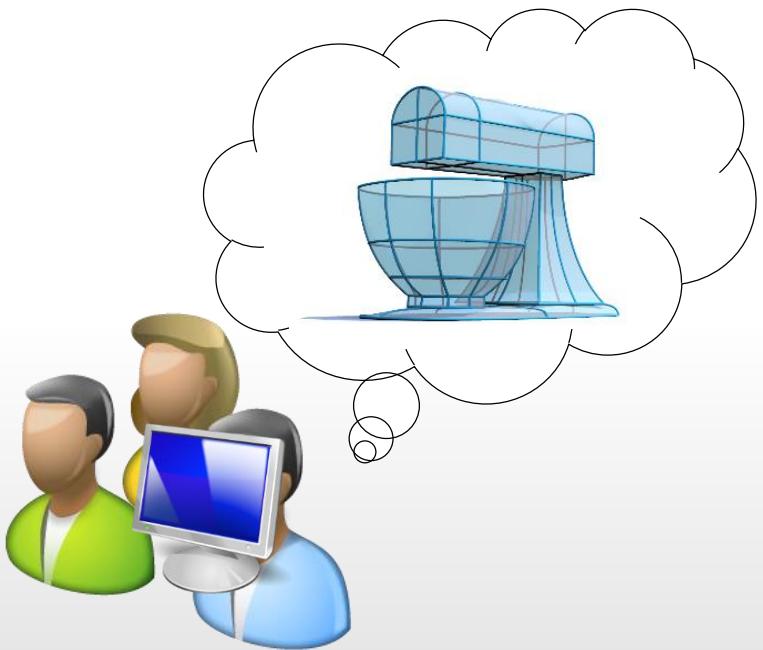
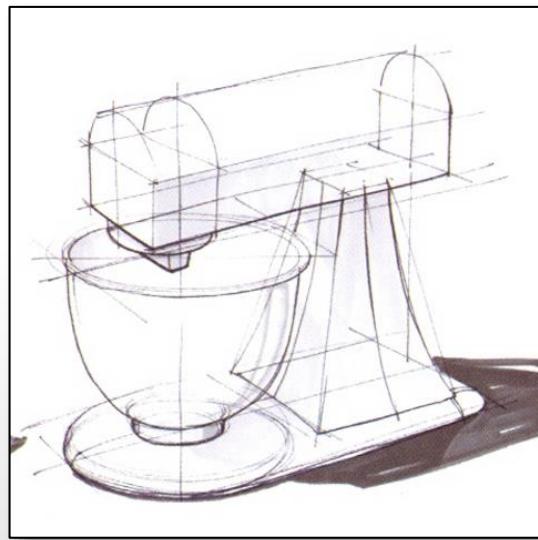
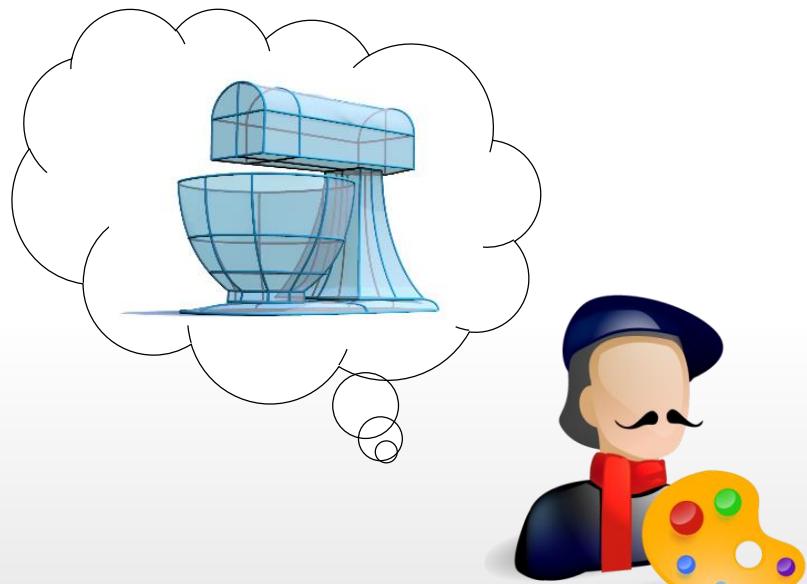
# SketchSoup



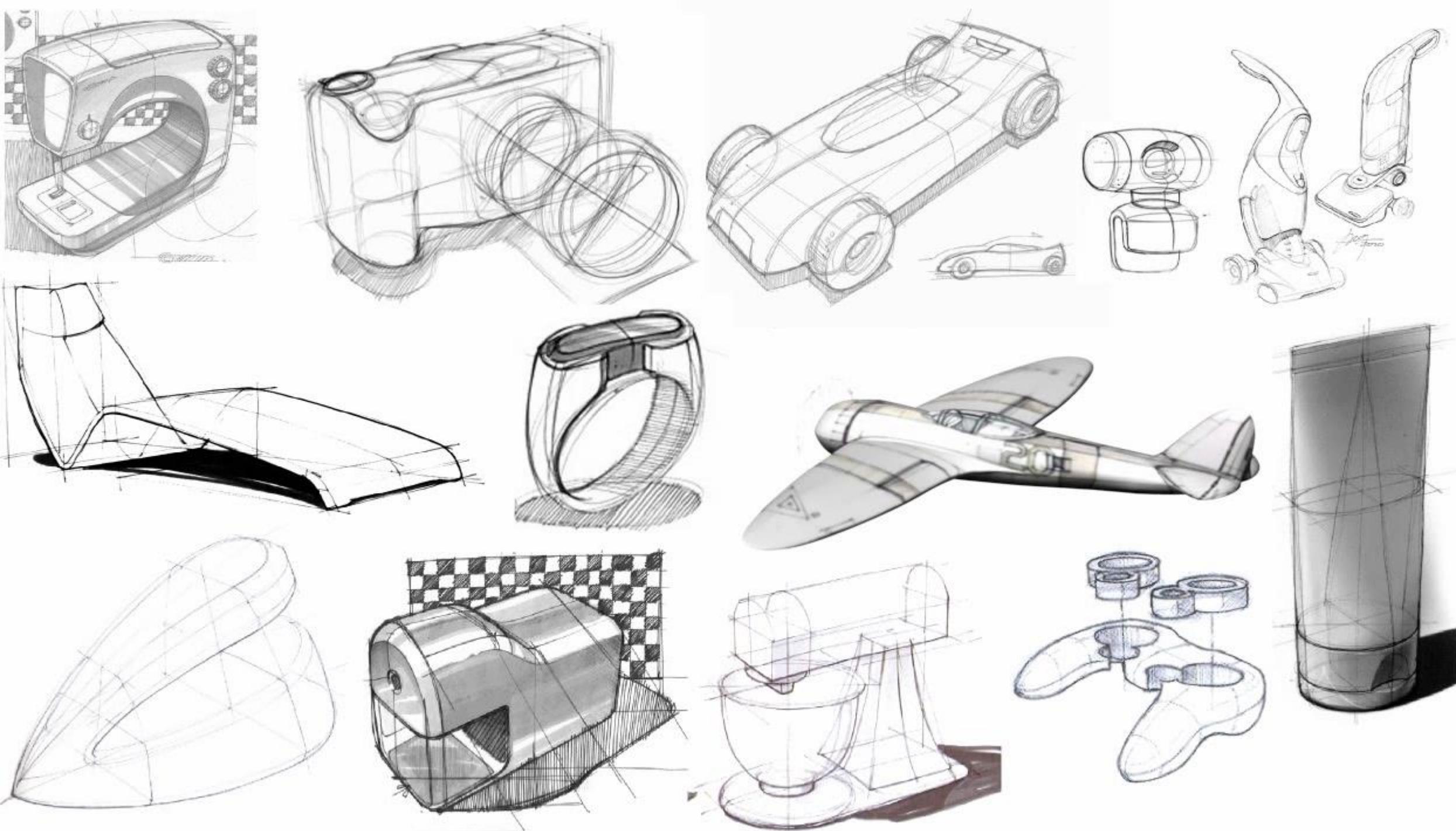
[SketchSoup: Exploratory Ideation using Design Sketches. Arora, Darolia, Namboodiri, Singh, Bousseau, *CGF 2017*]



