From 3D Printing and Personal Fabrication to Personal Design

Prof. Jan Borchers
Media Computing Group
RWTH Aachen University

Summer term 2016

http://hci.rwth-aachen.de/cthci

RWTH AACHEN UNIVERSITY

Midterm Exam Reminder

- Next week: **14.06.2016**
- Start at **10:15**
- Duration: **60 minutes**
- Room: **AH IV**
- More information tomorrow in the lab

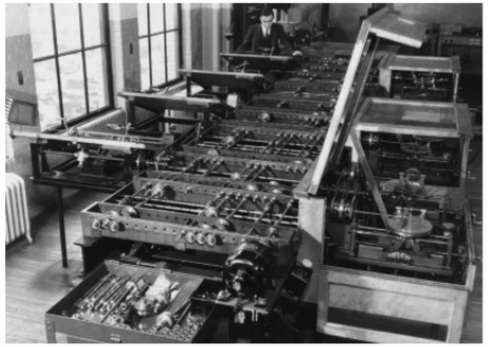
Today

- Personal Fabrication: Concepts and tools
- Fab Labs
- Personal Design and HCI

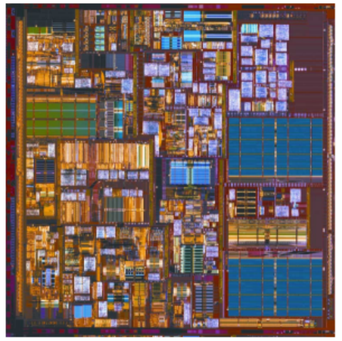
The 3rd Digital Revolution?

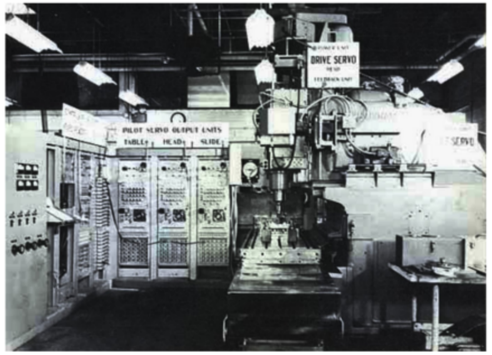
Digital Revolutions

analog → digital communication
~1945

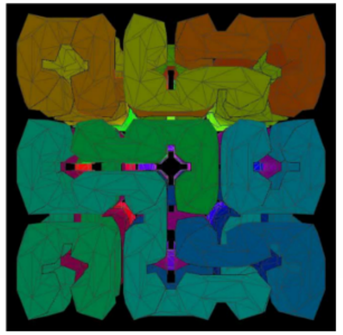


analog → digital computation
~1955





analog → digital fabrication
~2005



Source: Gershenfeld 2010

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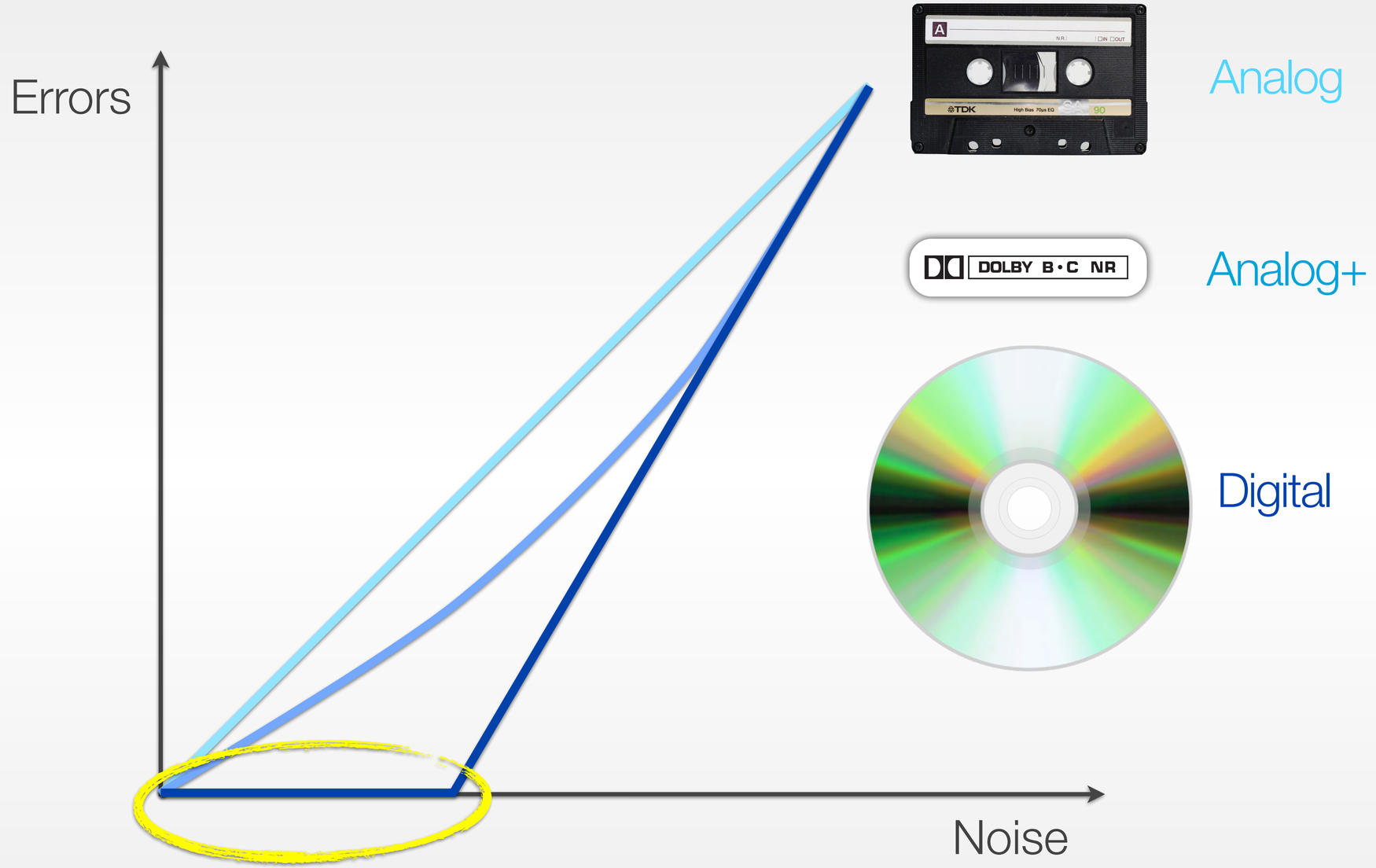


After Gershenfeld 2010

lossless

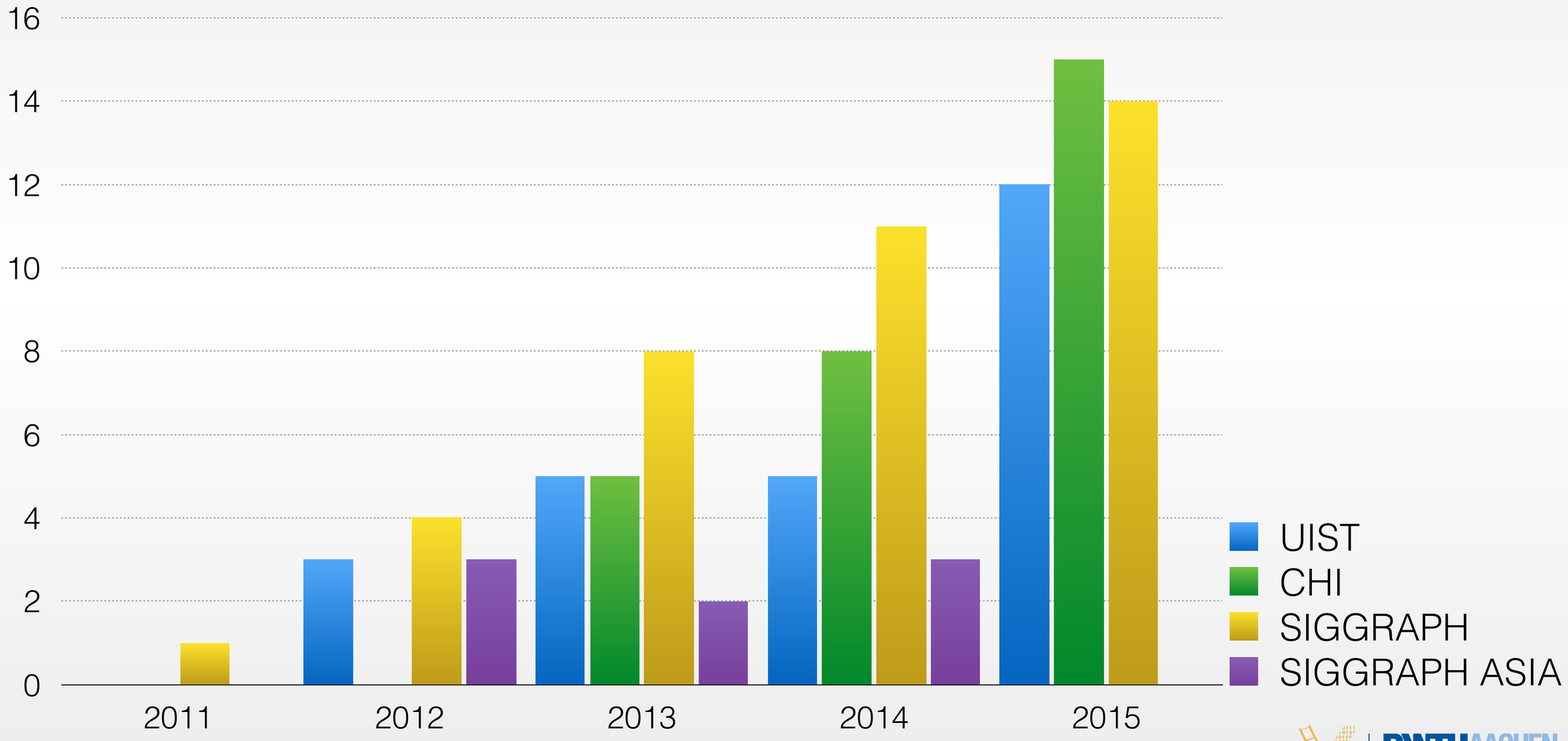
fast

cheap

Personal Fabrication (Fabbing)

