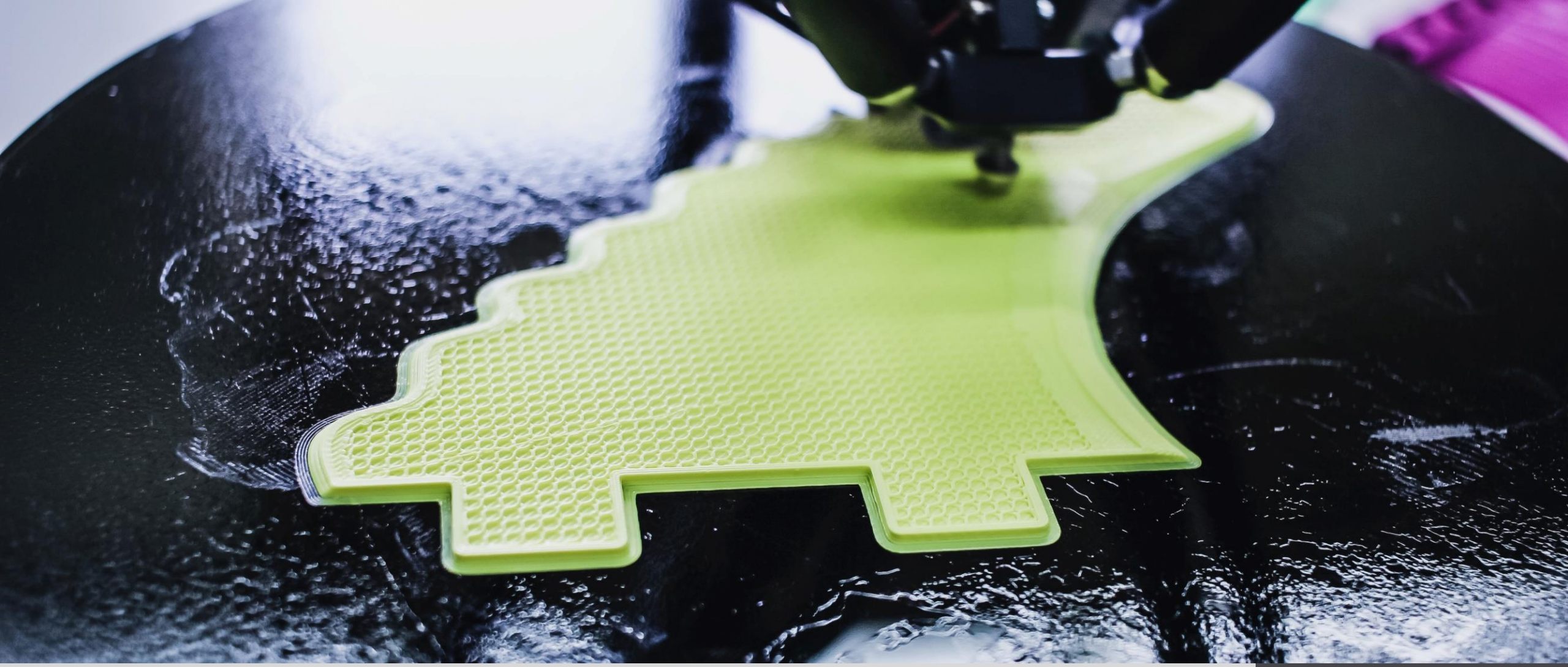

Rapid prototyping

GIZMO

2021 DE2-Gizmo (Physical Computing)
Lecture 3

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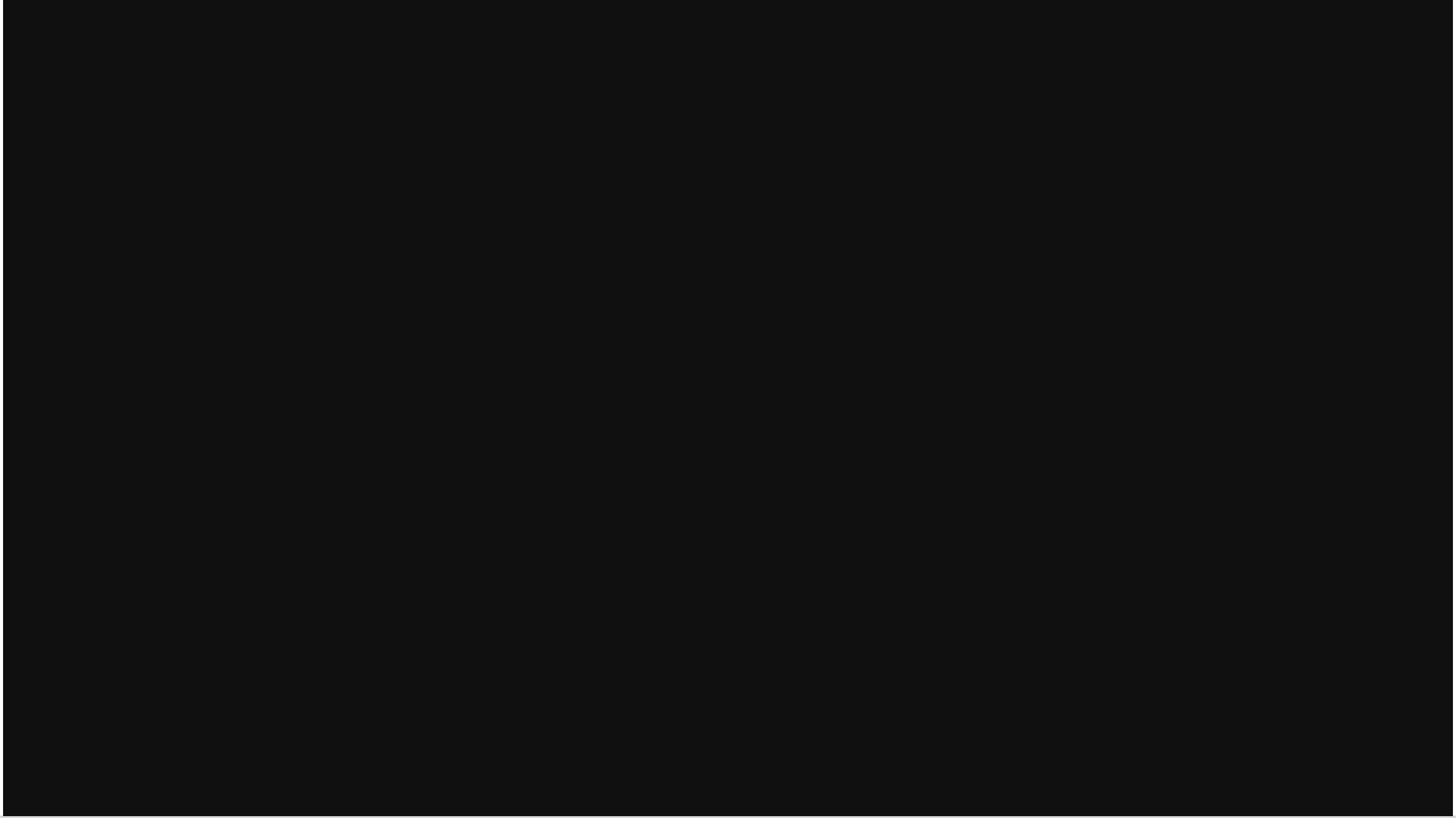
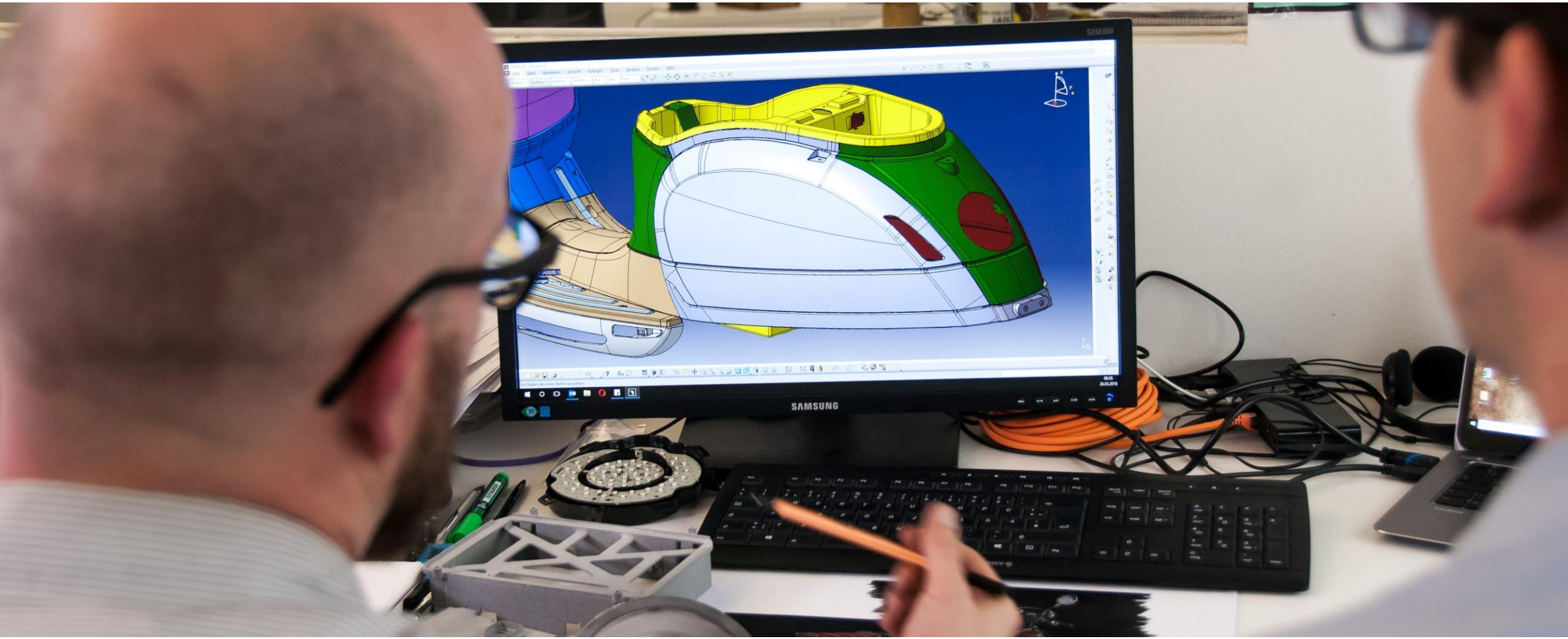
Dyson School of
Design Engineering