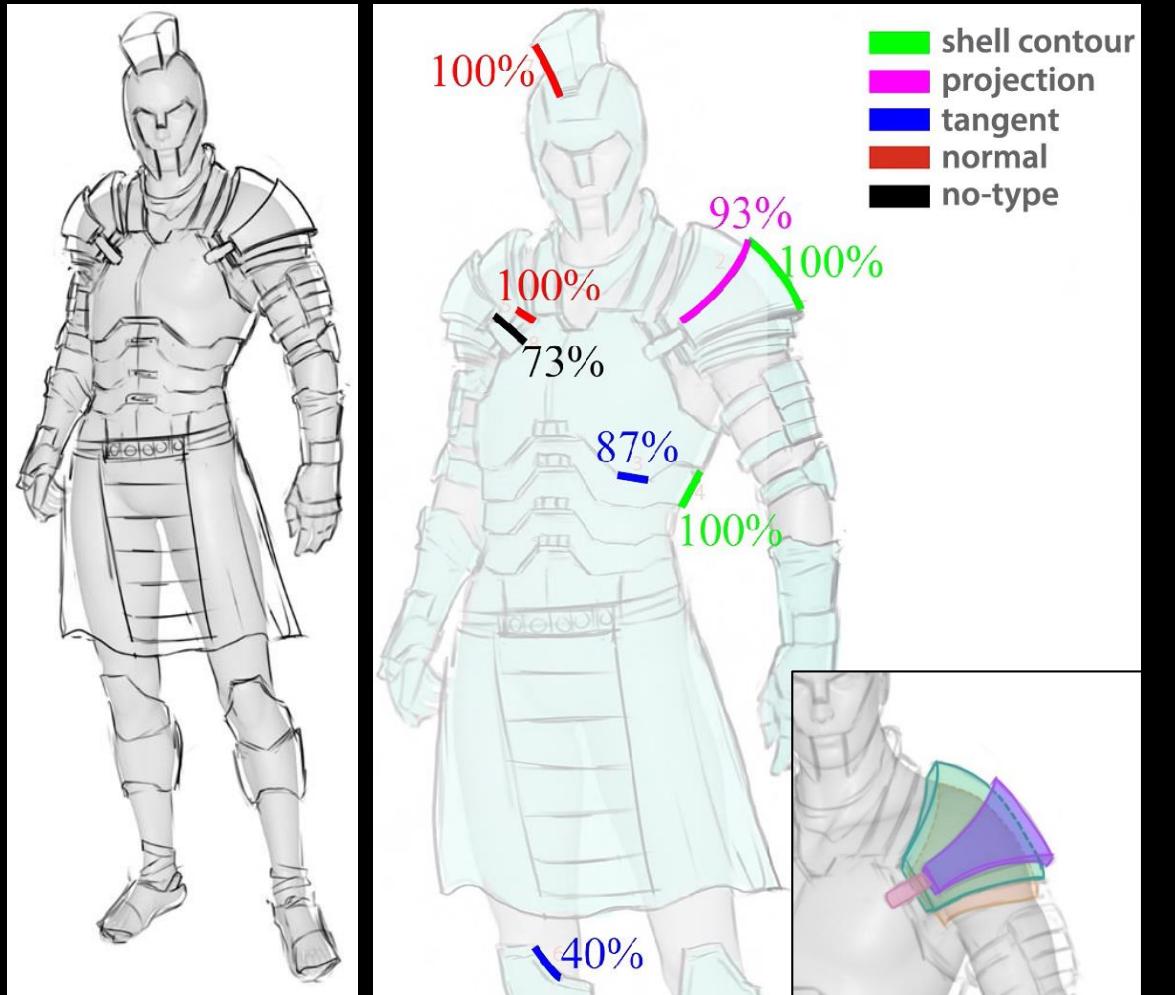
# True2Form: Conceptual 3D Modeling



[True2Form: 3D curve networks from 2D sketches via selective regularization, Xu, Chang, Bousseau, McCrae, Sheffer, Singh. SIGGRAPH 2014]



# SecondSkin

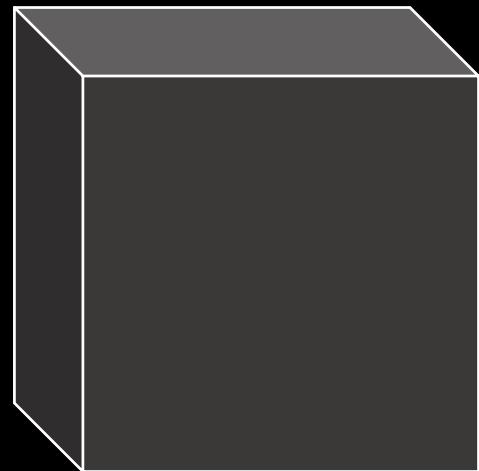


[SecondSkin: Sketch-based Construction of Layered 3D Models. DePaoli & Singh, SIGGRAPH, 2015]

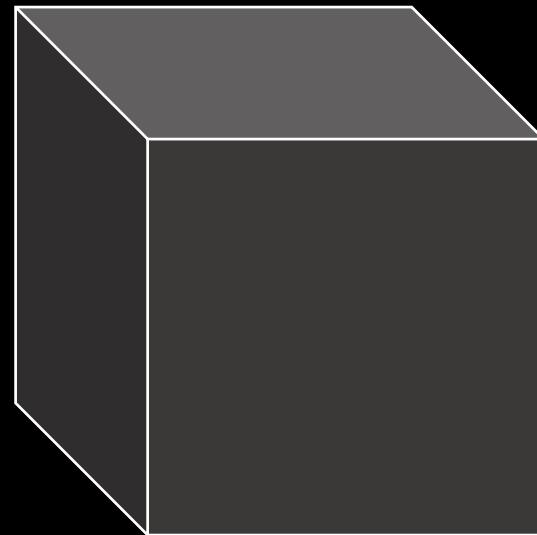


+

biased  
Humans have a<sup>A</sup> video IN!



A



B

[On expert performance in 3D curve drawing tasks. Schmidt, Khan, Kurtenbach, Singh, *SBIM 2009*]  
[www.dgp.toronto.edu/~rms/data/CurveDrawing](http://www.dgp.toronto.edu/~rms/data/CurveDrawing)

# Is it easier to infer planar curves?

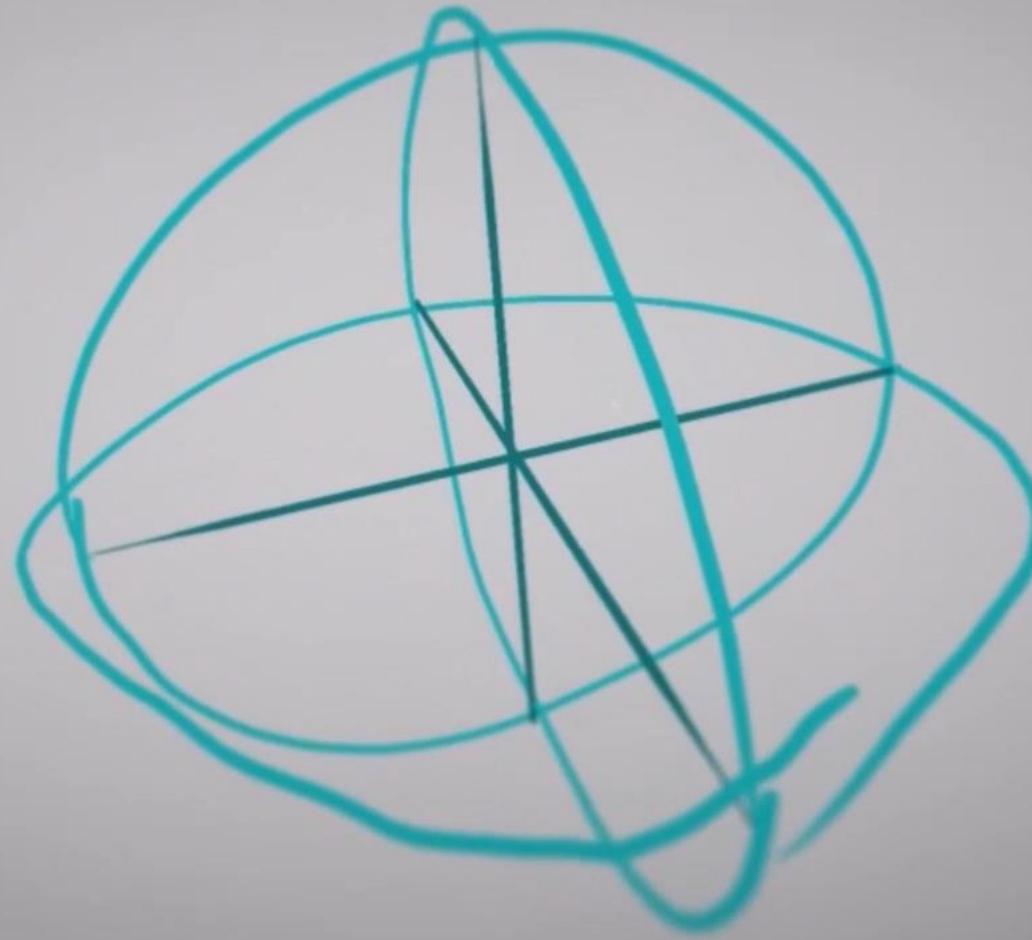


[FlatFitFab: Interactive Modeling with Planar Sections. McCrae, Umetani, Singh, ACM UIST 2014]  
<http://www.flatfab.com>