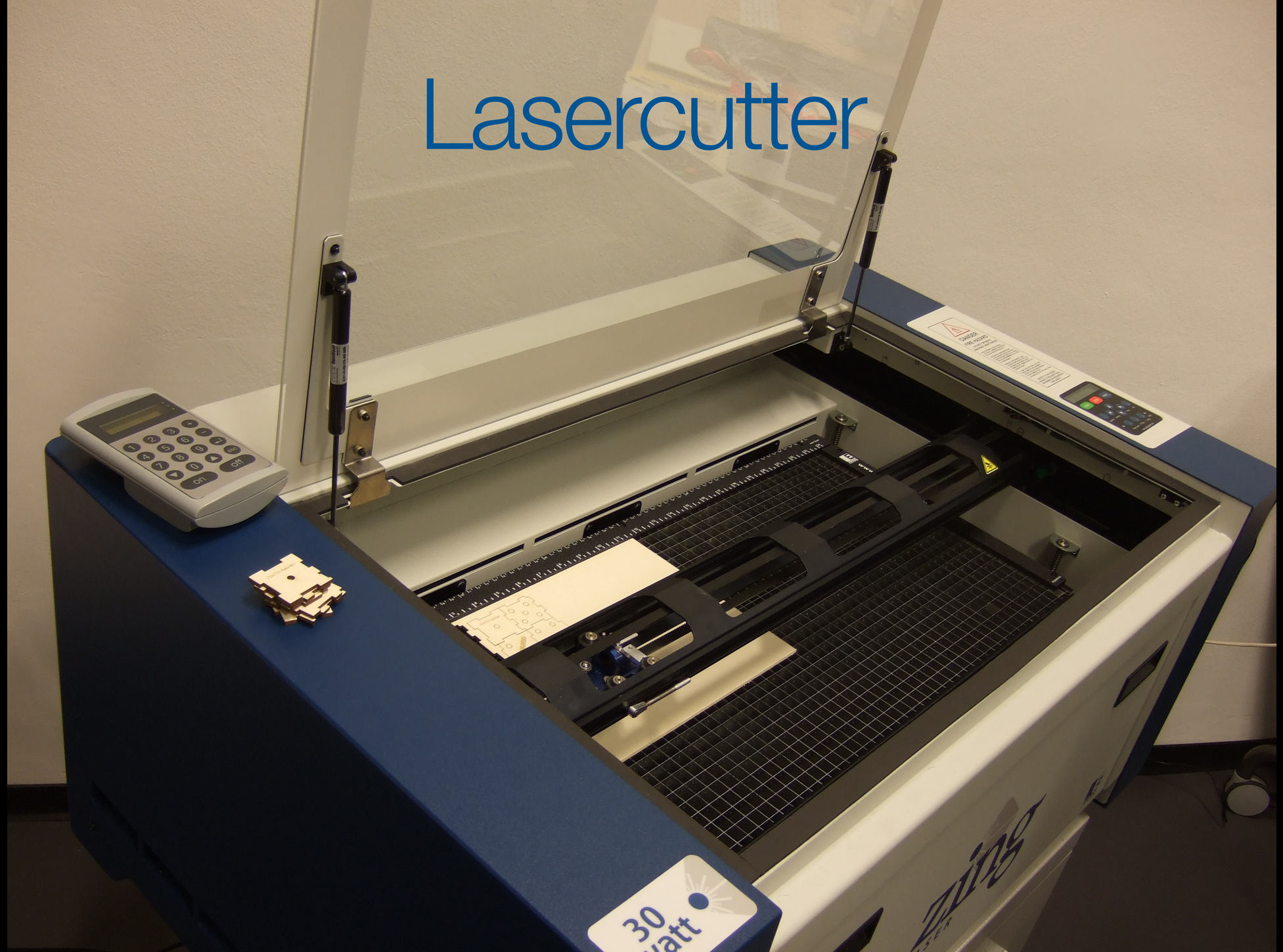
- Personal, digital fabrication of goods
- Personalizable to individual needs unlike mass-market products
- Largely missed by corporate world until now

