Steepest Dissent:

small scale digital fabrication

Nadya Peek, infosyncratic.nl

HOPE X, NYC 2014

December 5, 2009 1:11 PM PST

DARPA's giant red balloons officially at large

by Chris Jacob

*Update at 10:56 p.m. PST: The **MIT Red Balloon Challenge Team (PDF)** has won the competition.*

You may have heard about that **DARPA balloon challenge**, where the first team to identify the latitudes and longitudes of 10 moored weather balloons across the continental U.S. wins $40,000? Well, as of Saturday, the balloons are up in the air. If you don't have a team yet, here are some places to report a sighting.

What's cool is how most of the balloon-hunting communities I've found are working toward selfless goals. Both **DARPABalloon.com** and this **MIT group** are proposing to gather a huge number of participants, and rather than give each contributor a measly cut, the 40 grand will be donated to charity.

GIZMODO DARPA is holding its **Network Challenge** to mark the 40th anniversary of the Internet. The competition is meant to explore the roles the Internet and social networking play in the timely communication, wide-area team-building, and urgent mobilization required to solve broad-scope, time-critical problems.

DARPA says the balloons will be in readily accessible locations and visible from nearby roads.
(Credit: DARPA)


DARPA

THE CENTER FOR BITS AND ATOMS
Massachusetts Institute of Technology

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nm


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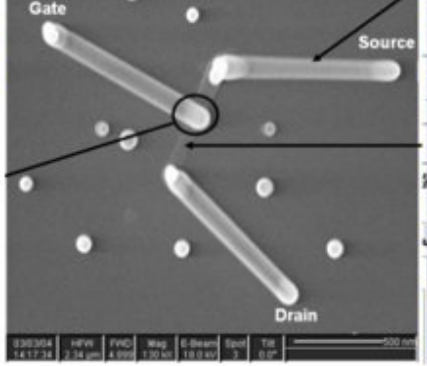
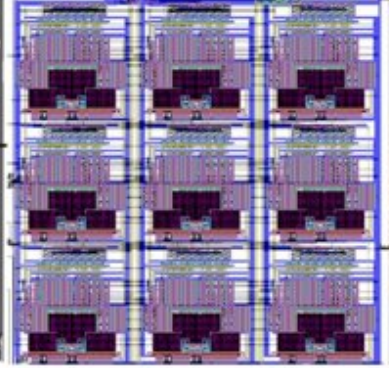
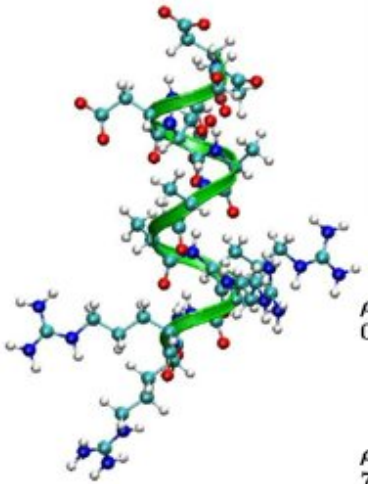
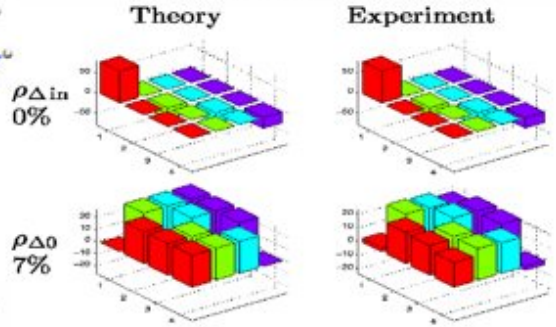
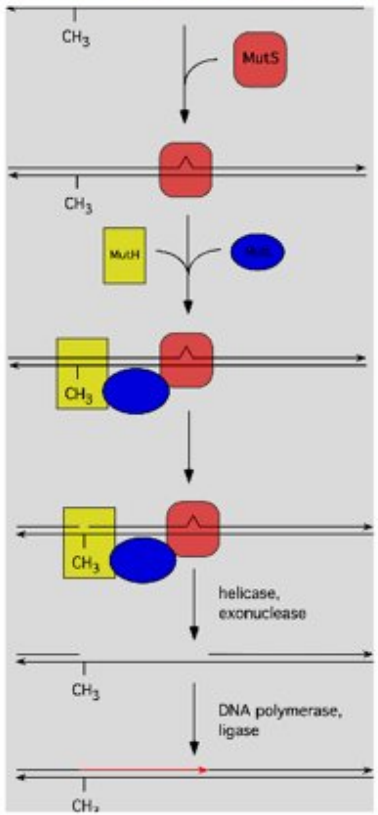
THE CENTER FOR BITS AND ATOMS
Massachusetts Institute of Technology