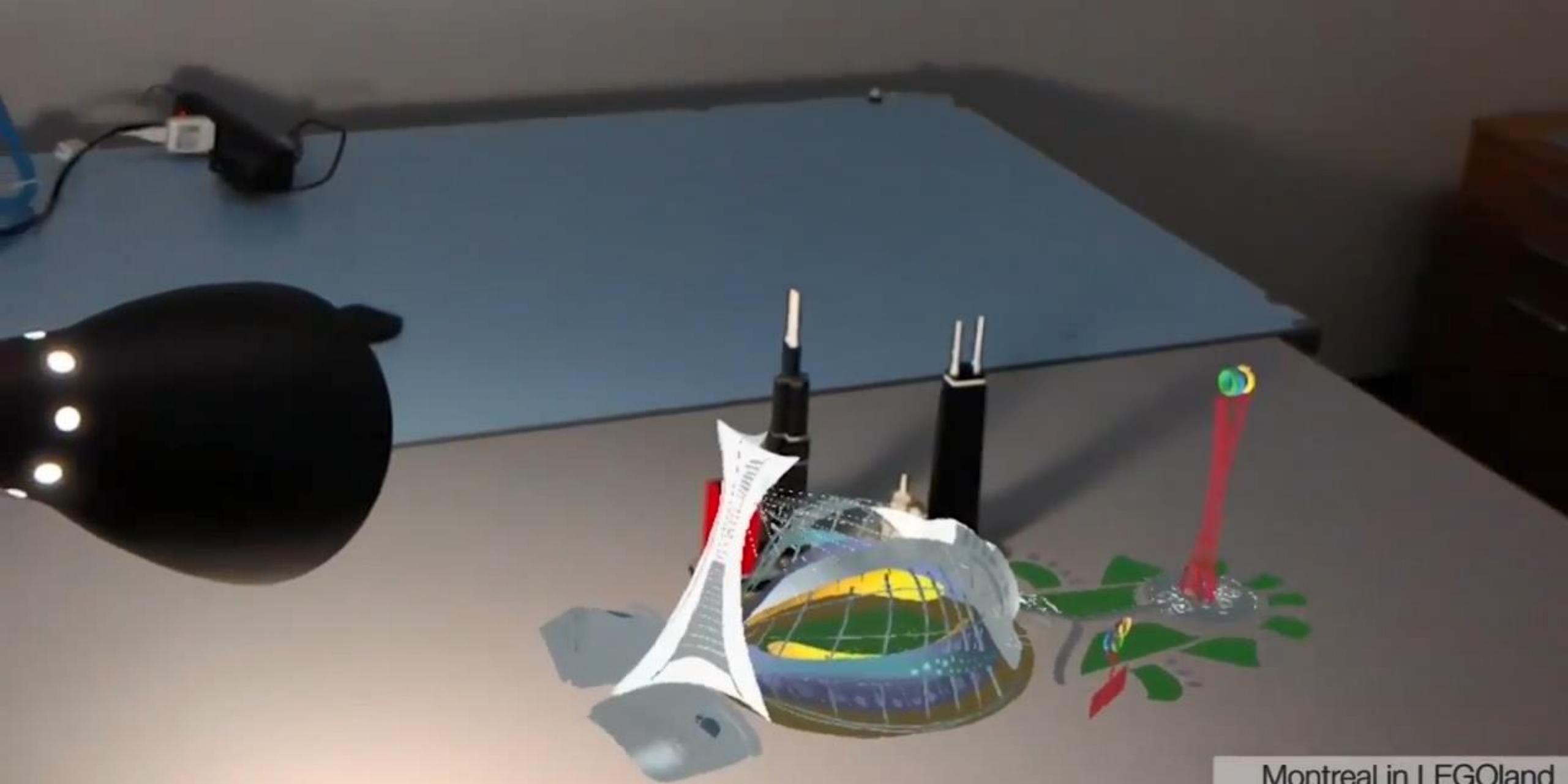
**flatfab**

# Is it easier to draw in 3D?



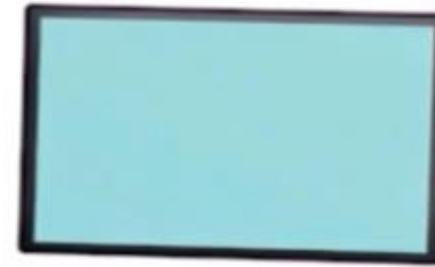
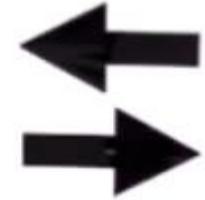
Tilt Brush  
by Google

[Experimental evaluation of sketching on surfaces in VR. Arora, Kazi, Anderson, Grossman, Singh, SIGCHI 2017]



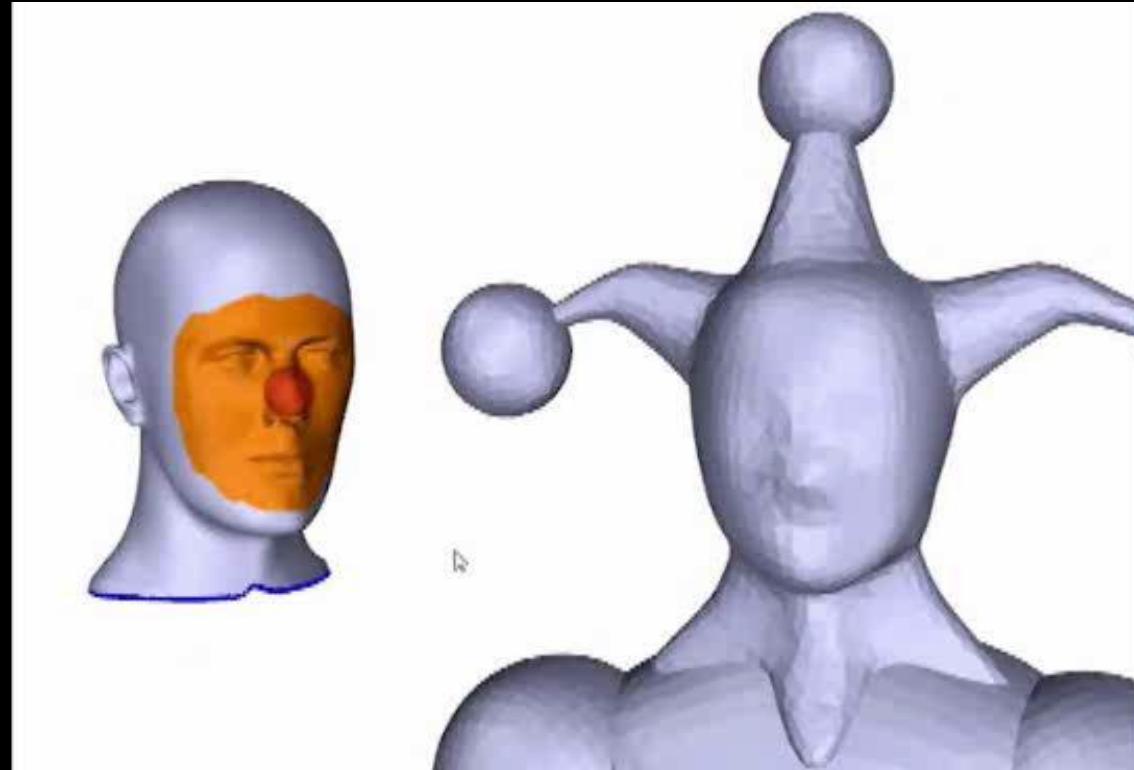
[SymbiosisSketch: Combining 2D & 3D Sketching for Designing Detailed 3D Objects in Situ.  
Arora, Kazi, Grossman, Fitzmaurice, Singh, SIGCHI 2018]

Montreal in LEGOland  
(Using physical props , surfaces  
and curved canvases)



[Multi-Device Storyboards for Cinematic Narratives in VR. Henrikson, Araujo, Chevalier, Singh, Balakrishnan, ACM UIST 2016]