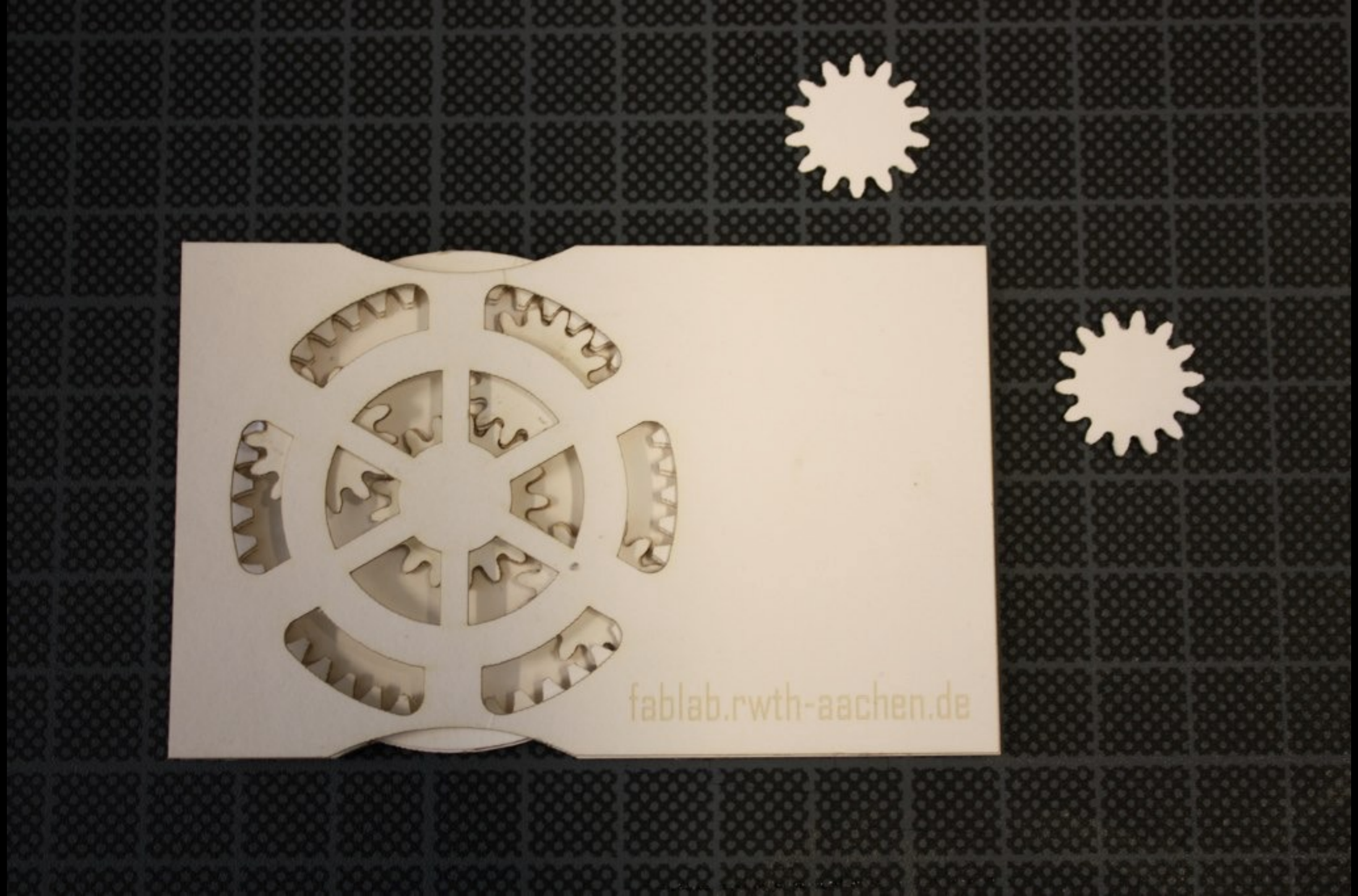
Publication Development



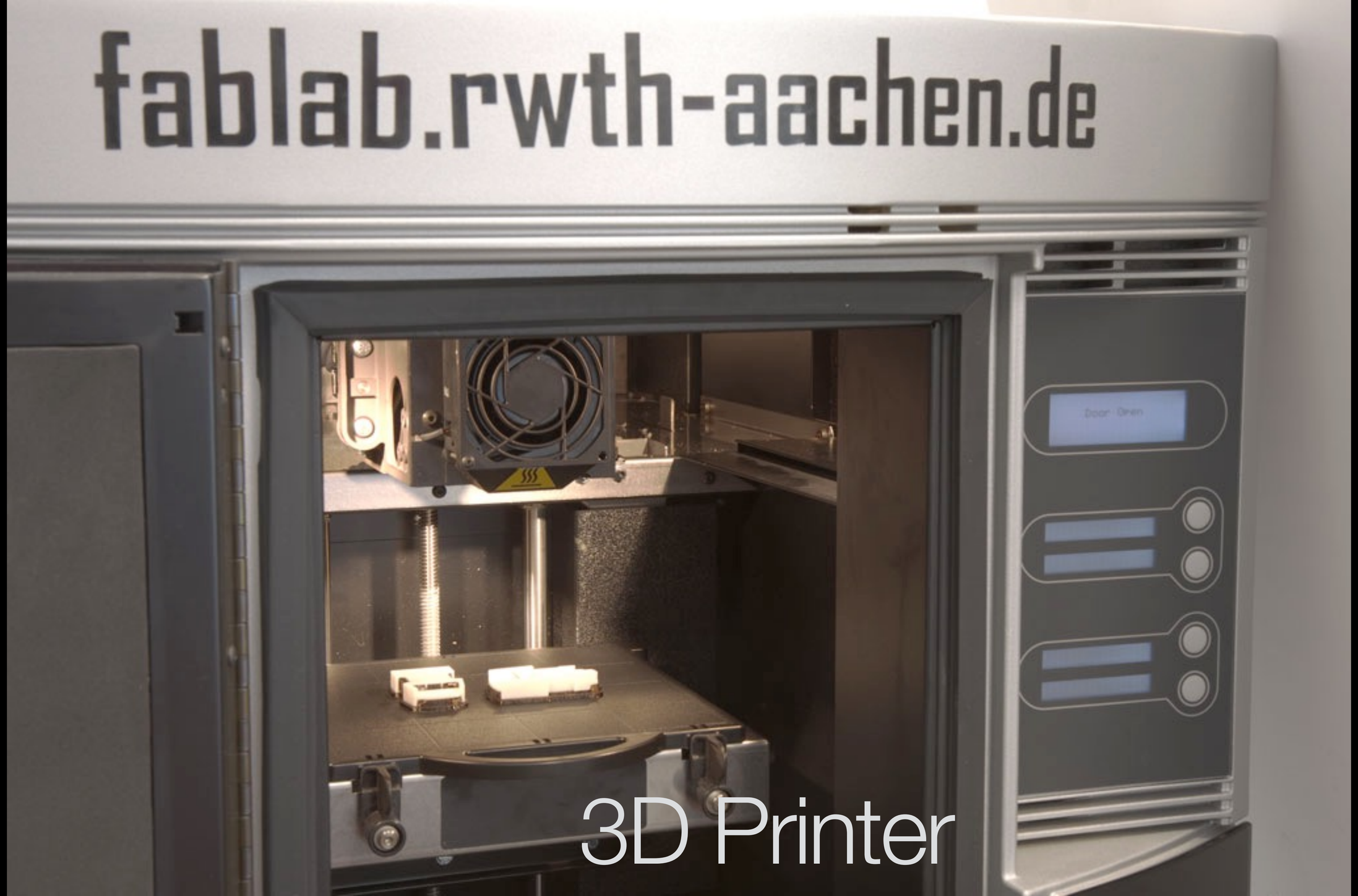
After: Mueller et al. 2016

Lasercutter

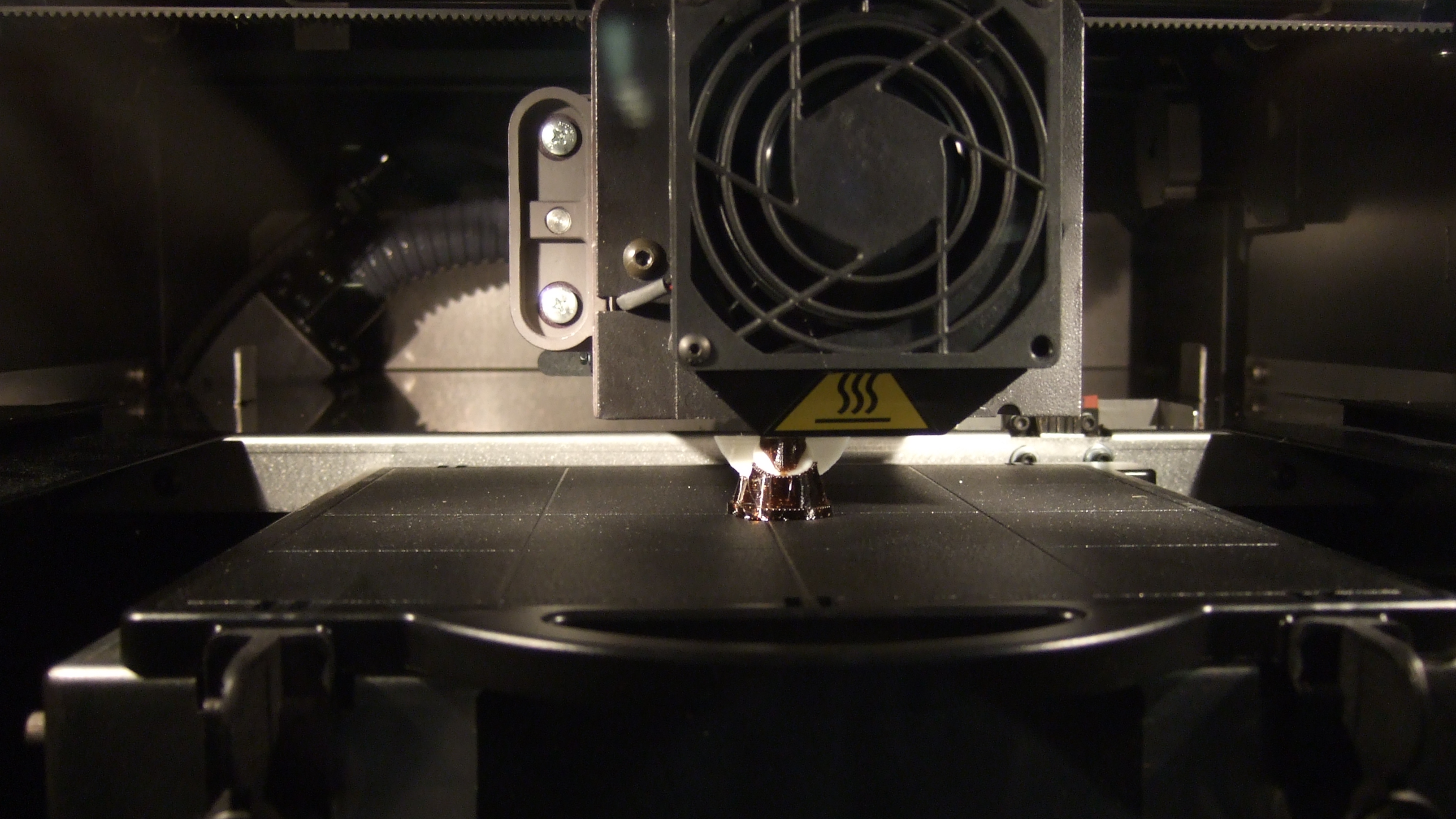


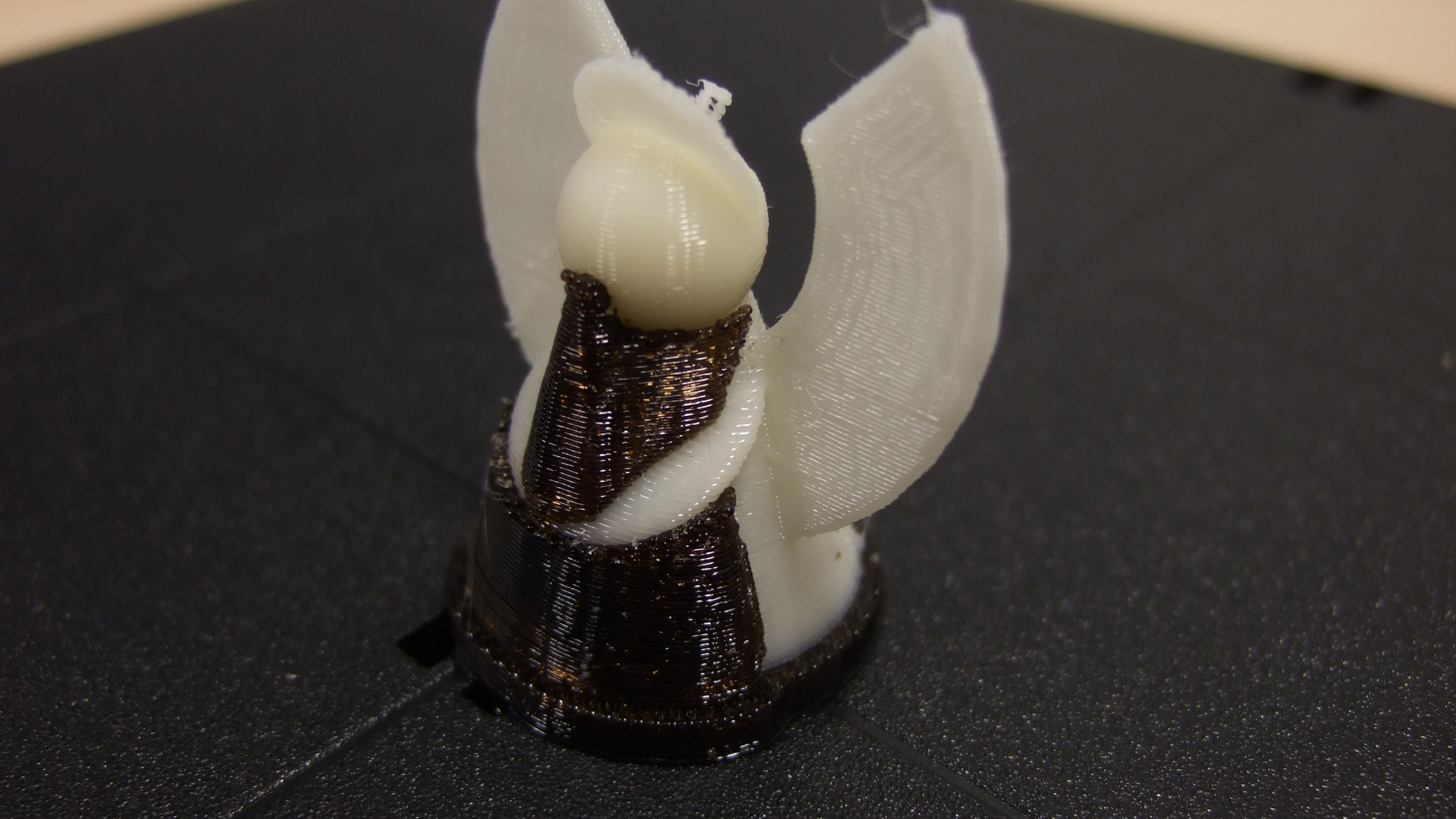

fablab.rwth-aachen.de

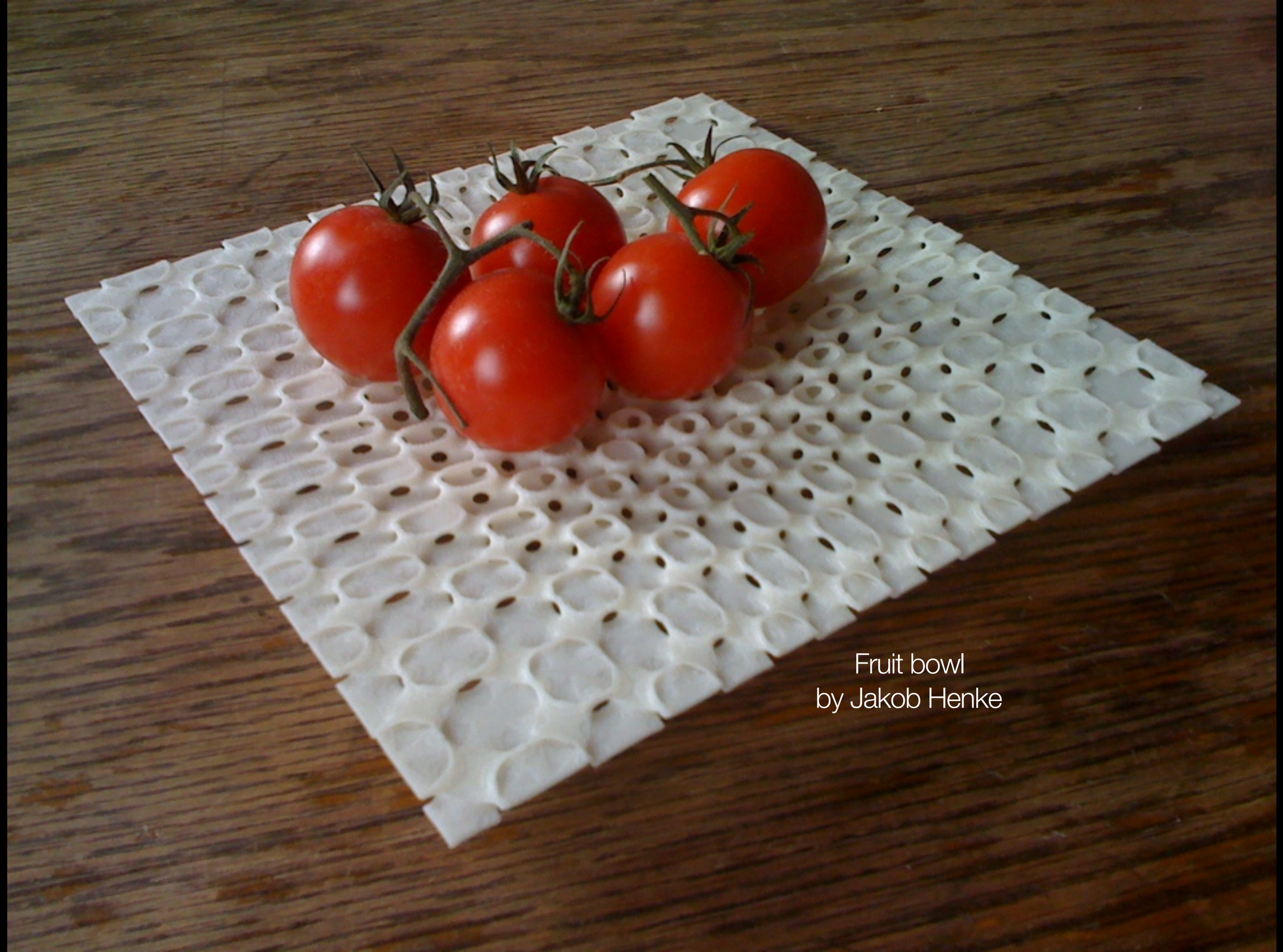