What is a Prototype?



Why do we Prototype?

Intended Users

→ User Feedback

The Design Teams

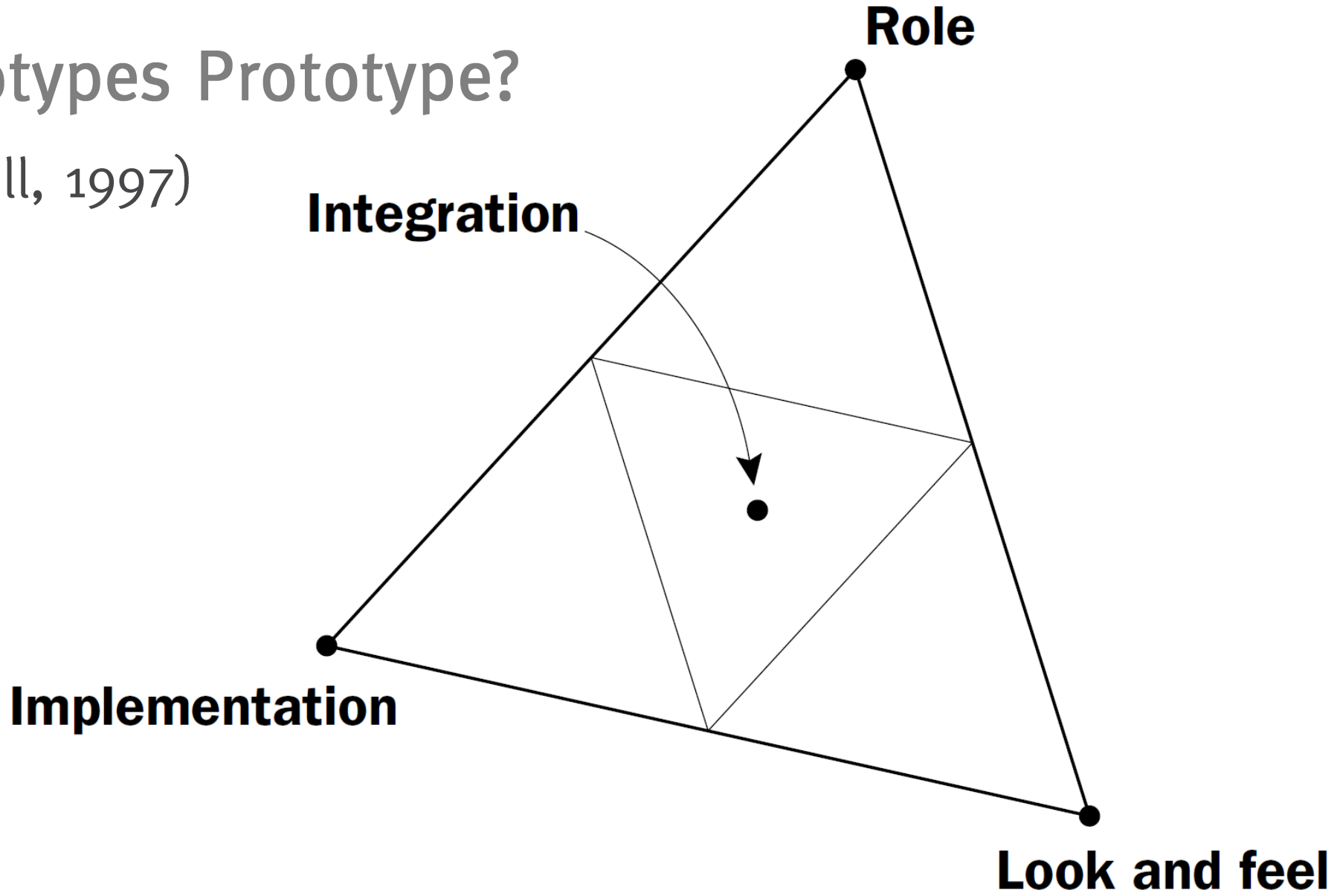
→ Evaluate options

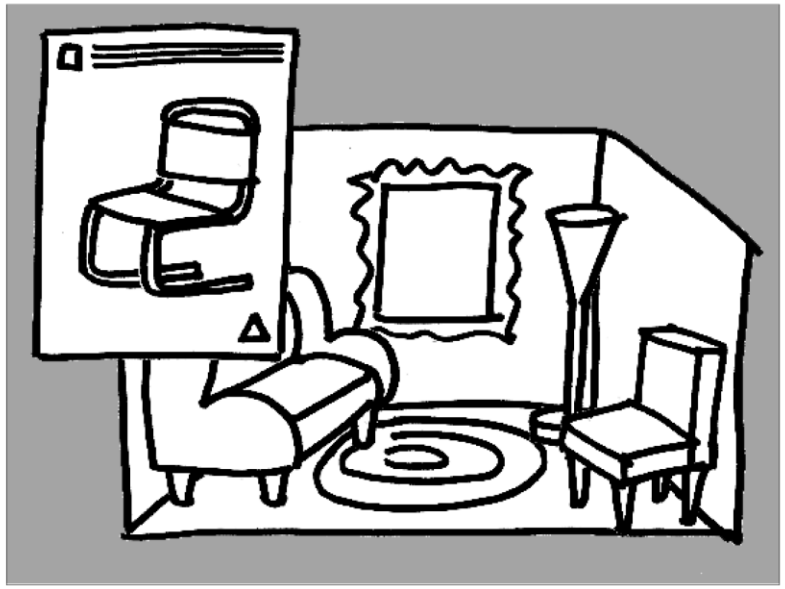
Supporting Organisations

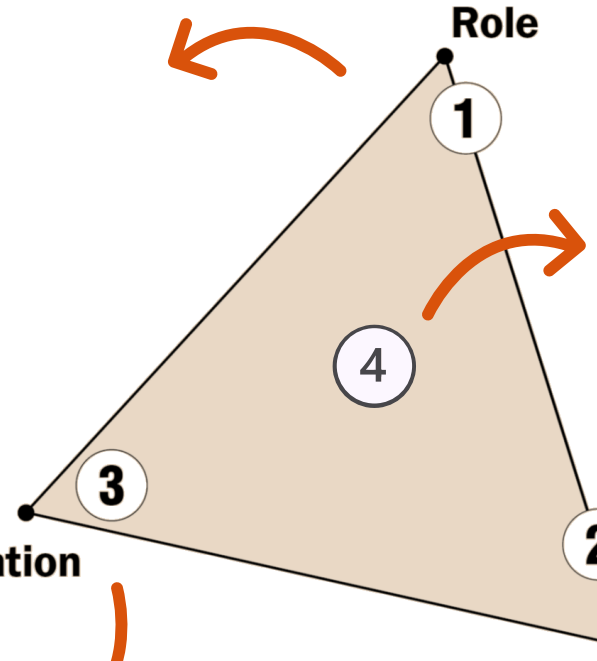
→ Indicate progress/direction

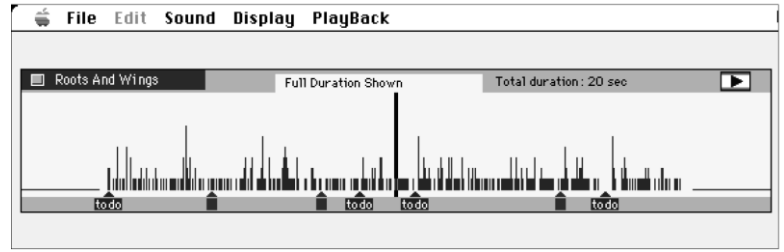
What do Prototypes Prototype?

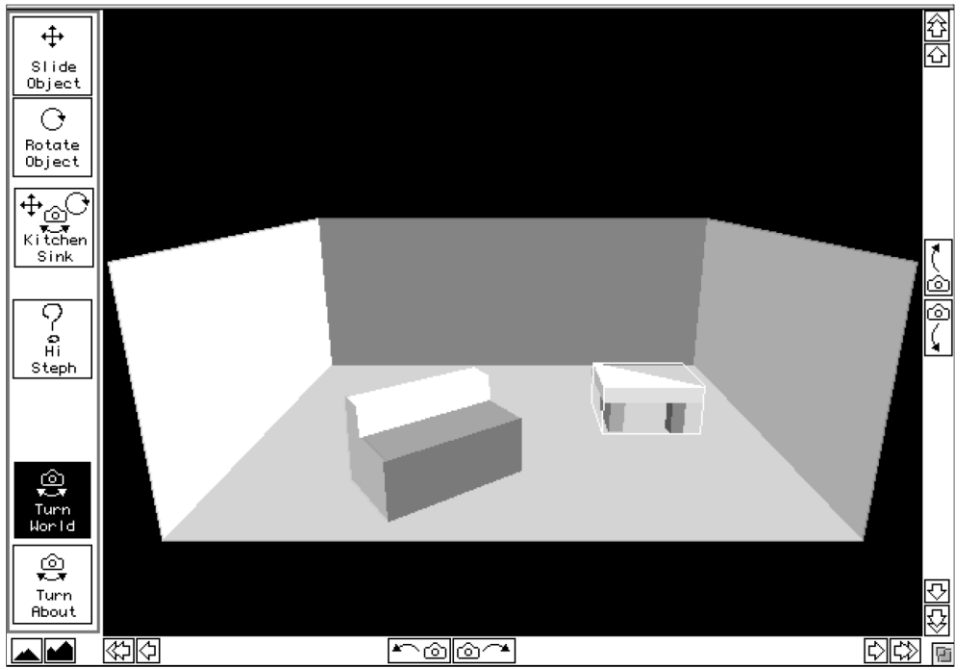
(S Houde and C Hill, 1997)