# MeshMixer

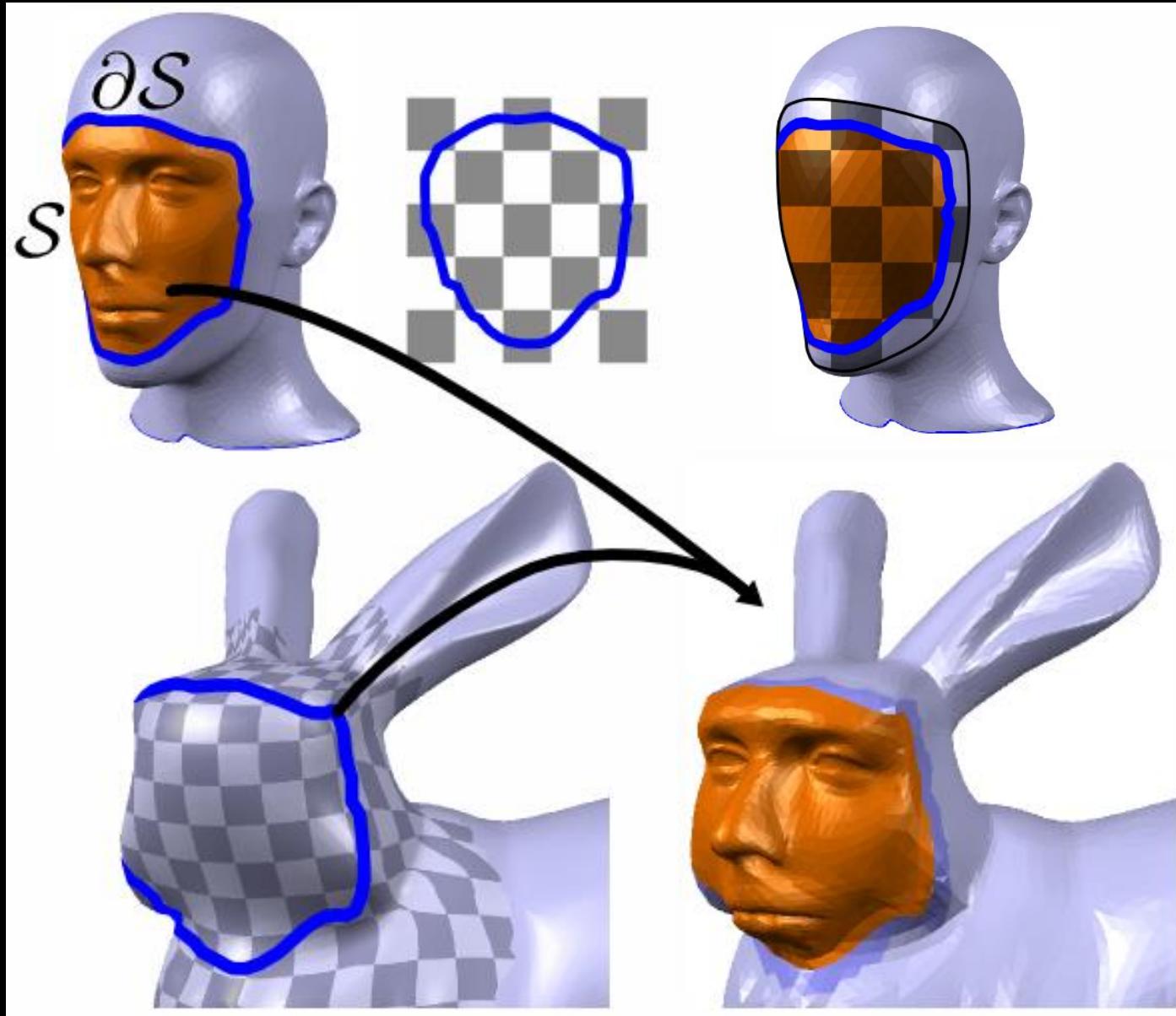


[MeshMixer. Schmidt, Singh, *SIGGRAPH 2010* ]

[www.meshmixer.com](http://www.meshmixer.com) (acquired by Autodesk Inc.)

[GeoBrush: interactive mesh geometry cloning. Takayama, Schmidt, Singh, Igarashi, Boubekeur, Sorkine, *Eurographics 2011*]

# MeshMixer



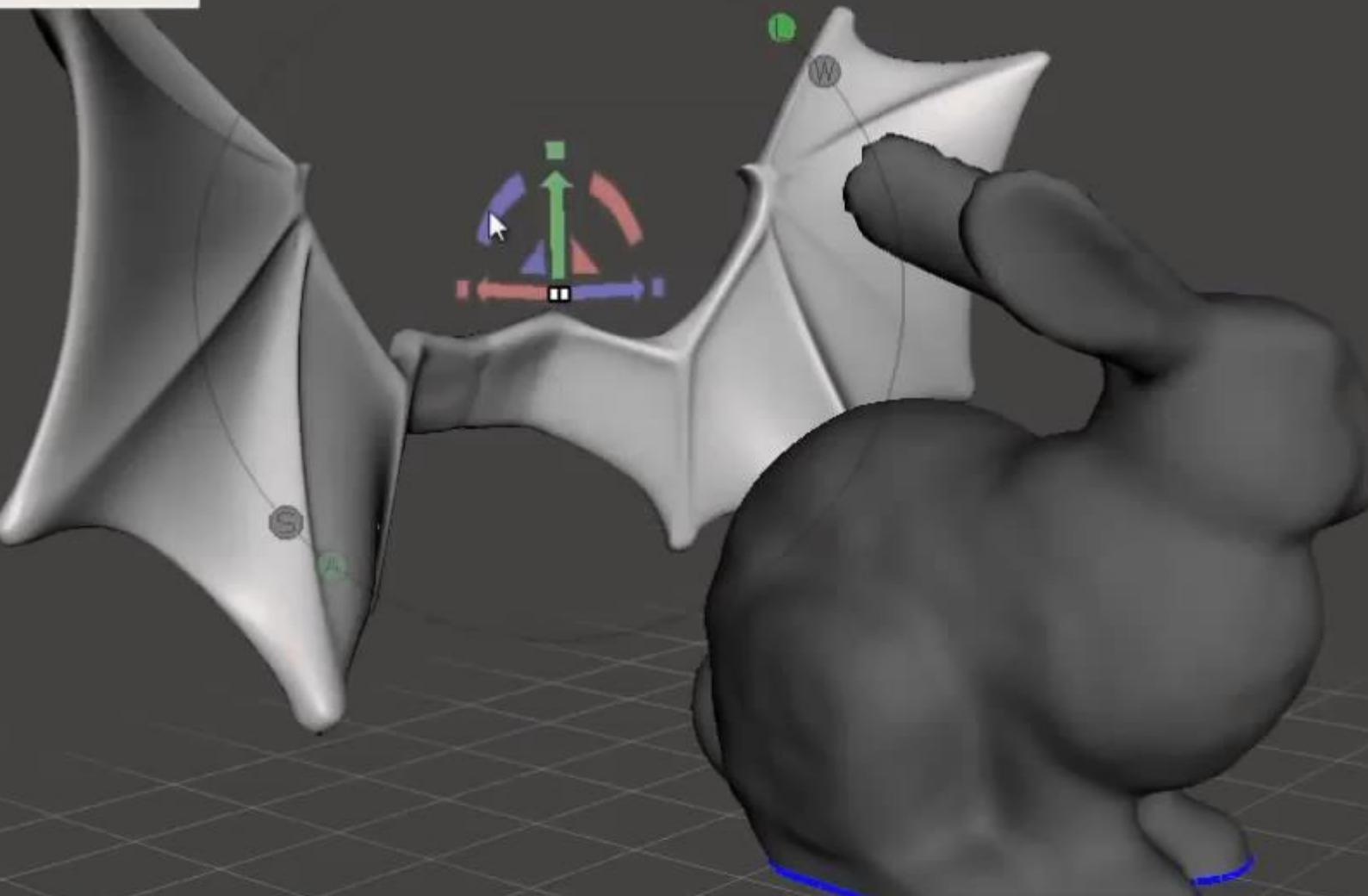
File Actions View Help Feedback



Transform

Accept

Cancel



Use the manipulator to transform the mesh.



wings.obj	...
bunnyr.obj	...

vertices: 19821 triangles: 39638

Transform Clay Paint Smooth Subdivide Selection Unique Base Cut Clip Sub Extrude Tear Erase Bevel

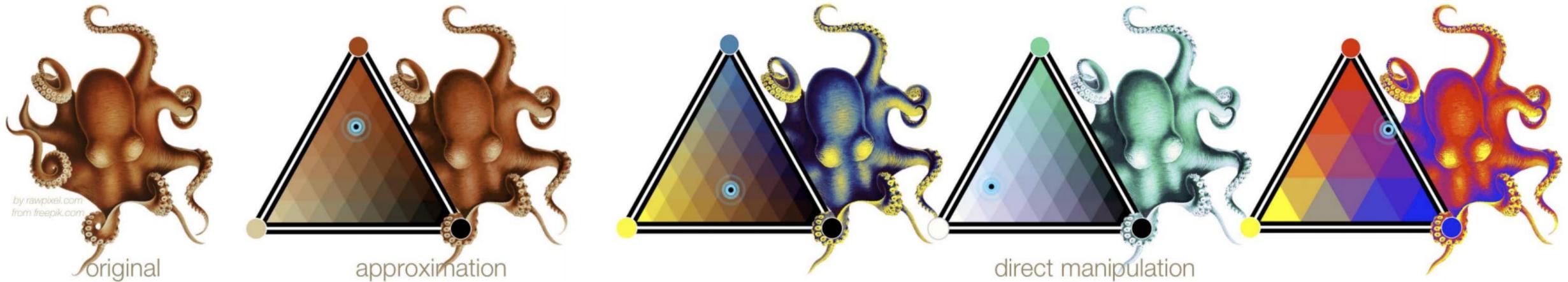
Objects 6 Tools 3

SCULPT  
LIGHT  
Selection - Element  
Axis  
Sculpt All Instances  
Groups

Projection - Same Depth  
Frame - Object  
SYMMETRY



# Color Sandbox



[Color Builder: a Direct Manipulation Interface for Versatile Color Theme Authoring,  
Shugrina, Zhang, Chevalier, Fidler, Singh, *SIGCHI 2019*]