CNC Router

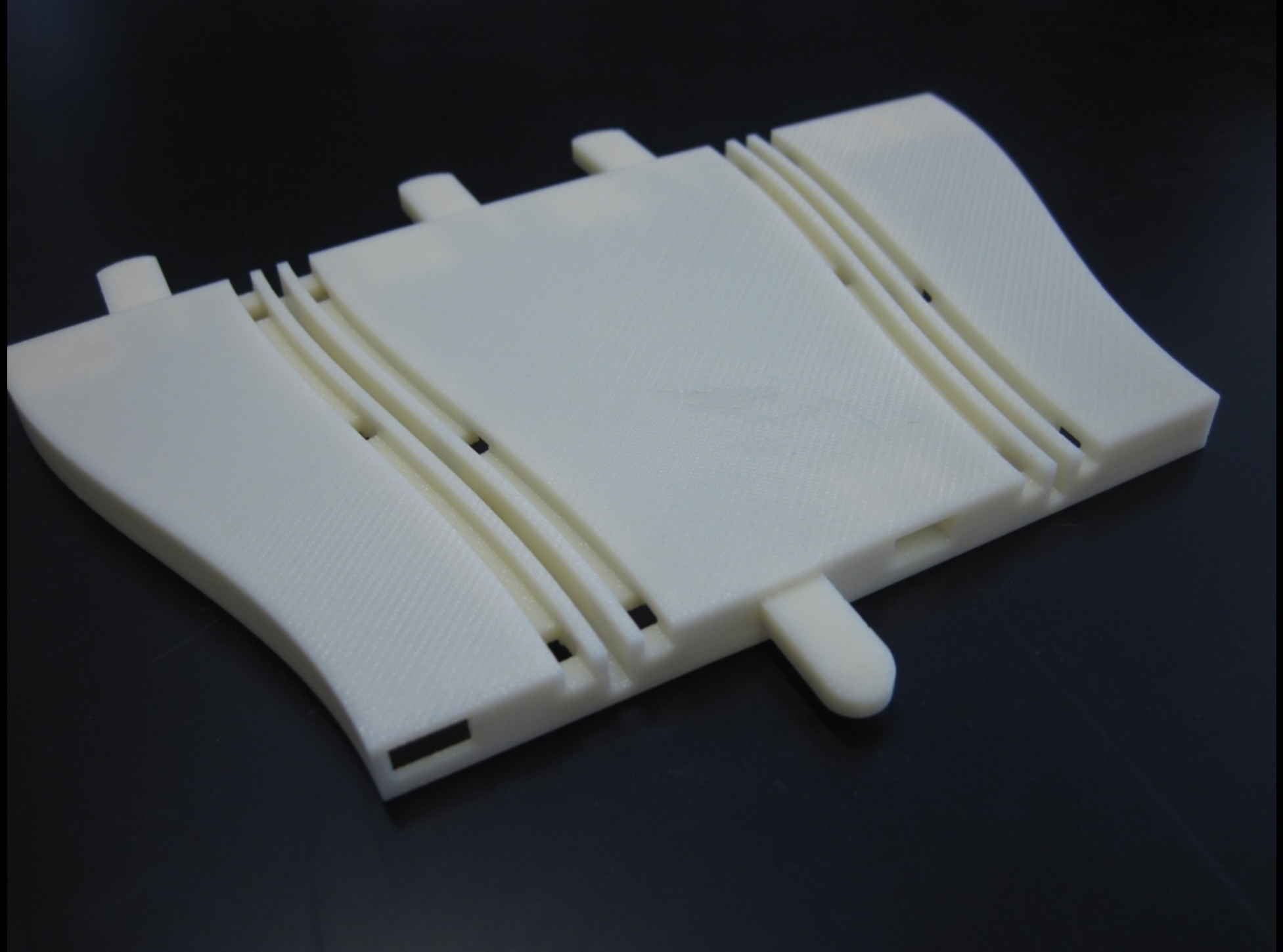


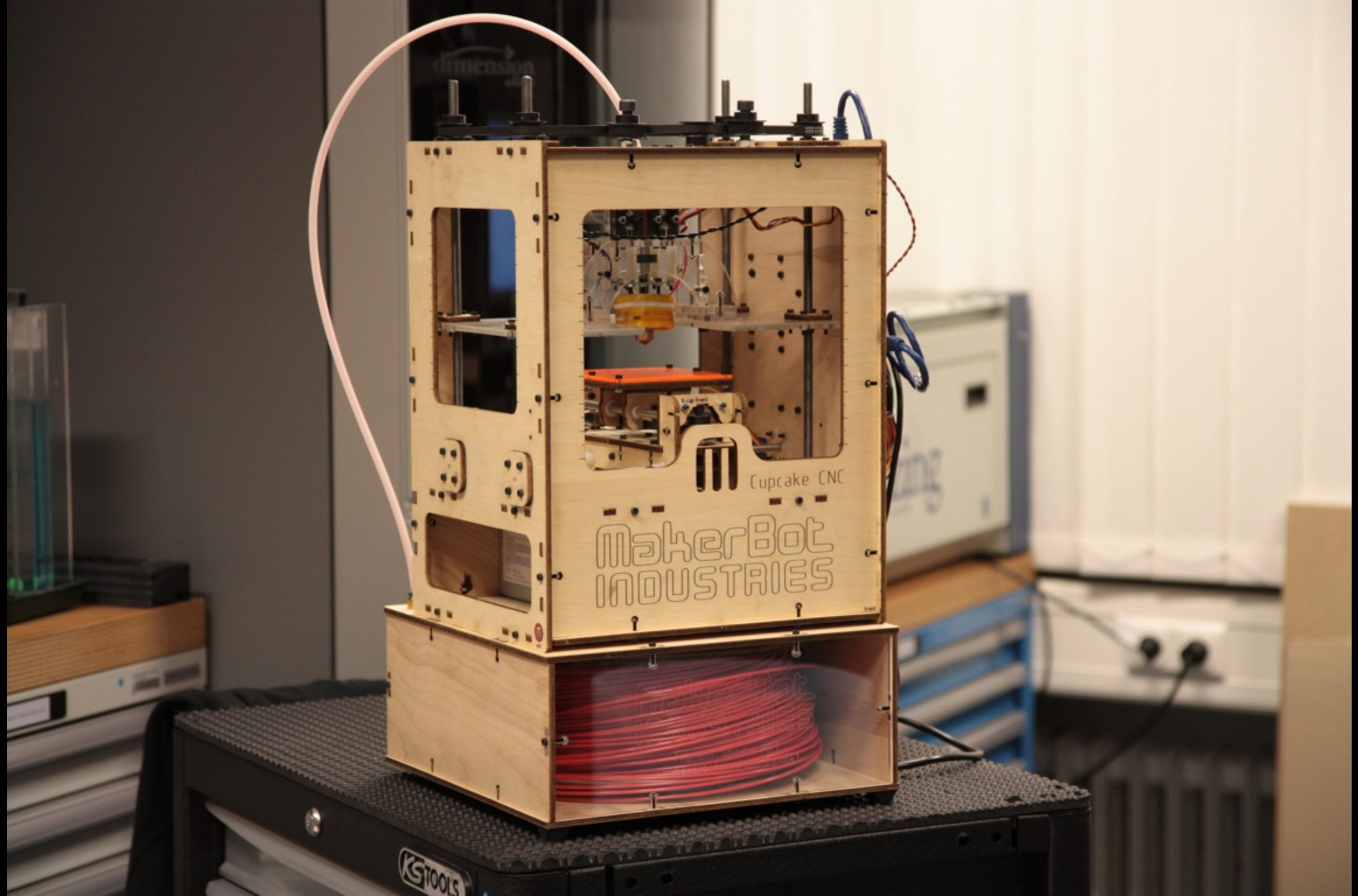
3D Printer



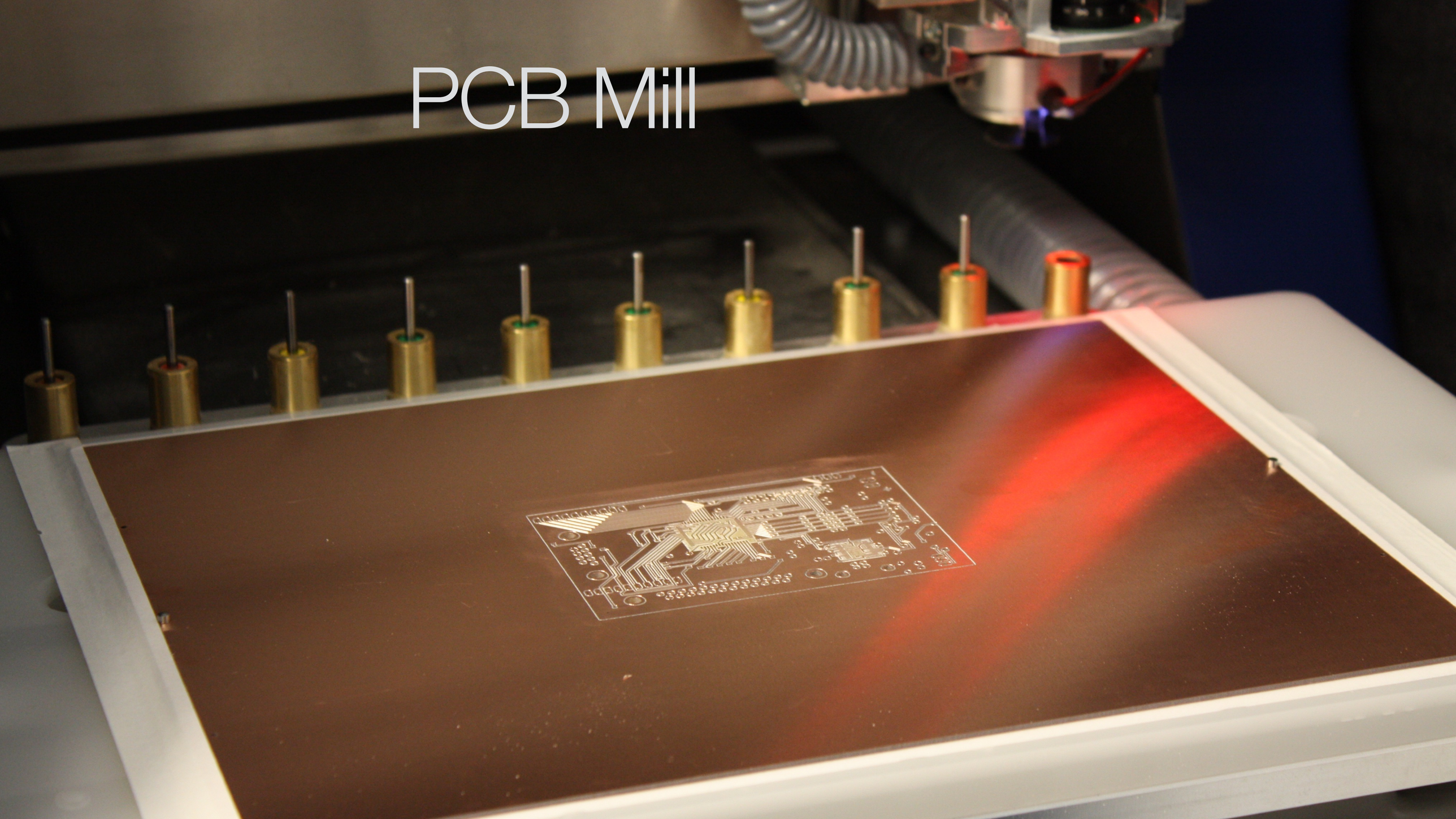


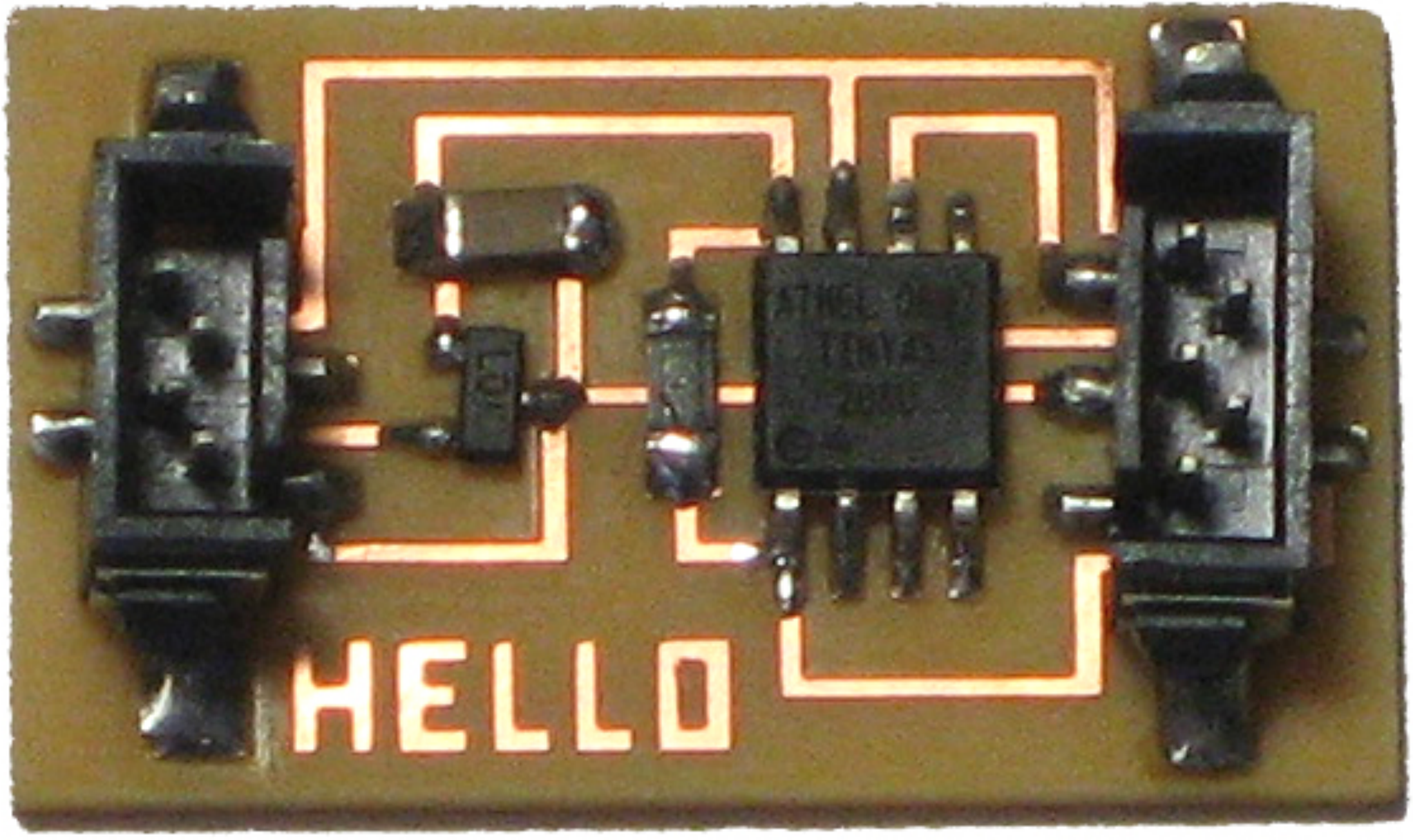

Fruit bowl
by Jakob Henke




Cupcake CNC
MakerBot
INDUSTRIES
KSTOOLS