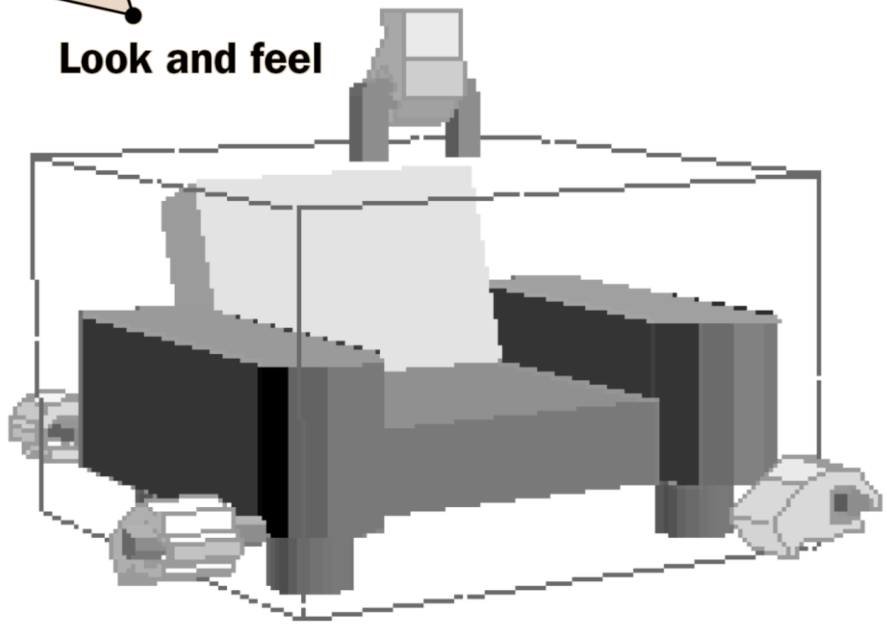




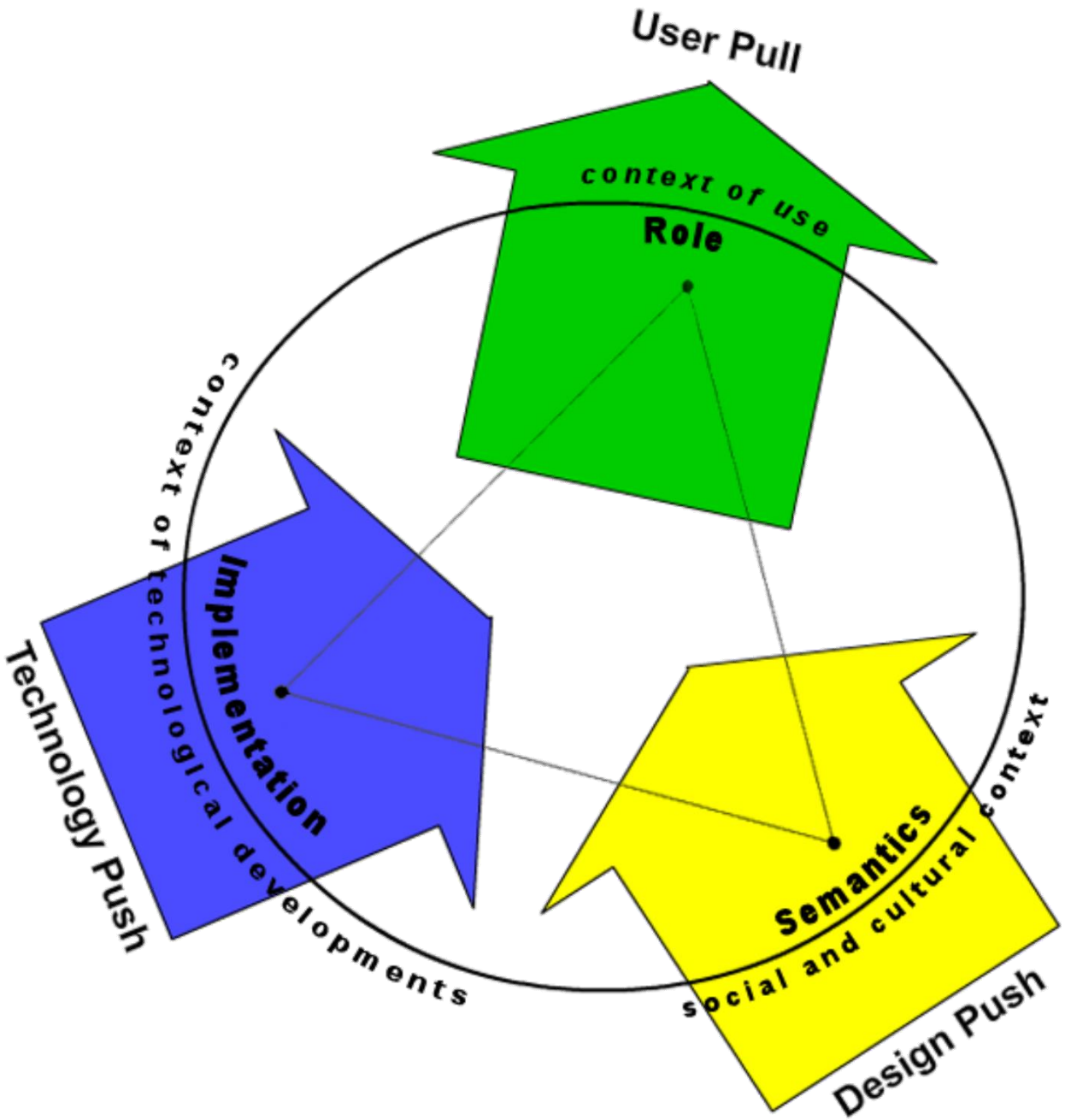

Role
1
2
3
4
Implementation
Look and feel


File Edit Sound Display PlayBack
Roots And Wings
Full Duration Shown
Total duration: 20 sec
todo
todo
todo
todo


Slide Object
Rotate Object
Kitchen Sink
Hi Steph
Turn World
Turn About



What do Prototypes Prototype?



Extension of the Houde & Hill model (Turnhout et al., 2012)

Extended to include three relevant contexts for design and three innovation forces

Prototype fidelity

Low fidelity prototype
(Nintendo Wii U)

High fidelity prototype
(Righthand robotics hand)

Rapid Prototyping

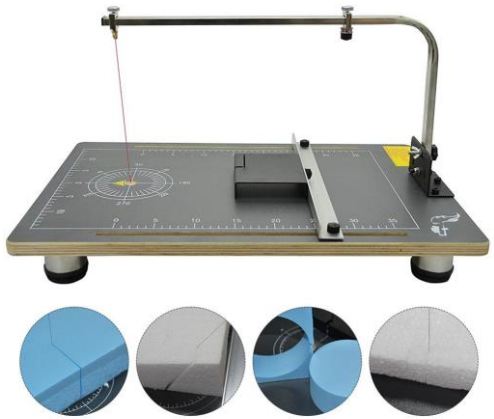
The process of creating prototypes quickly to visually and functionally evaluate an engineering product design.

Rapid Prototyping Methods

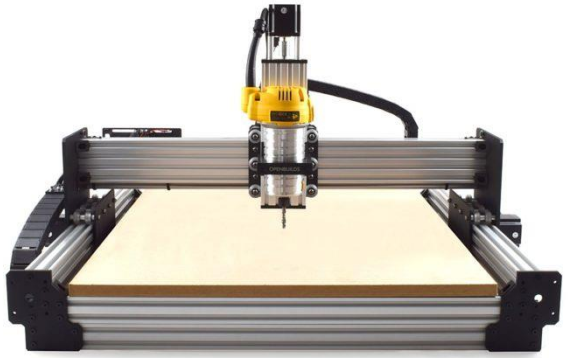
- Is rapid prototyping the same as 3D printing?