[Nonlinear Color Triads for Approximation, Learning and Direct Manipulation of Color Distributions,  
Shugrina, Kar, Fidler, **Singh**. *SIGGRAPH 2020*]

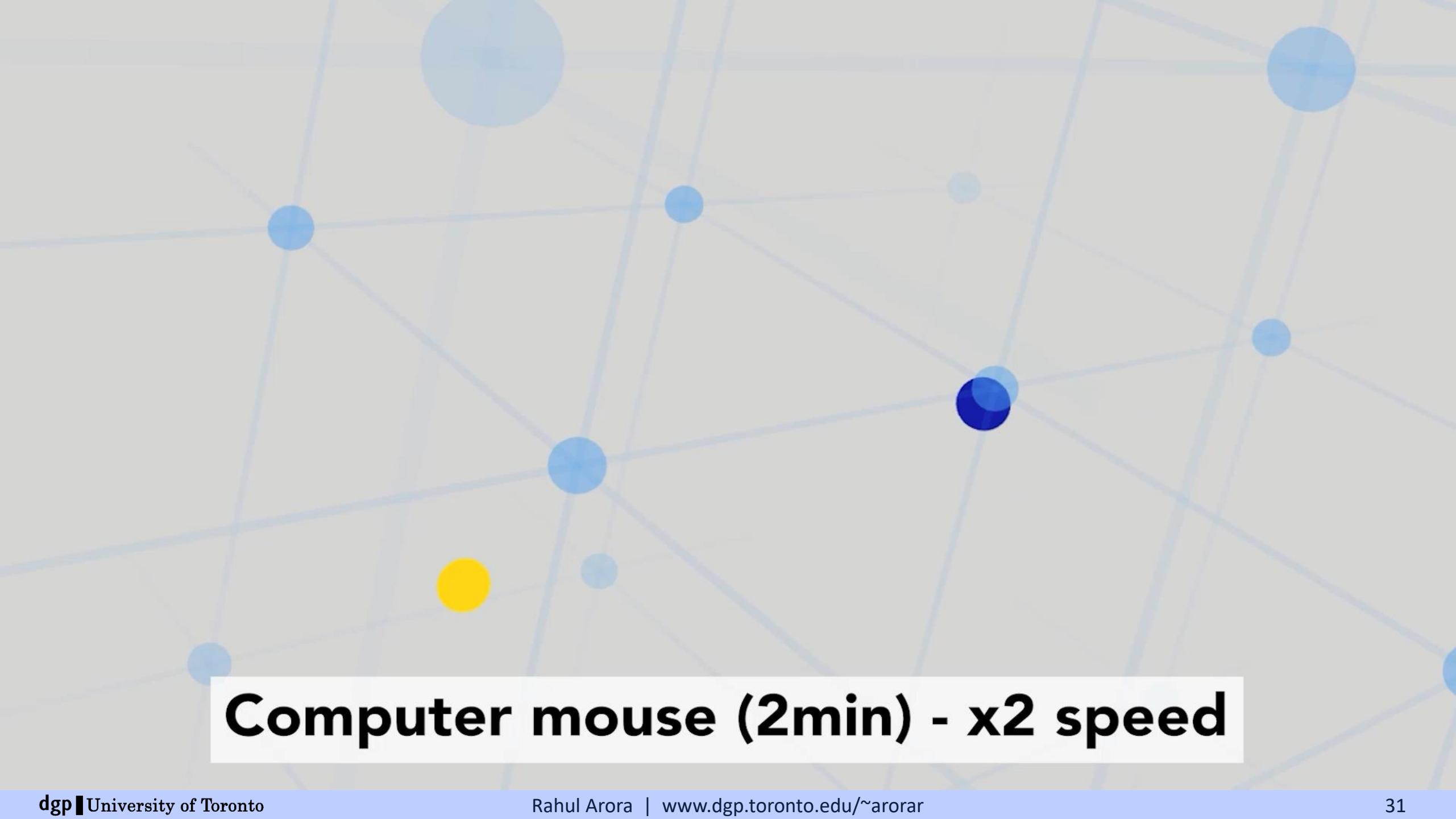


AR | VR

# CASSIE

**Curve and Surface Sketching in Immersive Environments**

**CHI 2021**



**Computer mouse (2min) - x2 speed**

## Ball

Timing and shape manipulation



## Tornado

Layering and follow-through



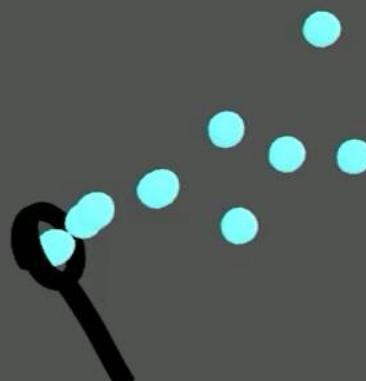
## Hook and Spring

Physical coupling/decoupling



## Bubbles

Particle emission



## Sheet

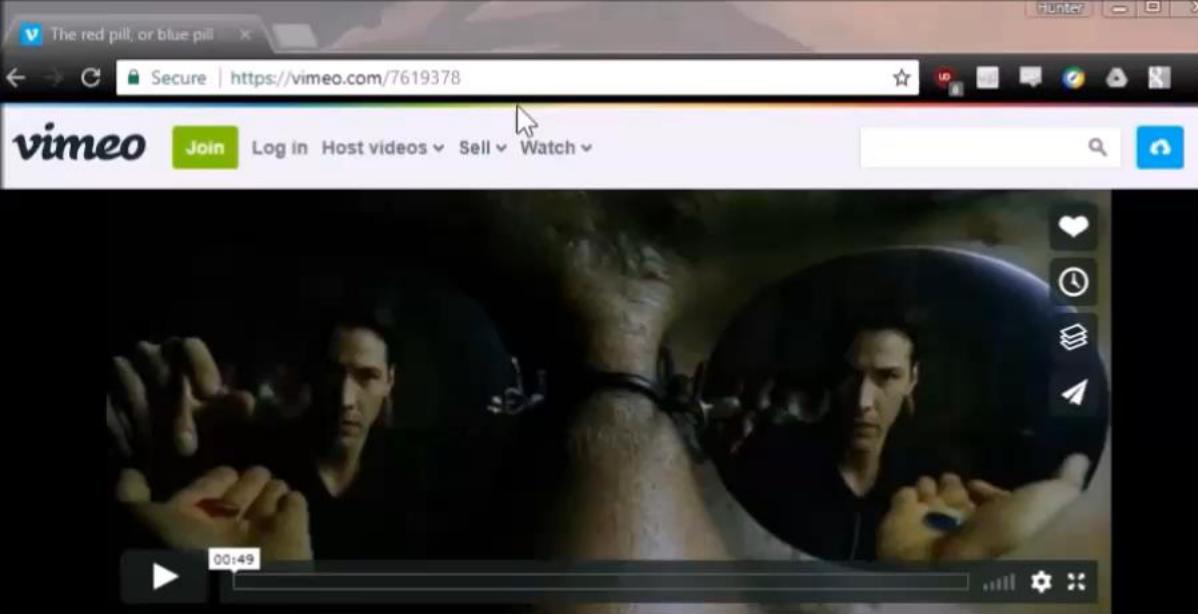
Cloth simulation and topological changes



## Smoke

Fluid simulation





## The red pill, or blue pill

8 years ago | More



Chris Messina

+ Follow

▶ 14.7K    ❤ 30    📺 3    💬 2

Share

A scene from the Matrix.

Copyright Warner Brothers.

### 2 Comments



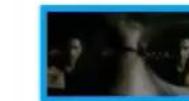
fcuardi 8 years ago

I think YouTube or your own website would be a better place to upload snippets of copyrighted material (as opposed to videos you've made).

Just my 2 cents.

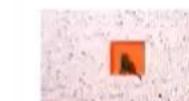
### Recommended

Autoplay next video



The red pill, or bl...

Chris Messina



Andrew B. Myers



Home Depot at T...

The Potter's House of Dallas



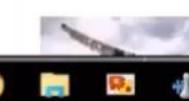
Dr. Henry Cloud: ...