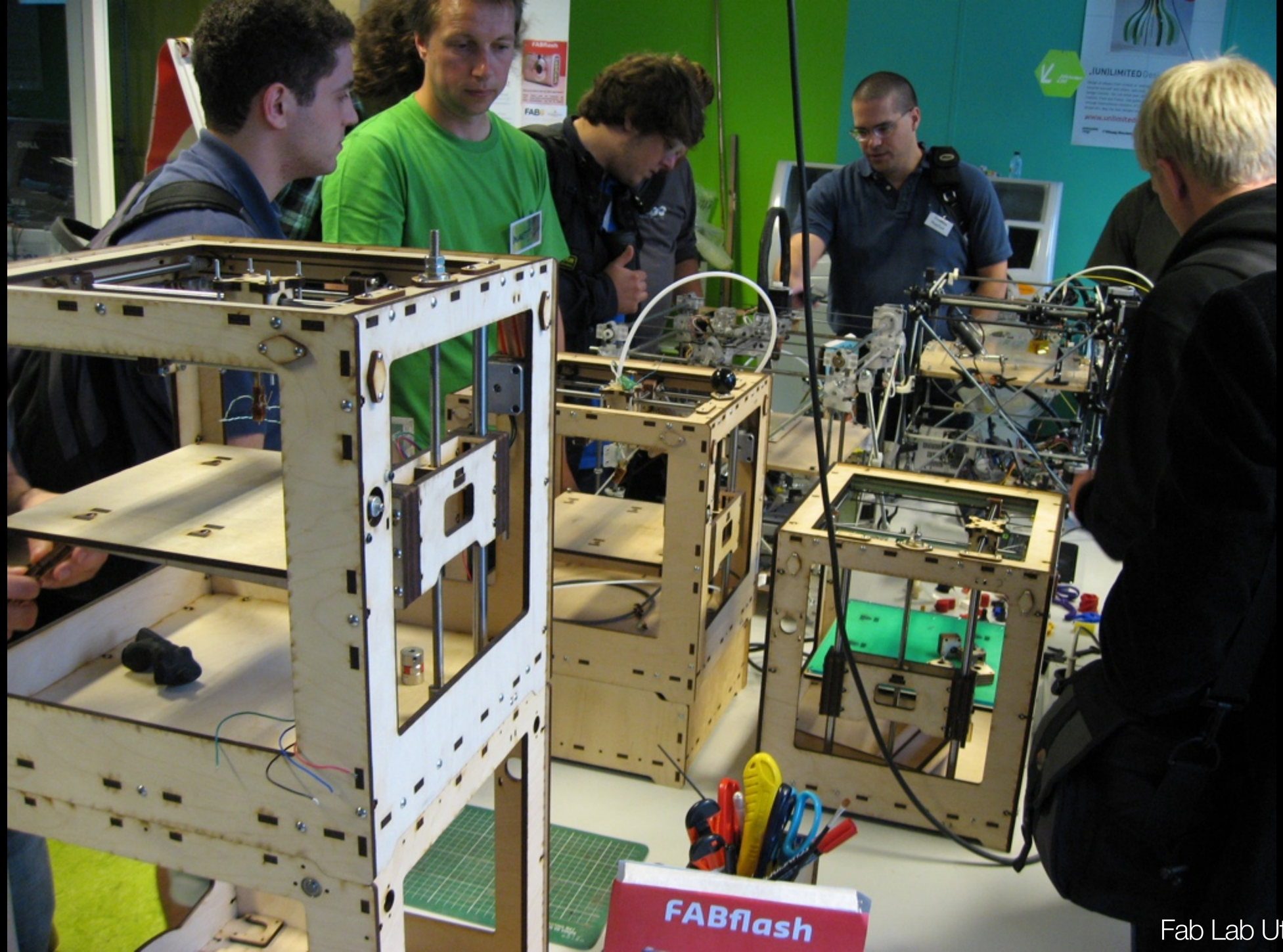
PCB Mill



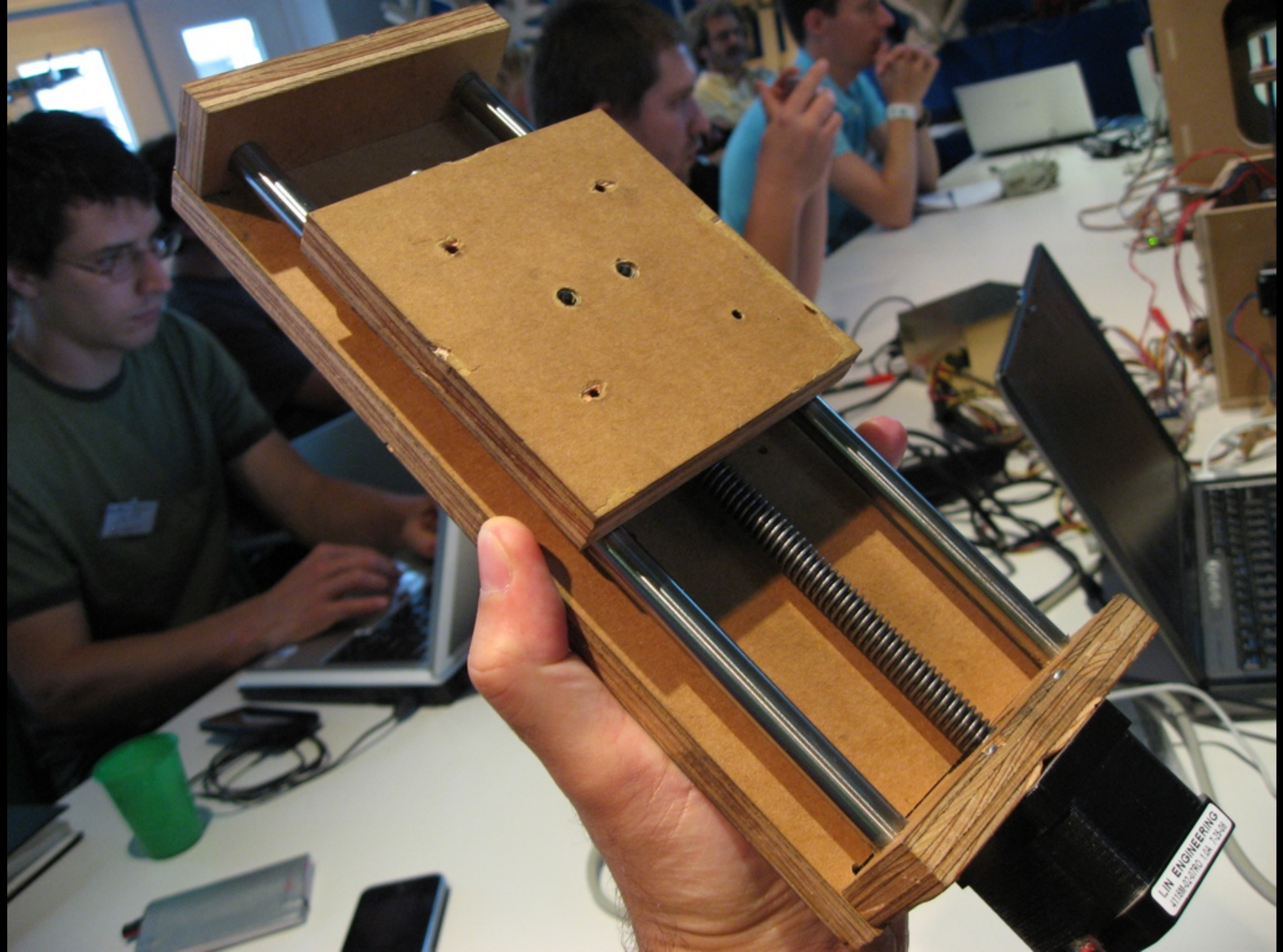

HELLO

Four Stages

- Fab 1.0: Expensive digital machines on dumb materials
- Fab 2.0: Easily replicated machines that make (MTM)
- Fab 3.0:, 4.0: Smart, self-arranging (replicating?) materials