3D Printing

Laser Cutting

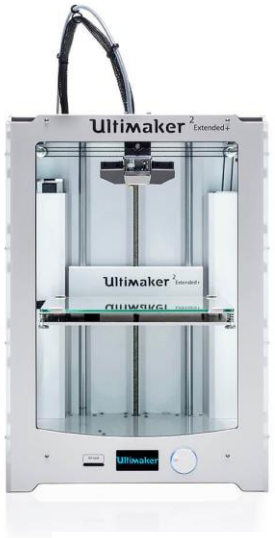


Foam Cutting



CNC Machining

3D Printing



+	-
Complex geometries and intricate structures	Costly to achieve perfect surface finish
Partially hollow or with integrated assemblies	Post-processing
	Limited materials
	Limited size

Cheap*

Fast*

Accurate*

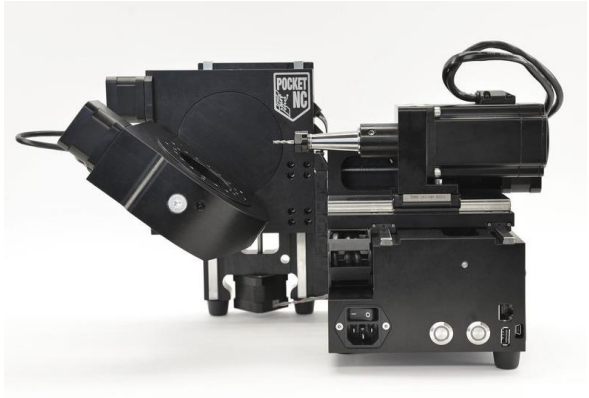
Laser Cutting

+	-
Very accurate and precise	HAZ post-processing
Small HAZ	Limited thickness
Suitable for lots of materials	Upfront cost
Fast	Limited to 2D
Can also be used for partial cutting (etching)	

Foam Cutting

+	-
Iterative process	Intricate details/internal features difficult/not possible
Manual/automatic	Slow
Low skill required	Very difficult to make repeats
Very large size	
Cheap	

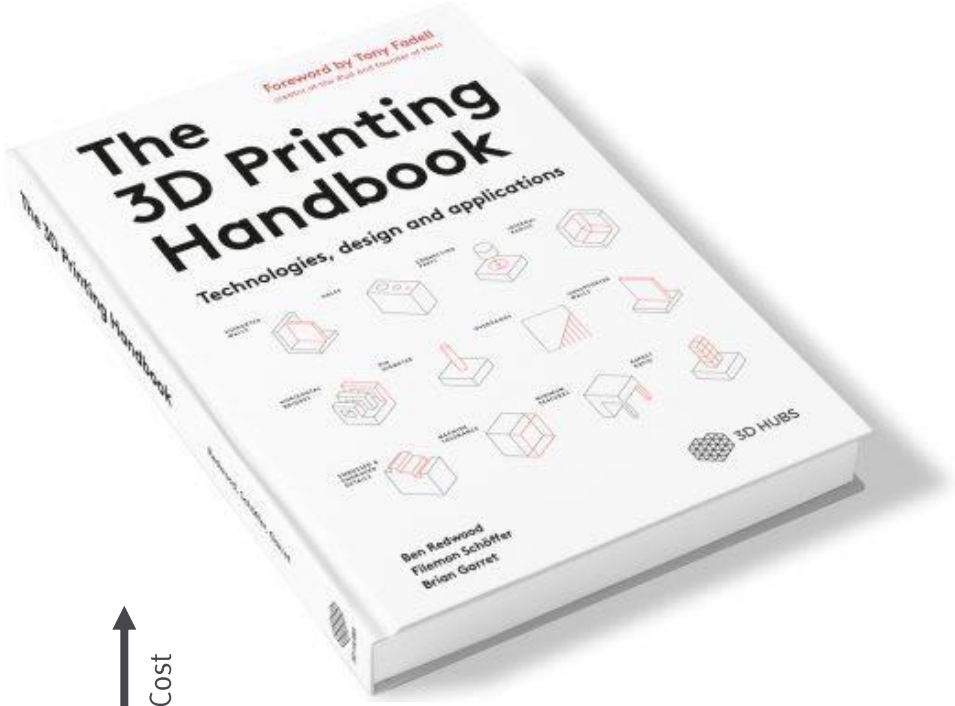
CNC Machining



+	-
Very accurate and precise	Expensive
Can work with metals	Design consideration
Can produce smaller/stronger parts than 3D printing	Build volume limited
	High skill level required

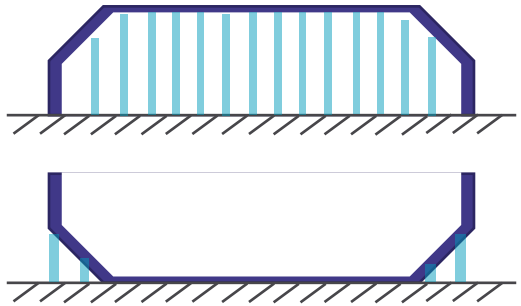
3D Design Optimisation

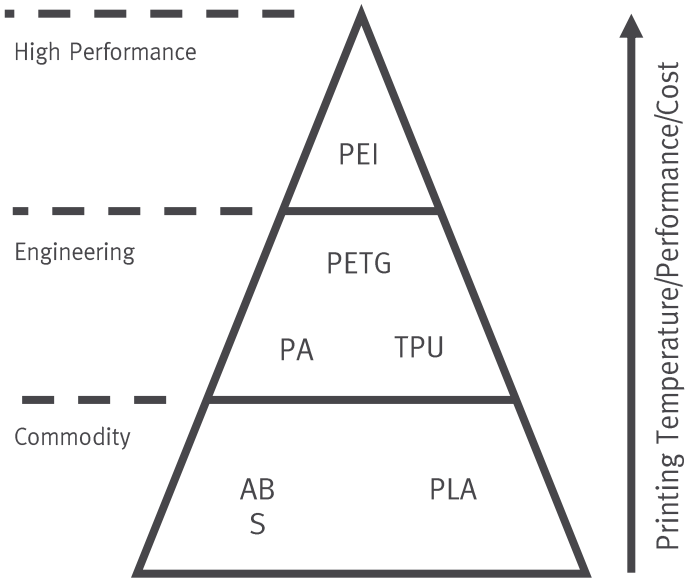
- Why optimise?



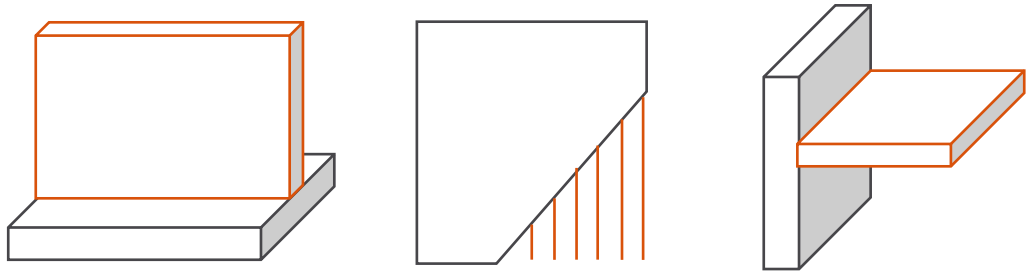
Considerations:

- Material
- Orientation
- Infill



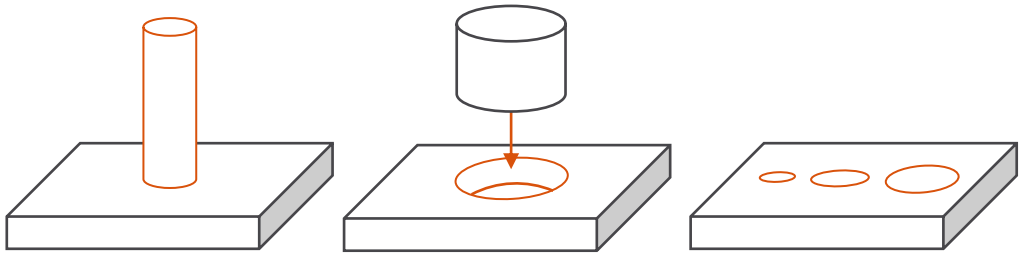


- Walls and Edges

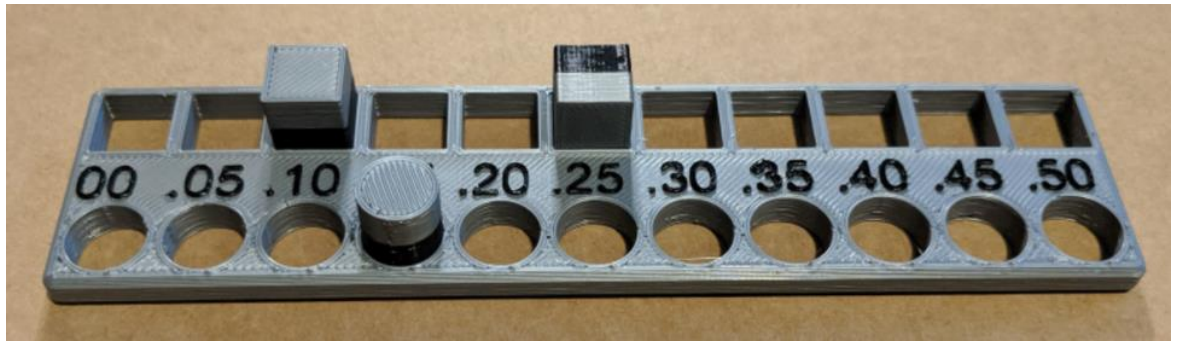


Walls Overhangs Ledges

- Accuracy/Tolerance

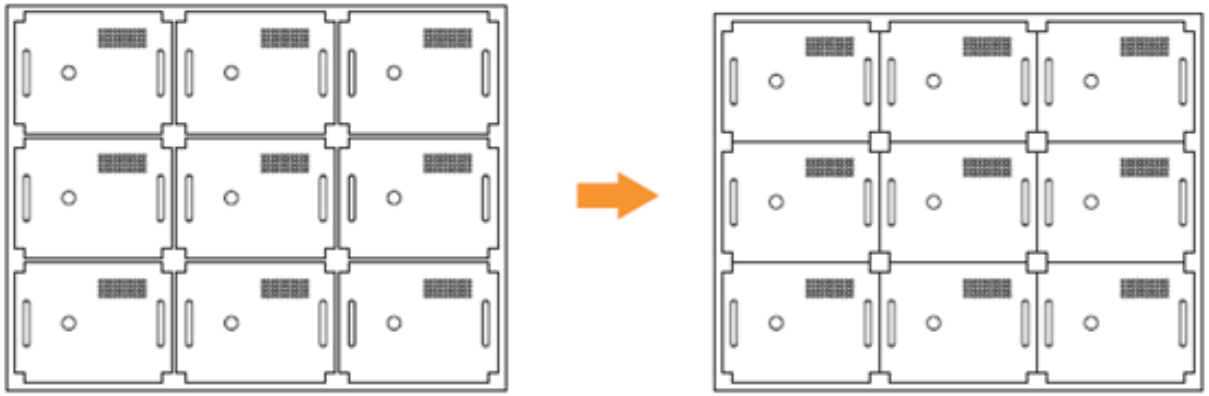


Pins Assemblies Holes



2D Design Optimisation

- Material thickness
- Spacing of parts on stock (shared edge optimisation)
- Cut depth/time (engraving)