The Foursquare Church

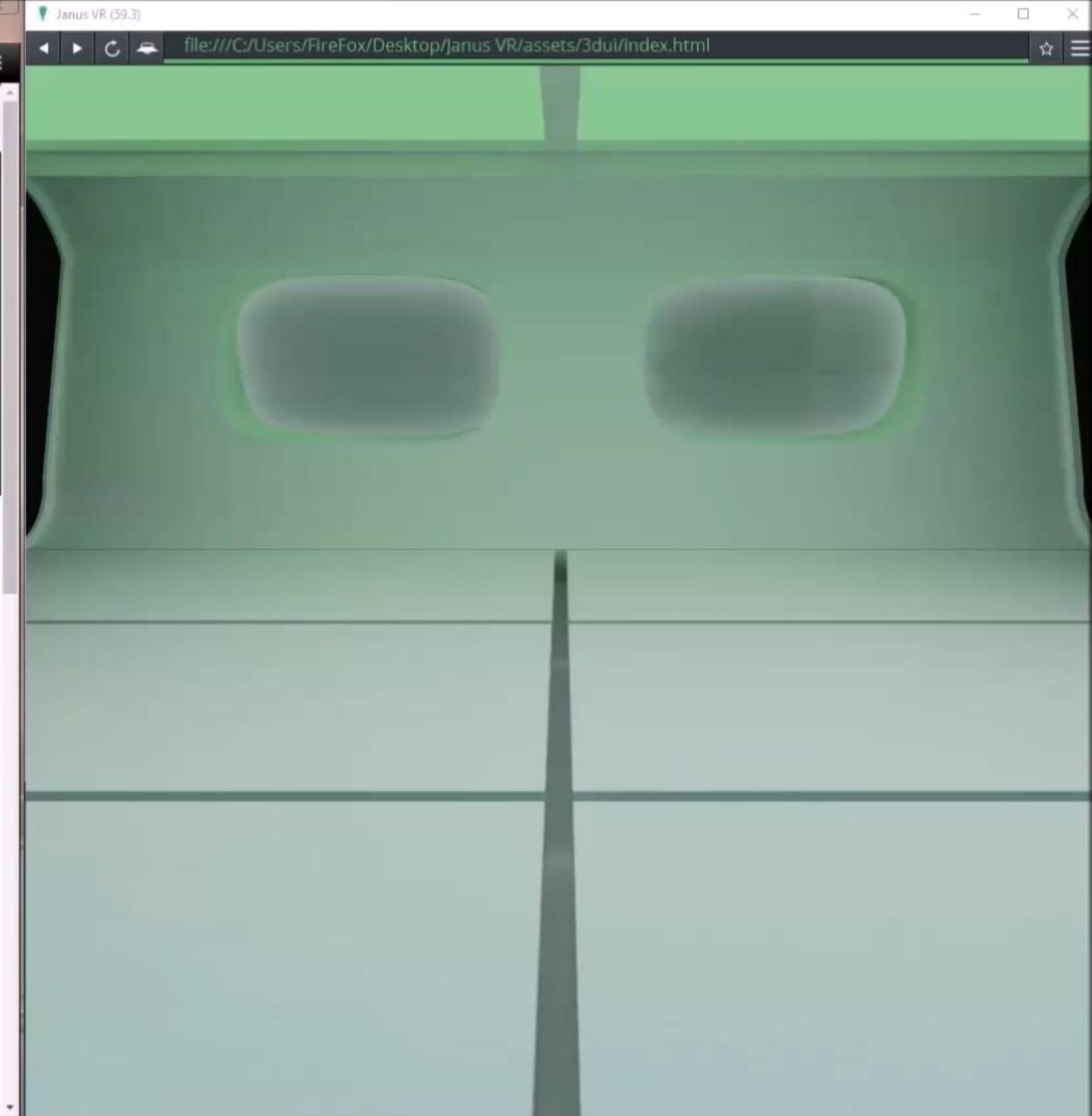


EARS - Sense by...

Made By Brick



Chomp - Ident





# Characters | Faces

# Face and Character Rigging in Maya

wires, wraps, blendshapes, sculpts...



[Wires: A geometric deformation technique. Singh & Fiume (SIGGRAPH 98)]

[Skinning Characters using Surface Oriented Free-Form Deformations. Singh & Kokkevis (GI 00).]

[Outside-In Anatomy Based Character Rigging (SCA 05)]

# Bodyworlds



Director of R+D  
Ryan (*Animated Short Oscar 2004*)





JALI



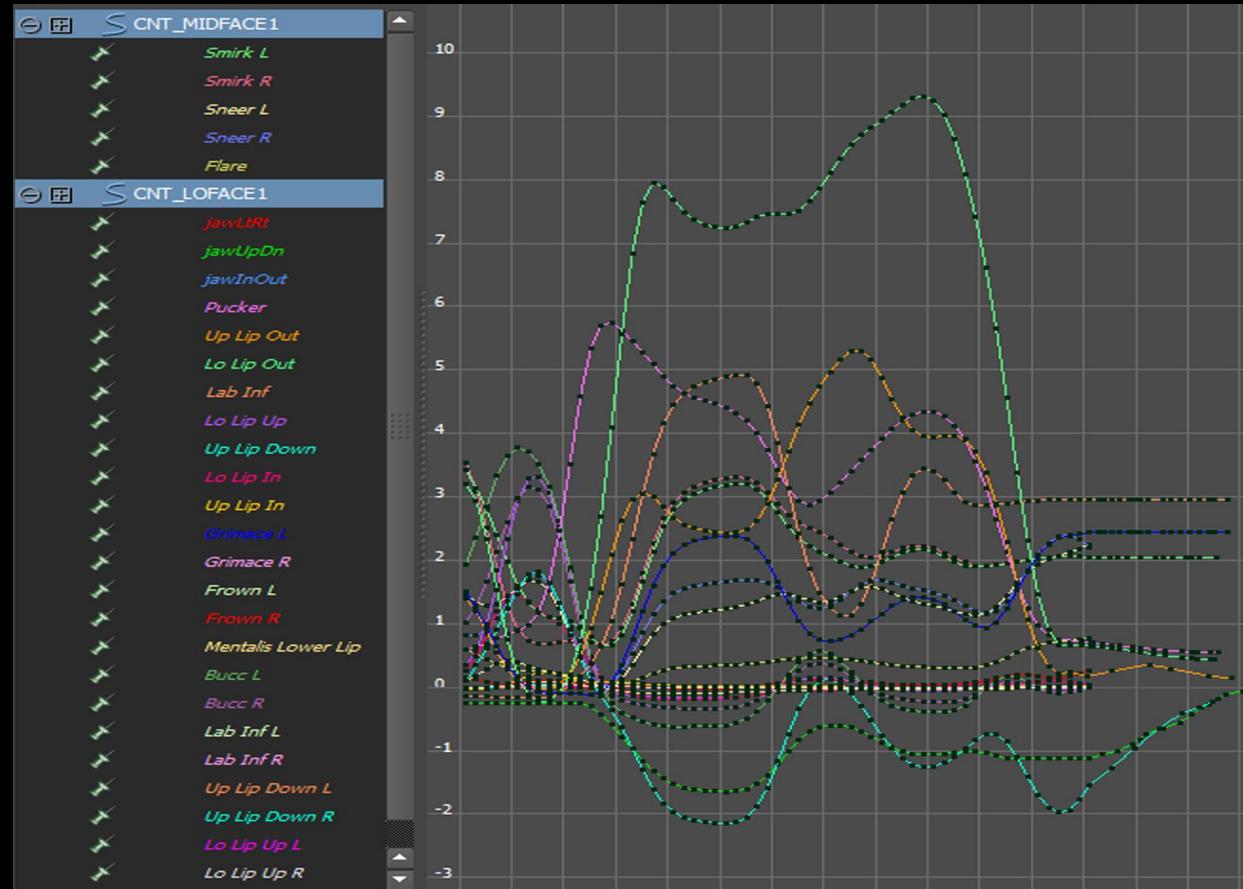
Audio+Phonetic  
Analysis



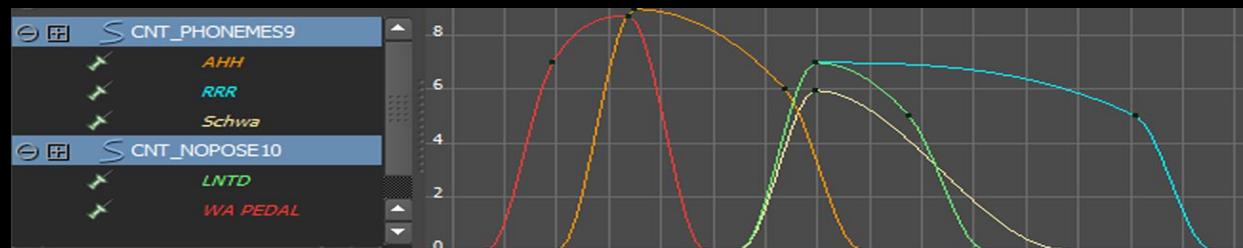
[JALI: An Animator-Centric Viseme Model for Expressive Lip-Synchronization, Edwards, Landreth, Fiume & Singh, SIGGRAPH, 2016]