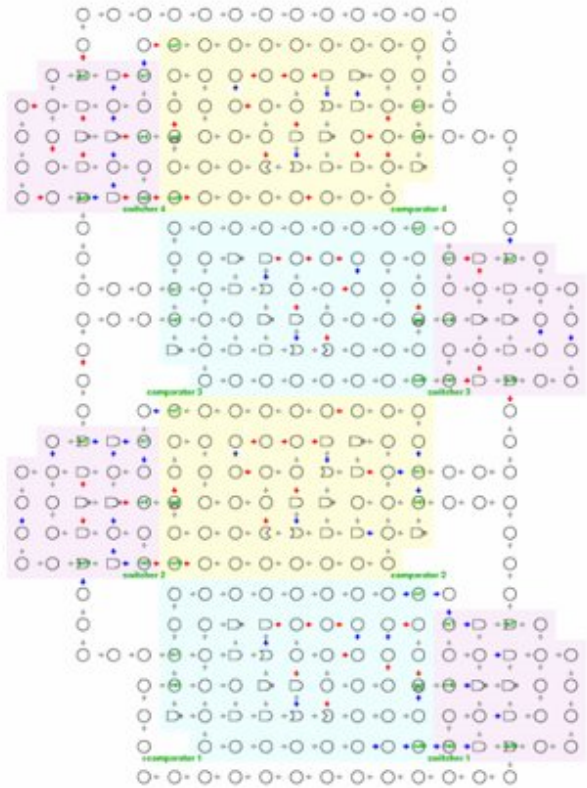


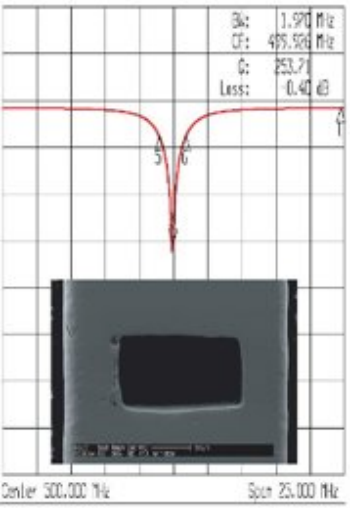


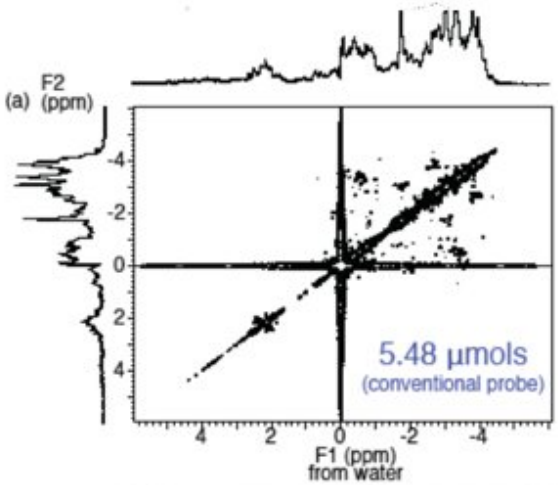


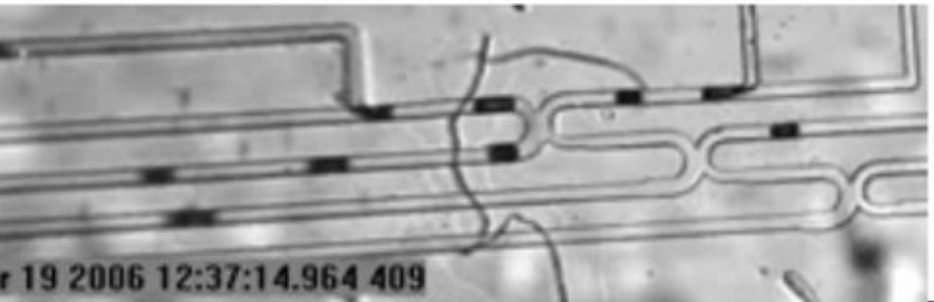


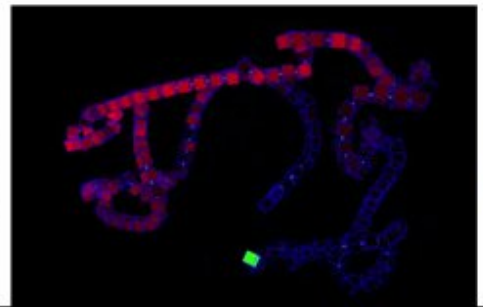


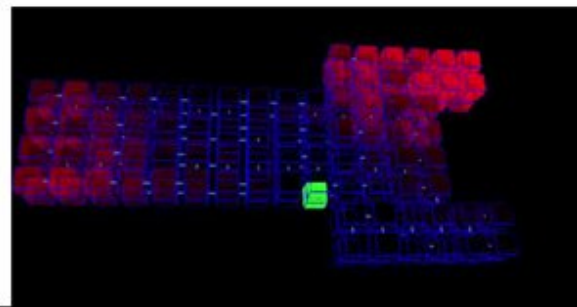













ONE WAY
DO NOT
ENTER

MIT MAS.863:

How to make

(almost) anything

THE CENTER FOR BITS AND ATOMS
Massachusetts Institute of Technology

in

out

m