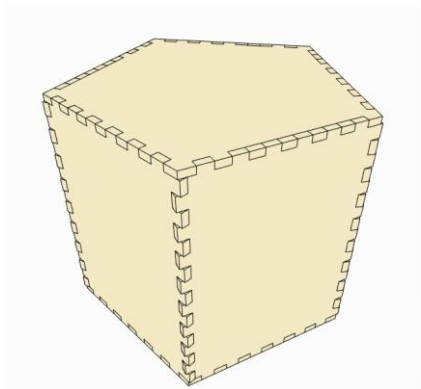


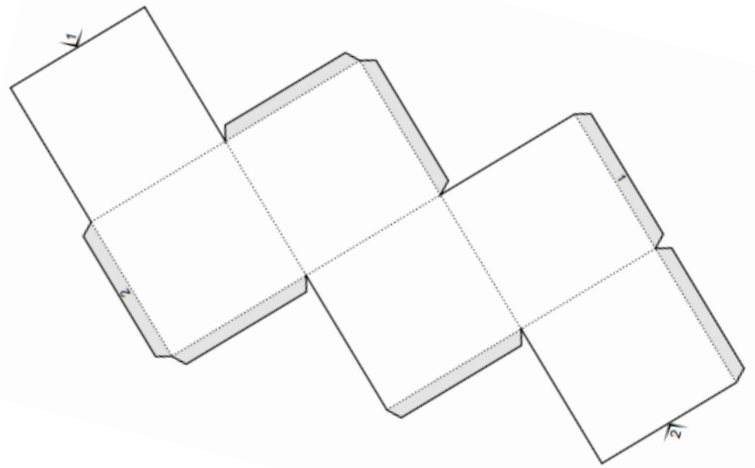
(a) Before shared edge optimization

(b) After shared edge optimization

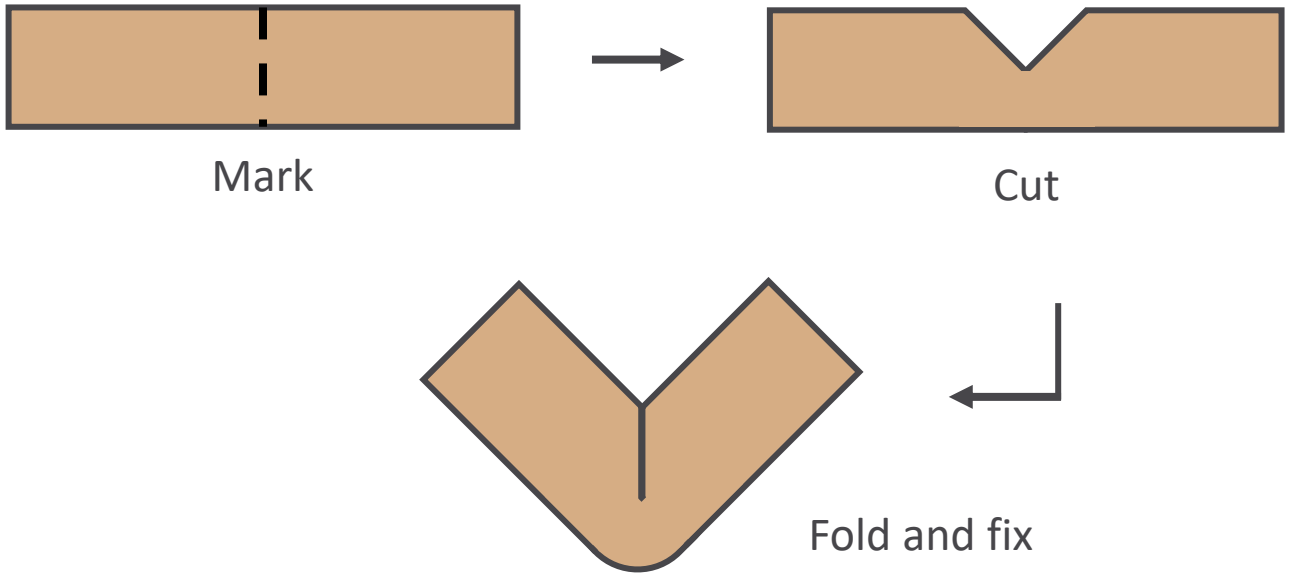
2D Design -› 3D Design

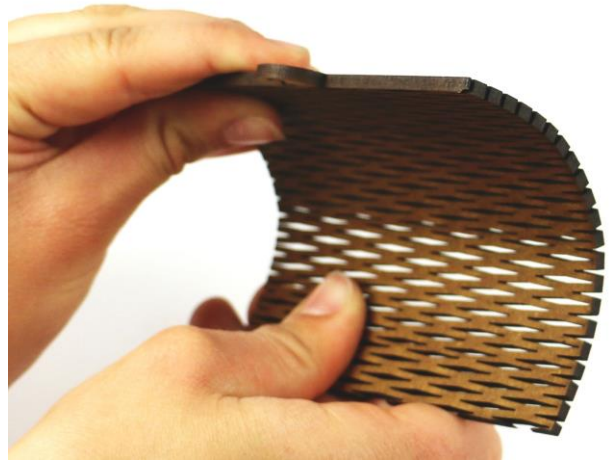
- Positioning of fixtures (tabs/pin holes/slots)





- Scoring angles for bending



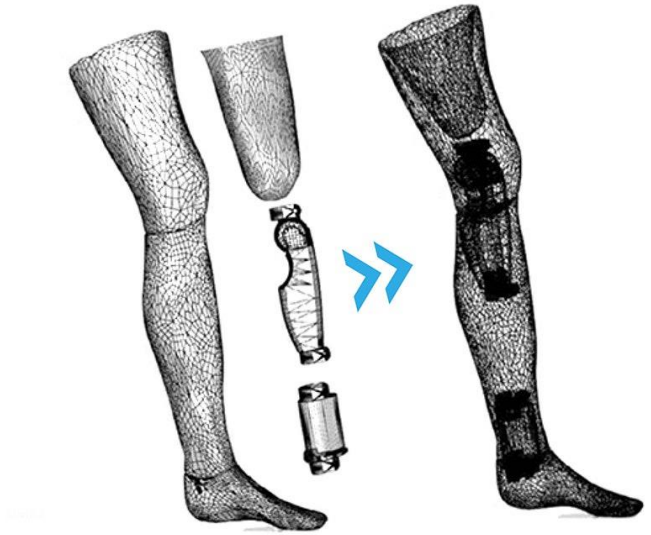


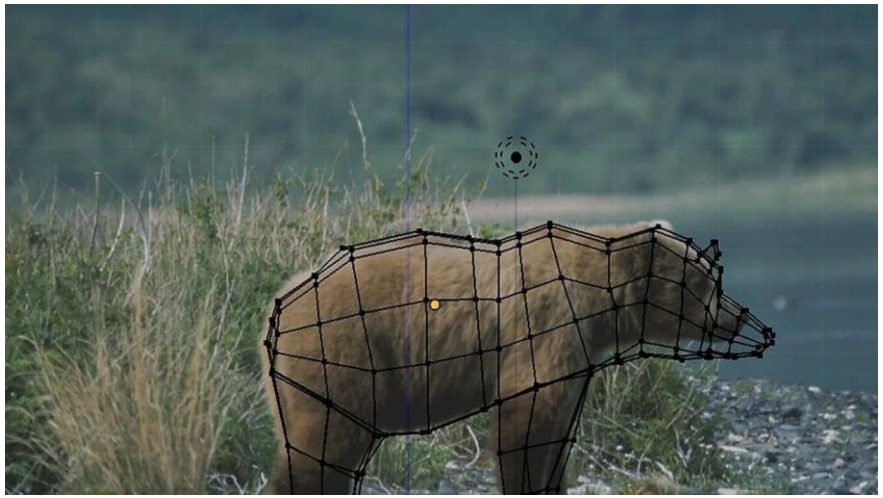
Working with Meshes

- Non-dimensional design