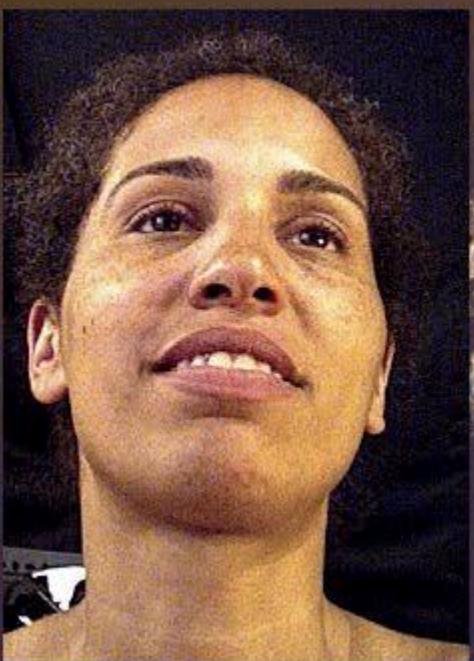
# JALI: Animation Curves

Performance Capture  
29 curves, 2252 keyframes



JALI Animation  
5 curves, 19 keyframes





Live action, actress  
Patrice Goodman



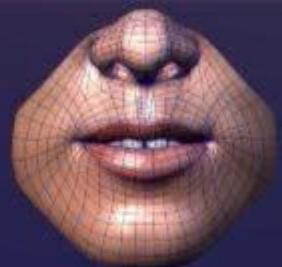
Mocapped  
speech



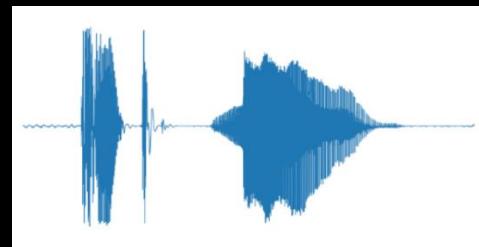
Keyframed  
speech



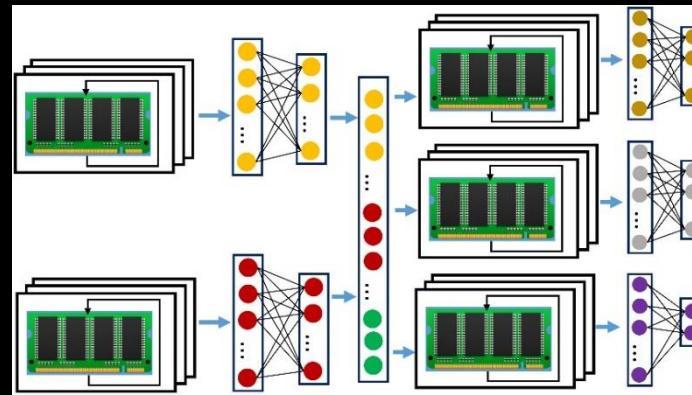
JALI  
speech



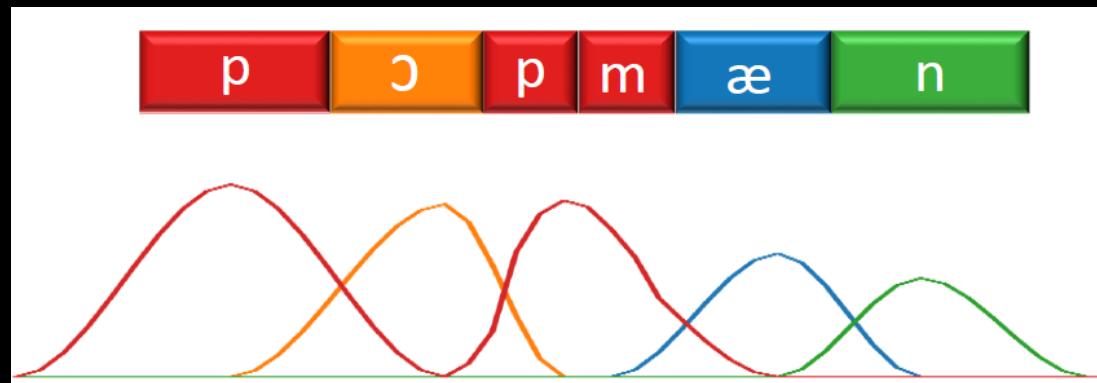
# VisemeNet



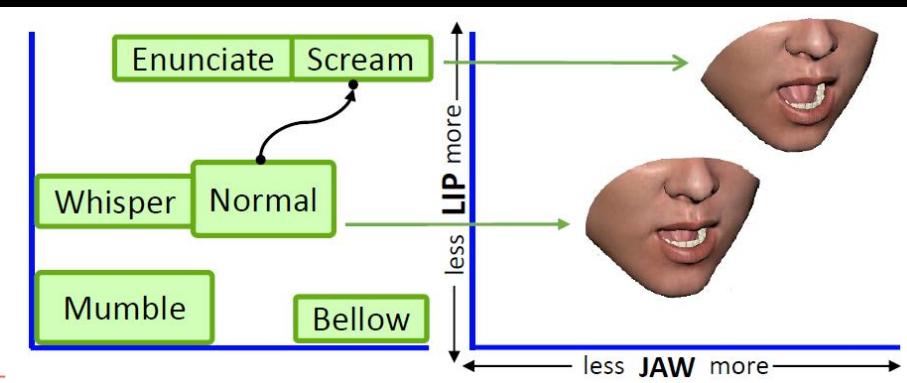
"pop man"



VisemeNet

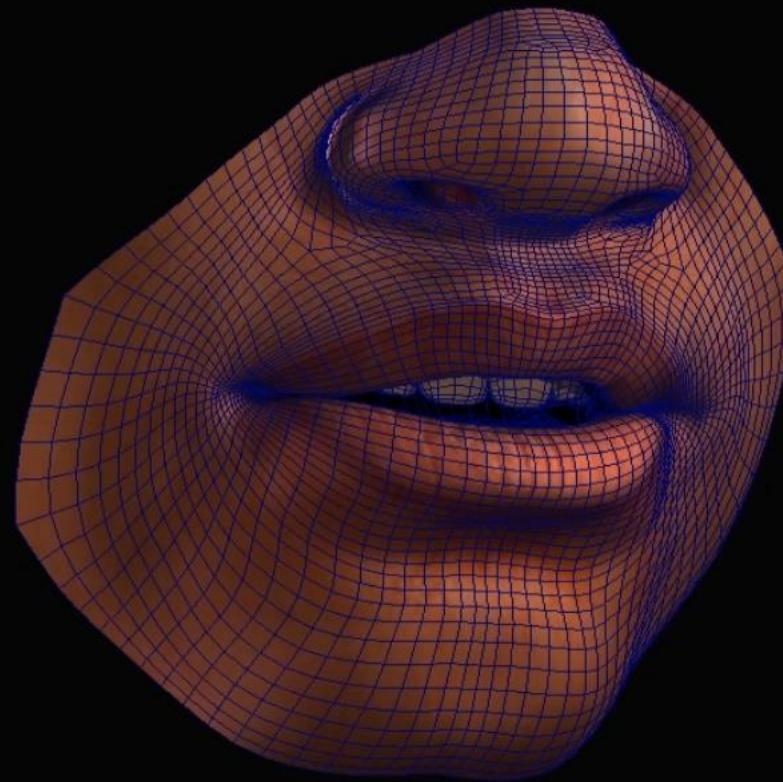
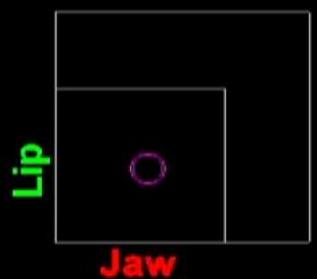
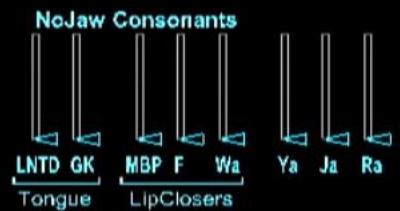
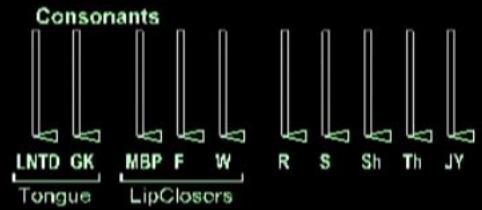
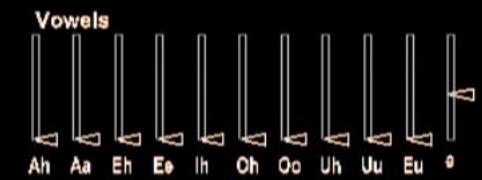


Viseme curves



Speech style

[VisemeNet: Audio-Driven Animator-Centric Speech Animation, Zhou, Xu, Landreth, Kalogerakis & Singh, SIGGRAPH, 2018]



# Cyberpunk 2077

# CUTTING EDGE

The technological innovations bring the world of **Cyberpunk 2077** to life.