Fab Lab Utrecht


LIN ENGINEERING

Physical Literacy

- Correcting historical error (“liberal arts” excluded making stuff)
- Reunite arts and artisans, creator and consumer

Impact on Society

http://www.bbc.co.uk/news/technology-22423883

The Law

1 You can't infringe trademarks

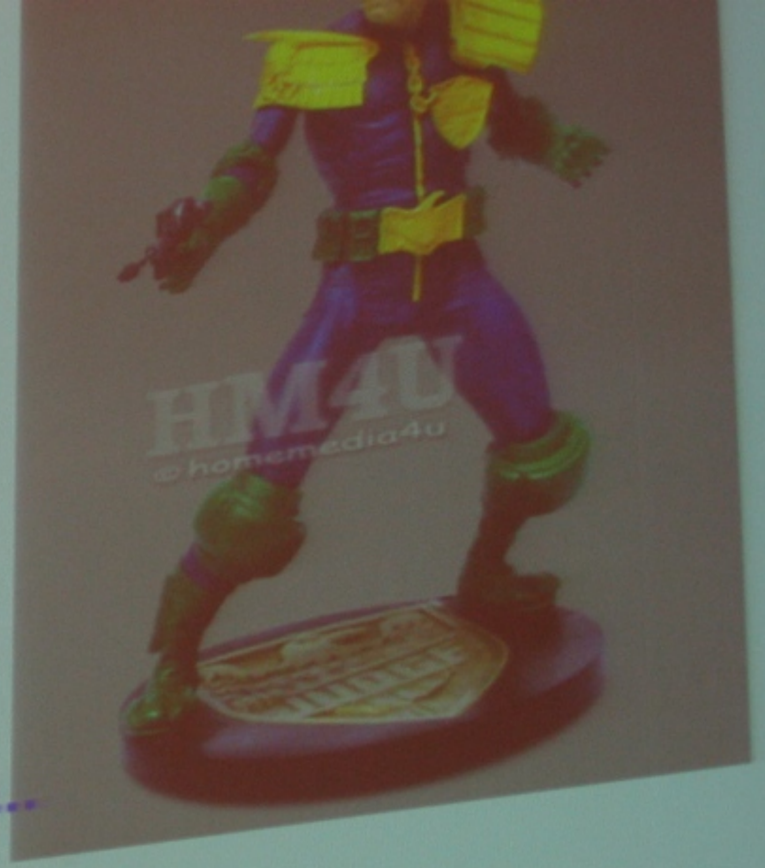
2 You can't forge (pass off)

3 You can't make copyright figurines

4 You can't include copyright artwork

5 You can't *sell* patented items

6 You can pretty much do anything else...



S Bradshaw, A Bowyer and P Haufe, "The Intellectual Property Implications of Low-Cost 3D Printing", (2010) 7:1 SCRIPTed 5, http://www.law.ed.ac.uk/ahrc/script-ed/vol7-1/bradshaw.asp

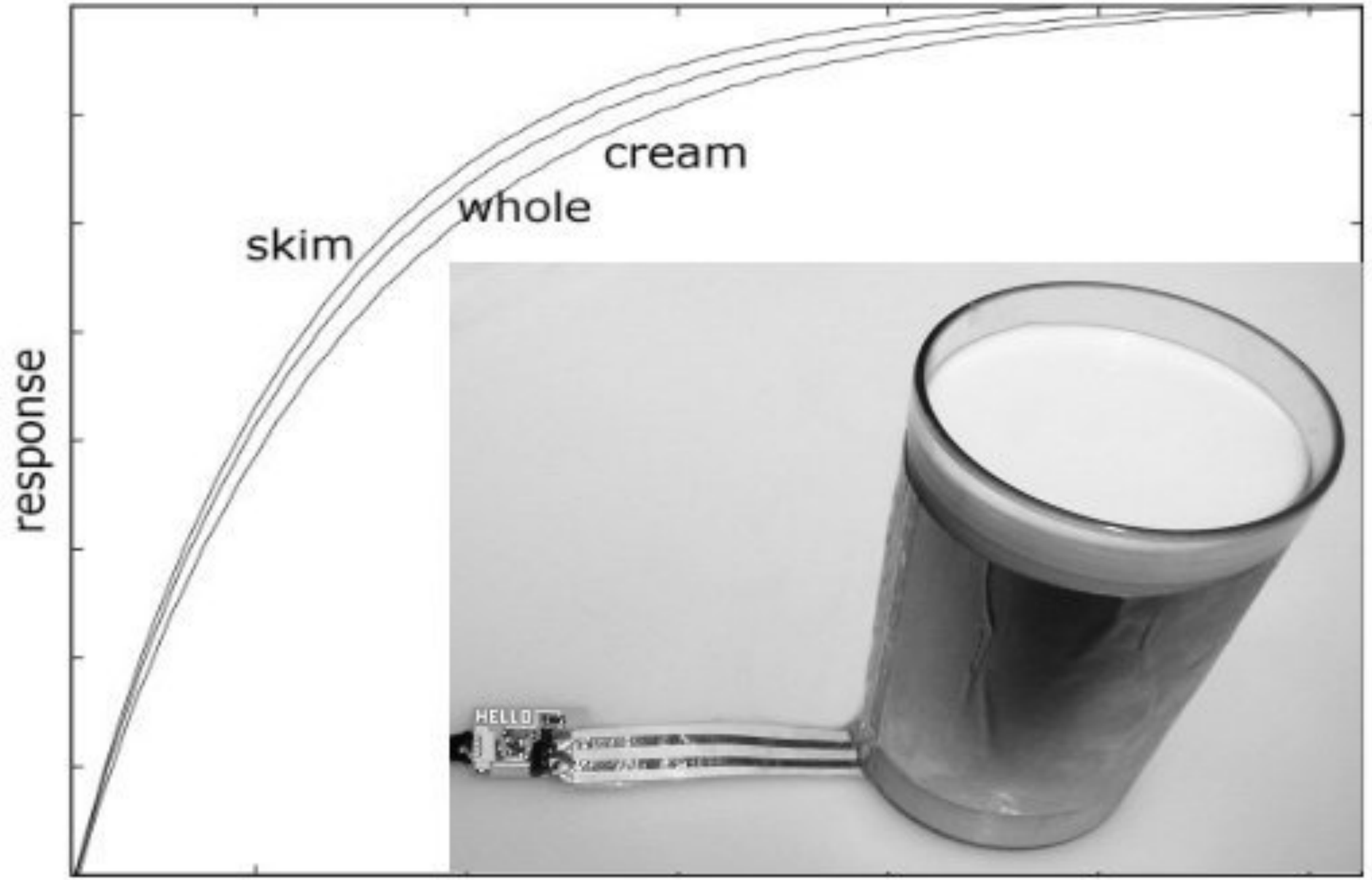
RepRap

Adrian Bowyer (Bath)

Fab Labs

- Free, open access
- Teach “revolutionary” skills
- Community based
- 432 around the world (240 in Europe)
- Fab Lab Aachen: Germany’s first
- http://fablab.rwth-aachen.de


we make things
no war
Fab Lab
Afghanistan



Source: Gershenfeld 2010

FABLABHOUSE
IaaC | CBA | Fab Lab

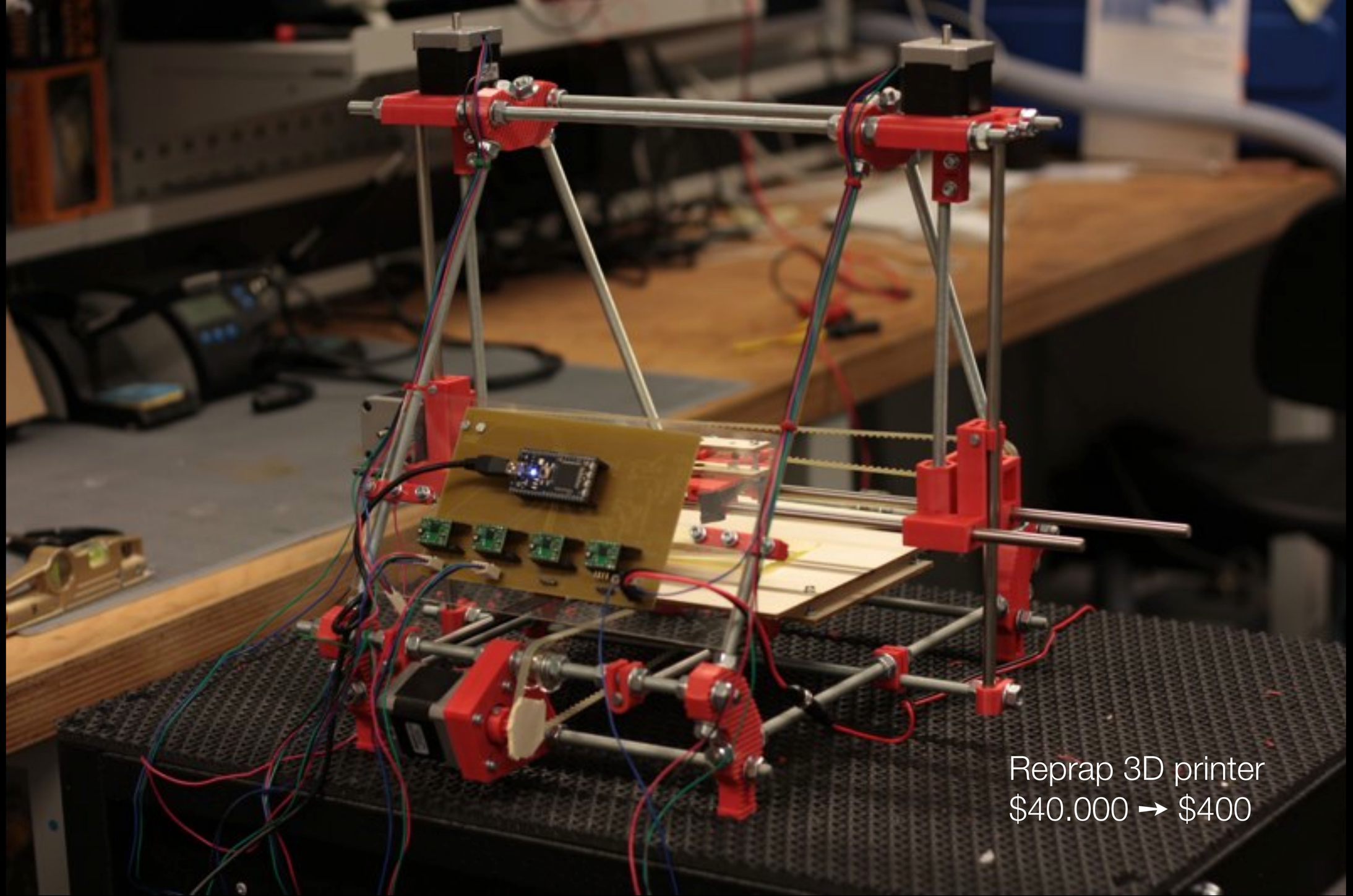
FABLABHOUSE www.fablabhouse.com
PROTOTIPO DE VIVIENDA SOLAR
SOLAR DECATHLON EUROPE
www.SDEUROPE.ORG