- Typically used for dynamic/biological applications
- Great for fabric/fluid materials

Mesh Process

- Typically start from existing reference
- Reference can be used to create base
- Design can be extended from base





Link to video

Prototyping Software

AUTODESK® FUSION 360™

PePaKuRa Designer

SOLIDWORKS

AUTODESK® AUTOCAD®

Xd ADOBE XD

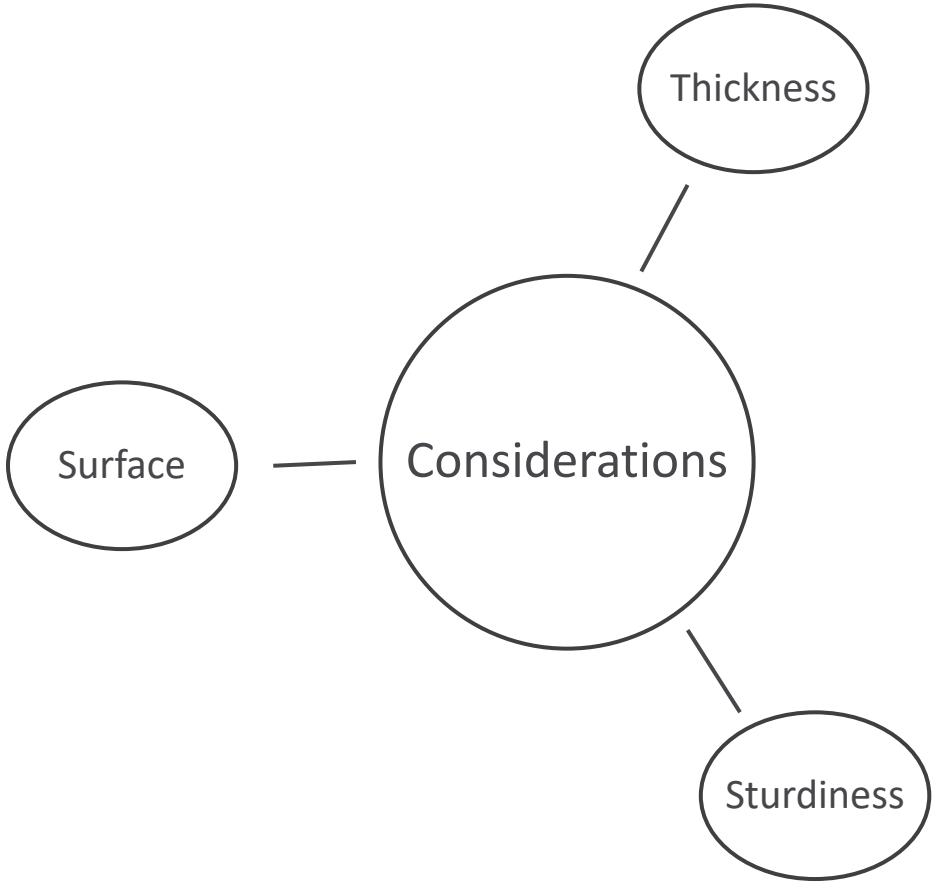
blender®

Meshlab

Prototyping with Cardboard

- Cheap
- Strong
- Recyclable
- Easy to manipulate
- Accessible across the world!