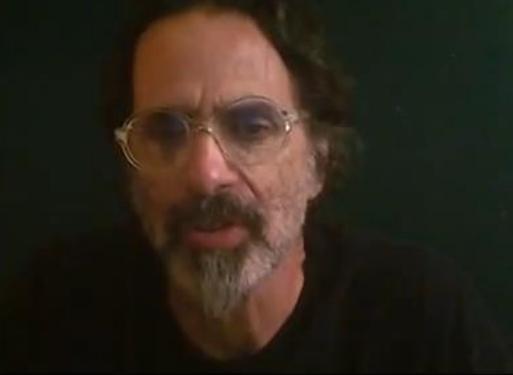
By Jacob Ridley

"While it's home to never seen before systems, one of Cyberpunk2077's most impressive has to be JALI. JALI is software capable of complete automation of lip syncing and facial animation that offers developers complete control to fine tune the end result." — PC Gamer Dec 2020



Jali





English



French



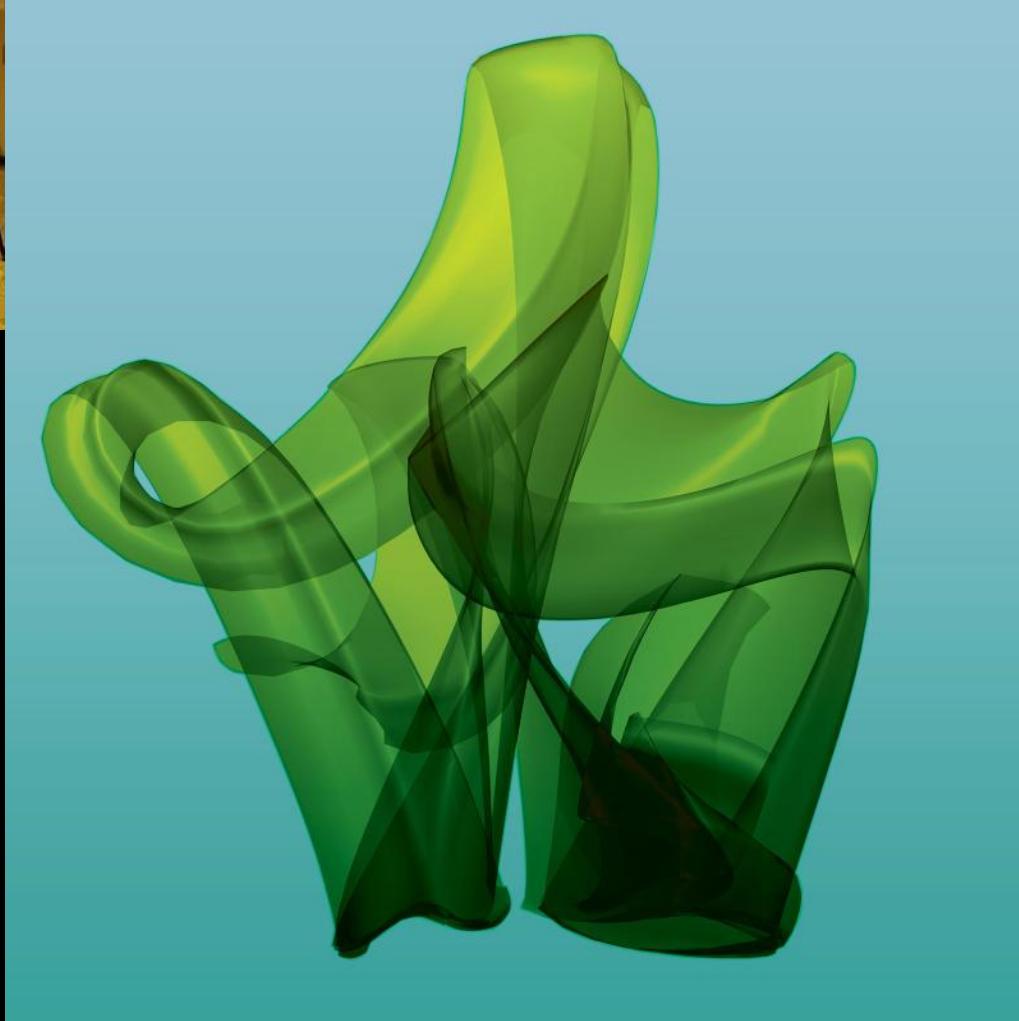
German



Japanese

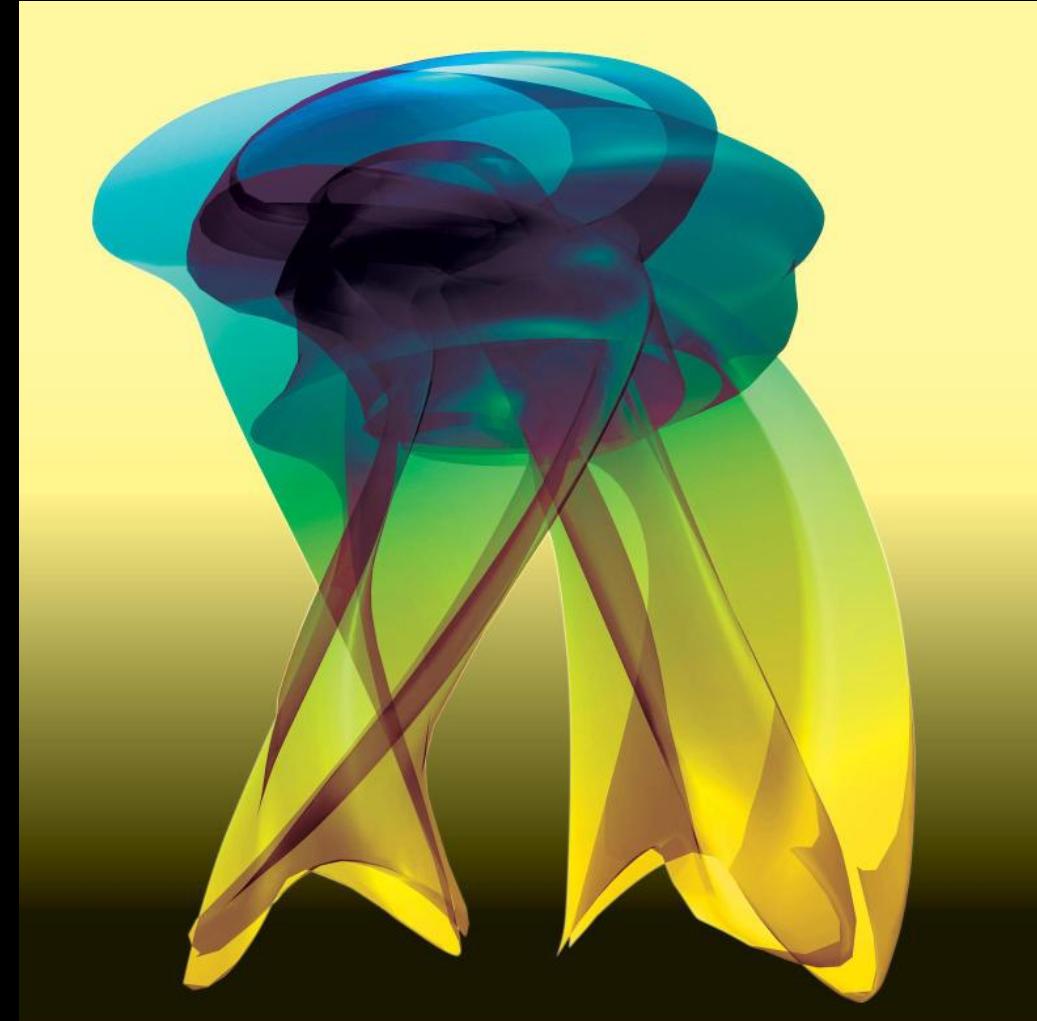


# Shape of Sound



Diverse

© Deaf Cultural Center & Bruce Mau Design



Unite

# Art + Interaction + AI

- Sketch | Sculpt | Color.
- AR | VR.
- Characters | Faces.

Upgraded Tools = Upgraded Communication  
Upgraded Tools ≠ Upgraded Creativity



Acknowledgements: CDPR, jaliresearch.com, janusxr.org, flatfab.com and all my co-authors