IAAC- INSTITUTO DE ARQUITECTURA AVANZADA DE CATALUÑA
www.iaac.net
MIT- CENTER FOR BITS AND ATOMS
cba.mit.edu
FAB LAB NETWORK
fab.cba.mit.edu

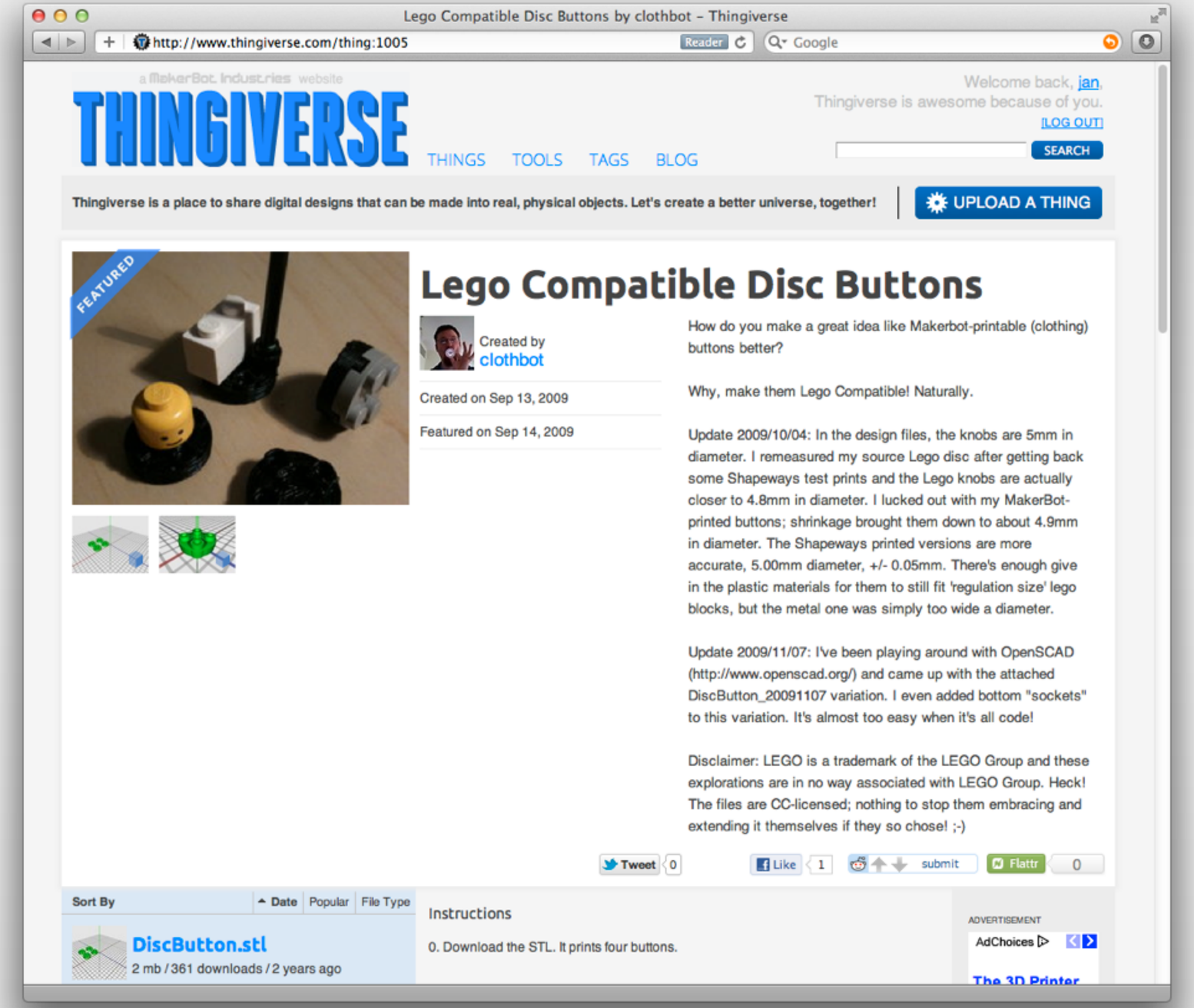
Personal Fabrication *Enables* New HCI Design/Research/Teaching Practices

http://weatherella.wordpress.com/

Personal Fabrication *Requires* New User Interfaces


Reprap 3D printer
$40.000 → $400

Altair: $397 (1975)



Download 10K+ free 3D models, or use free 3D modeling apps to create your own!

Start with a 3D model, then customize it to your liking. Or, start from scratch with any of these amazing, free apps.

Meet the Apps | Browse 3D Models

123D Catch
Generate 3D models from photos

123D Circuits
Design your next electronic project

123D Design Updated!
Easy 3D modeling for Mac and PC

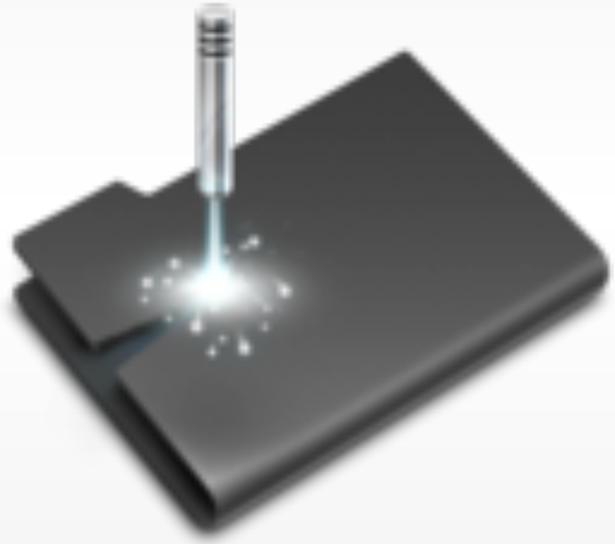
123D Make
Unique 3D models from 2D slices

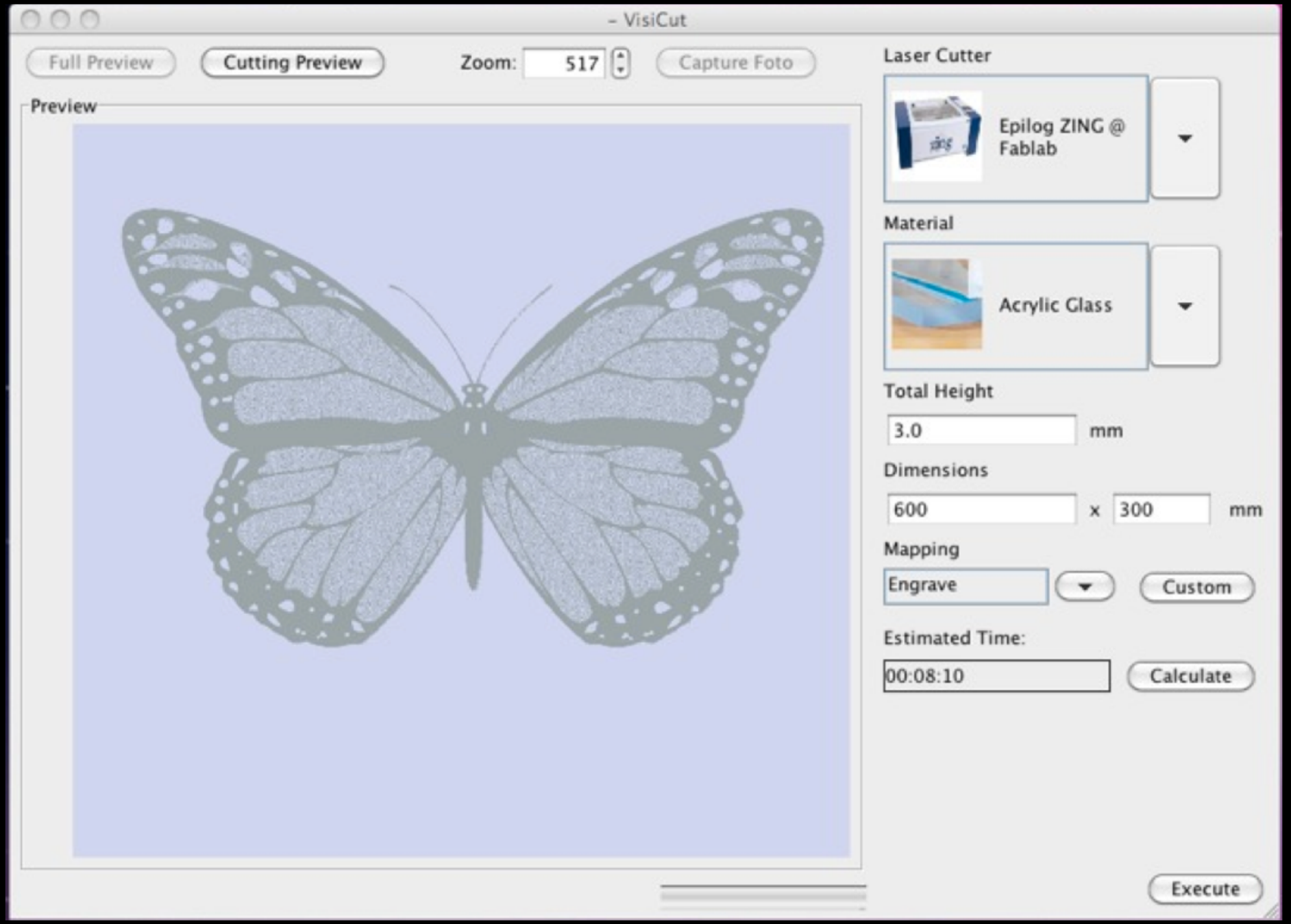
123D Sculpt+
Create 3D sculptures on iPad