Cardboard Types



Cardstock

Corrugated Cardboard

Chipboard

Hexacomb Cardboard


SHELLYHICKOX.BLOGSPOT.COM


CARDBOARD BICYCLE

Where to get cardboard?

- Around the house
- Local grocery stores and supermarkets
- Kitchen stores/Bike stores
- Purchased online

Cutting Cardboard

- Scissors (light/medium/heavy)



- Utility Knife (fixed/folding)

- Rotary Cutter (manual/automatic)

- Paper Cutting Machines

Forming Cardboard

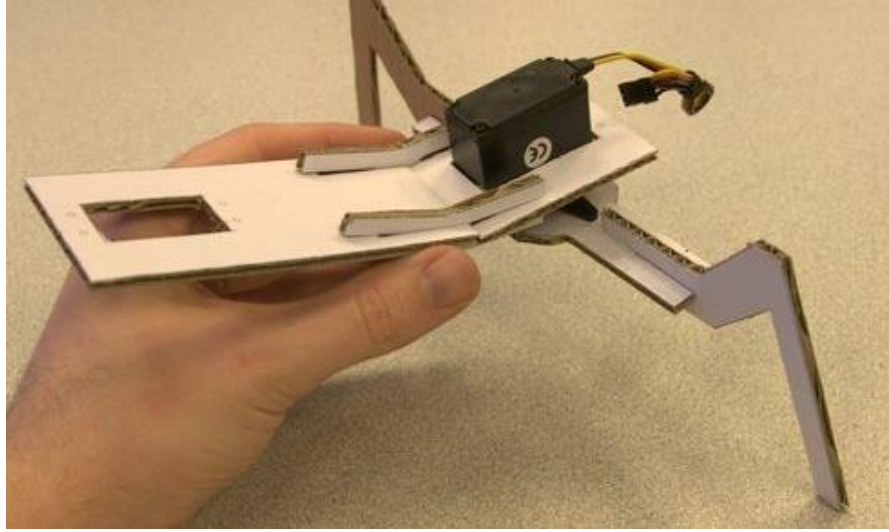
LAYERING

Frank Gehry's Edge cardboard furniture

FOLDING

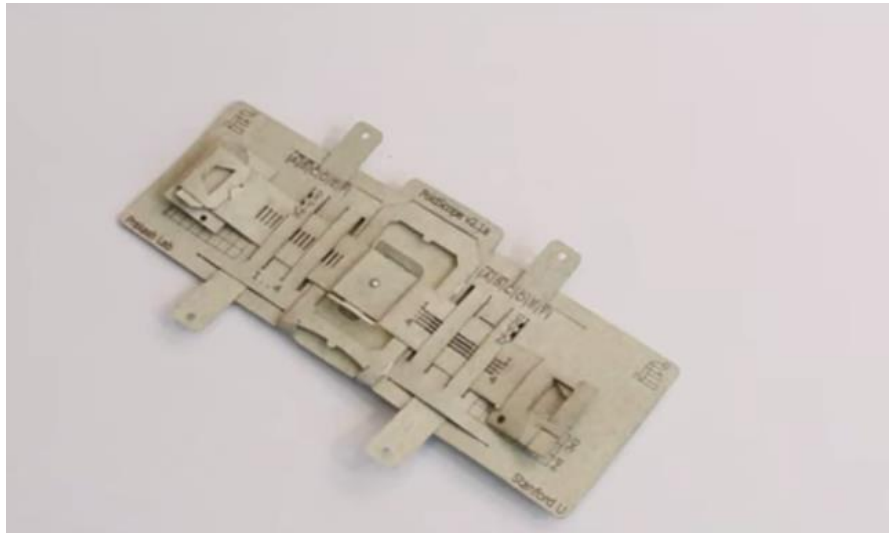
Origami phone prototype

PRESS-FIT

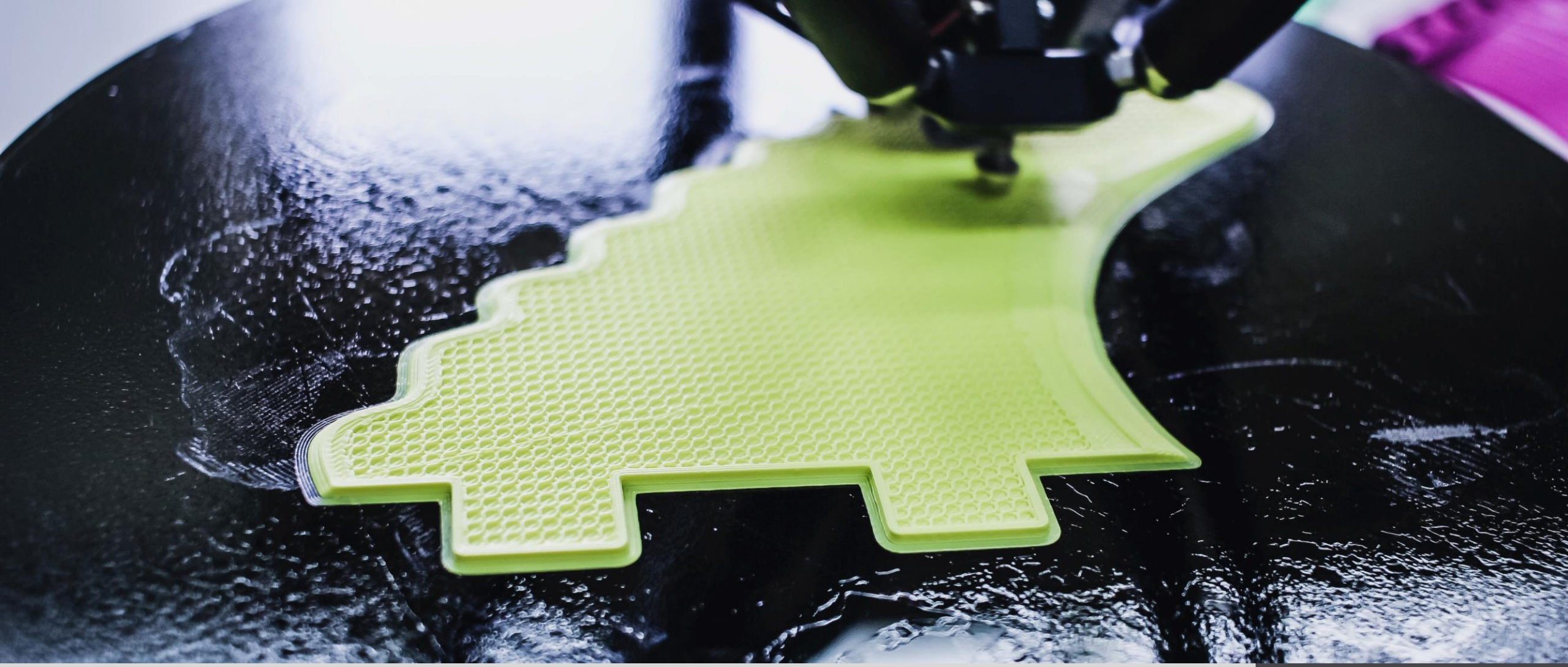


Walking robot prototype

GLIDE



Low cost cardboard microscope (Foldscope Stanford University)



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