Tinkercad
Get started with 3D modeling

VisiCut

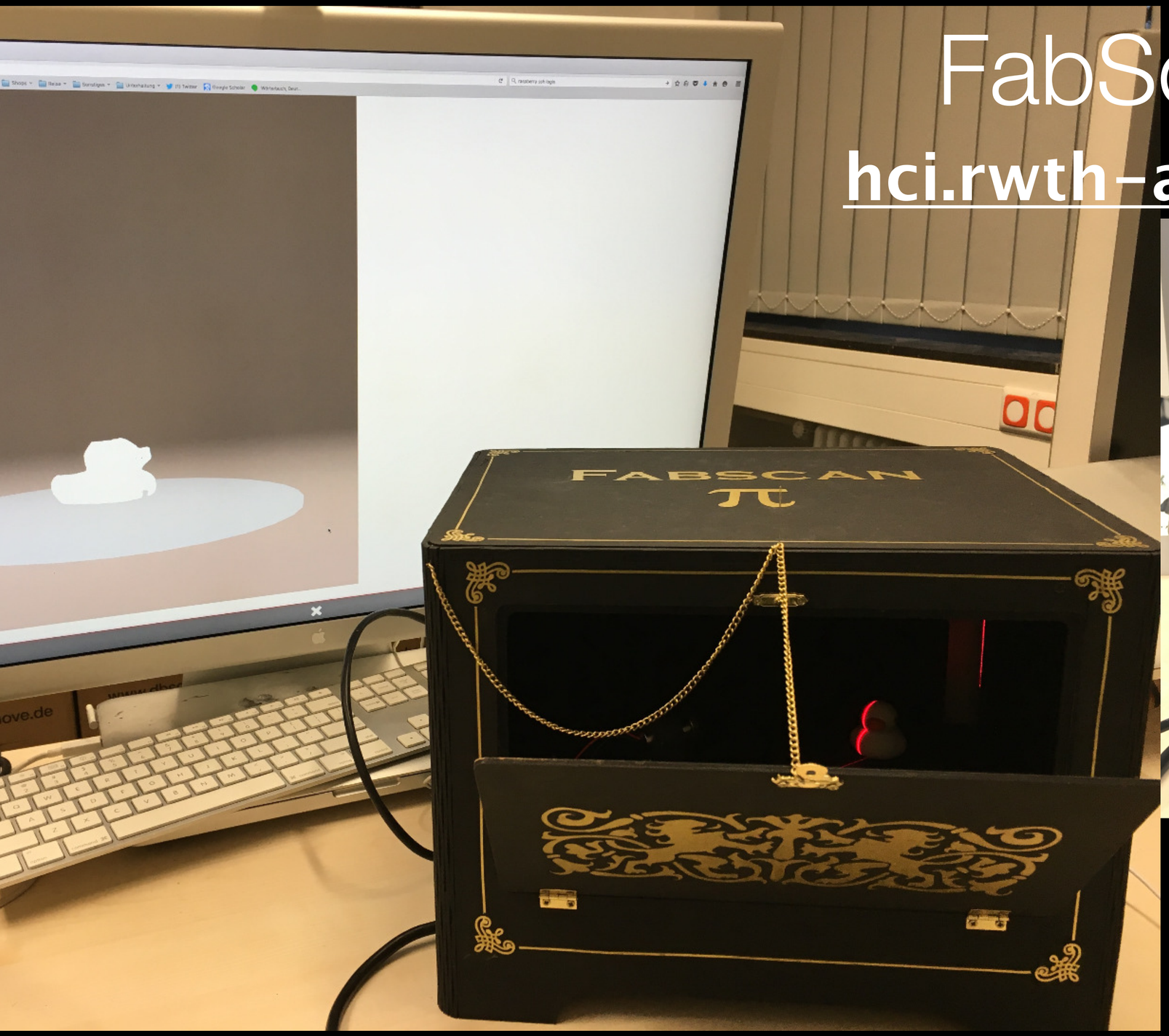
- The VisiCalc of LaserCutting
- Open-source, free
- http://hci.rwth-aachen.de/visicut




– VisiCut
Full Preview
Cutting Preview
Zoom:
517
Capture Foto
Preview
Laser Cutter
Epilog ZING @ Fablab
Material
Acrylic Glass
Total Height
3.0
mm
Dimensions
600
x
300
mm
Mapping
Engrave
Custom
Estimated Time:
00:08:10
Calculate
Execute

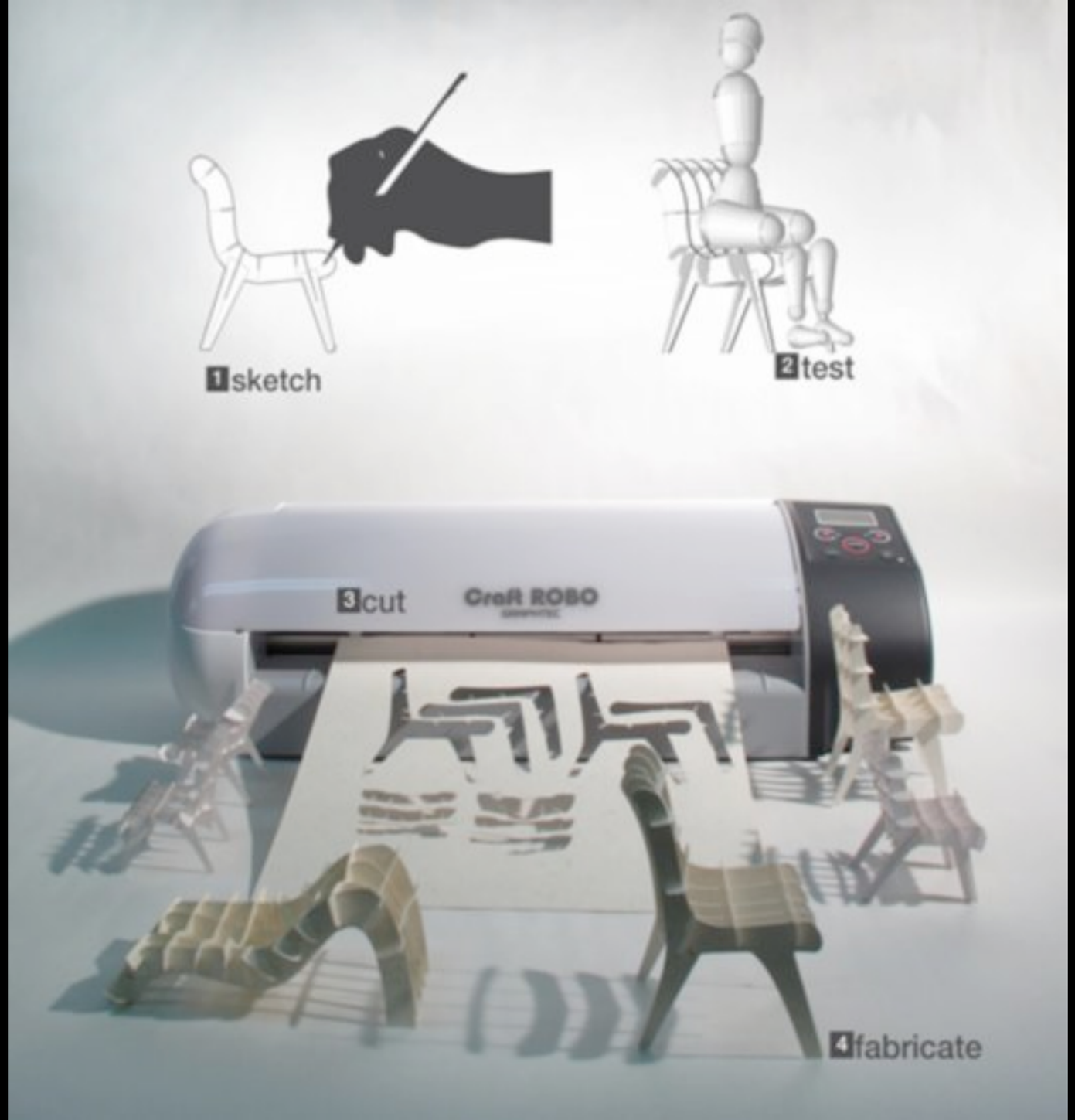
FabScan Pi (RWTH)

hci.rwth-aachen.de/fabscan



youtu.be/LHZC0uubb0c

Cassius Lamp
(AEC ’09)



Sketch Chair
(Greg Saul, 2010)

Food

Furniture

Consumer electronics

(Copyrighted) Toys

WHAT?

Weapons

Replacement parts

Prosthetics

Art

Small-market gadgets

3D Scan

AI, Assistants, Templates

CAD

Crowdsourcing

HOW?

Parameterization

Download/Query

Gesture

Touch&Haptics

Personal Design vs. Personal Fabrication

	Local Design	Outsourced Design
Local Fabrication	AutoCAD +RepRap	Thingiverse
Outsourced Fabrication	Shapeways	Traditional

HCI Research Topics

- Tools for HCI Research
  - Examples: SLAP, Madgets, Pneumatic Displays (CHI 2009)
- Software for Fabrication
  - 123D Make (Autodesk)
  - SketchChair.cc (Igarashi)
- New Interactions for Fabrication (beyond CAD)
  - FreeD
  - Constructables

D-Coil: A Hands-on Approach to Digital 3D Models Design

- Huaishu Peng, Amit Zoran, and François V Guimbretière, CHI 2015
- Handheld actuated extruder device knows 3D model, uses wax coiling to bring tangibility to the design

D-Coil: A Hands-on Approach to Digital 3D Models Design

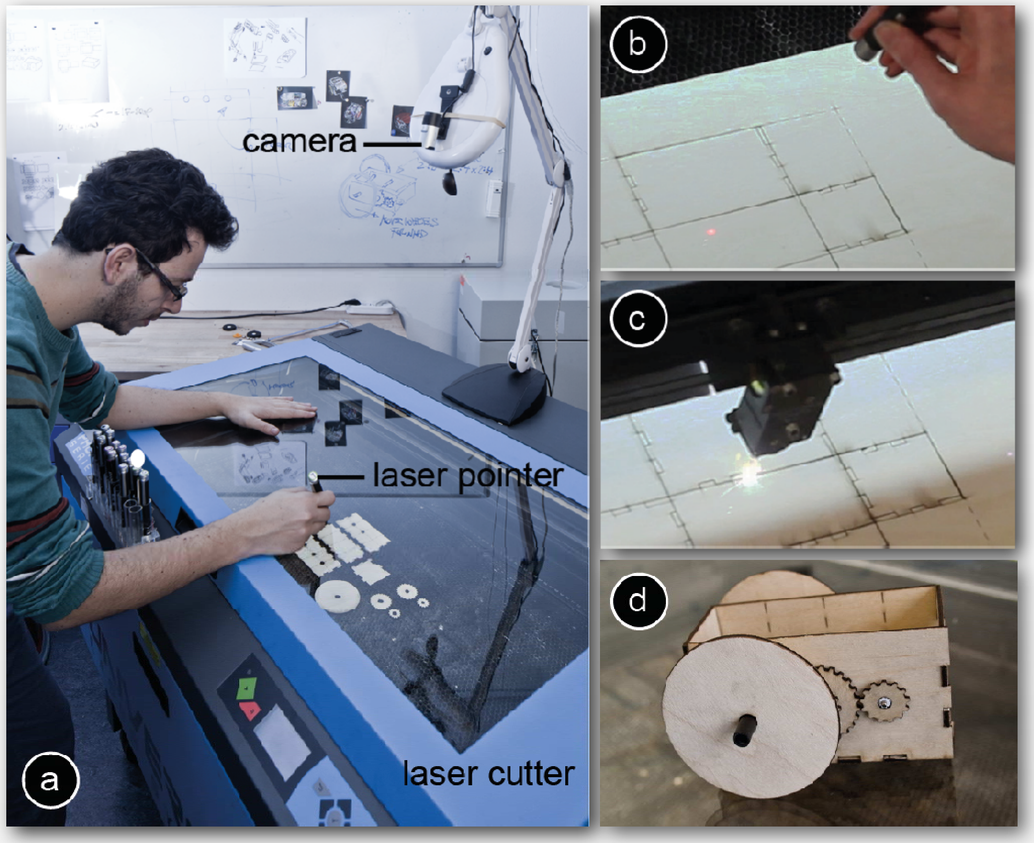
Huaishu Peng [1]
Amit Zoran [2]
François Guimbretière [1]

[1] Cornell University
[2] The Hebrew University of Jerusalem

האוניברסיטה העברית בירושלים
The Hebrew University of Jerusalem

Interactive Construction

- Stefanie Mueller et al. (HPI), UIST 2012 (youtu.be/8g3LaF9oVFY)
- Use laser pointers to draw on material, lasercutter cuts interactively



- *“People doing strange things with electricity”*
- International network of people doing interactive art and electronic hacks
- We launched the Aachen dorkbot chapter in 2009
- Meetings every 3rd Wed of the month, here (room 2222)
- dorkbot.de