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nm

But where did digital fabrication come from?

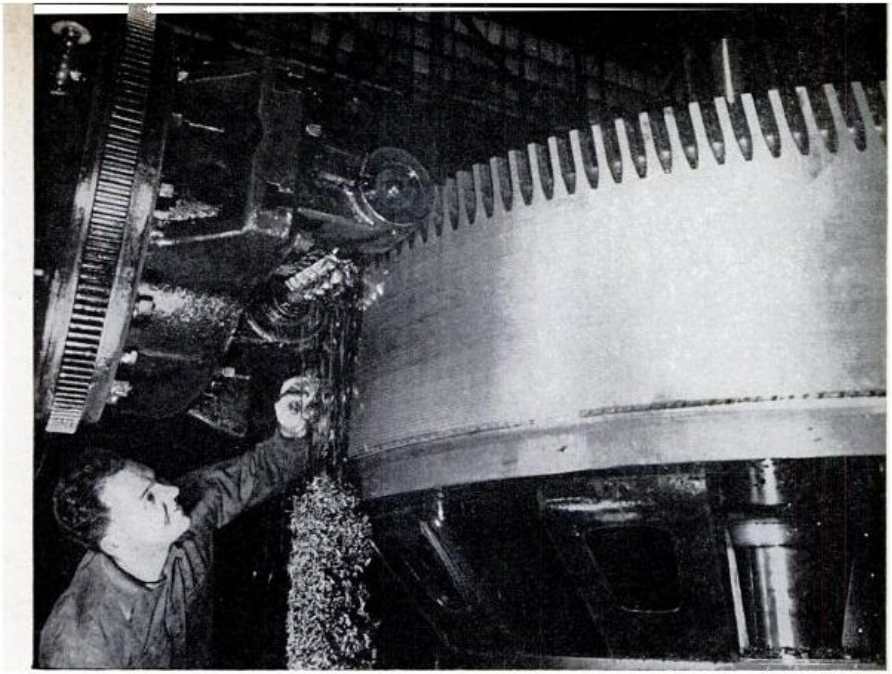
Pyrmont Bridge

Automobile Showroom, Montreal Canada

Chullora Aircraft Factory circa 1943

(B.586)

Adventures in the Atom, 1948



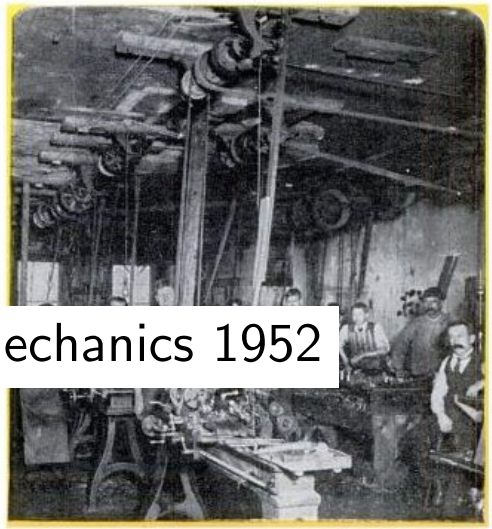
Westinghouse photo

Hobbing machine cuts teeth in a gear over eight feet in diameter; chips pile up beneath the cutting tool

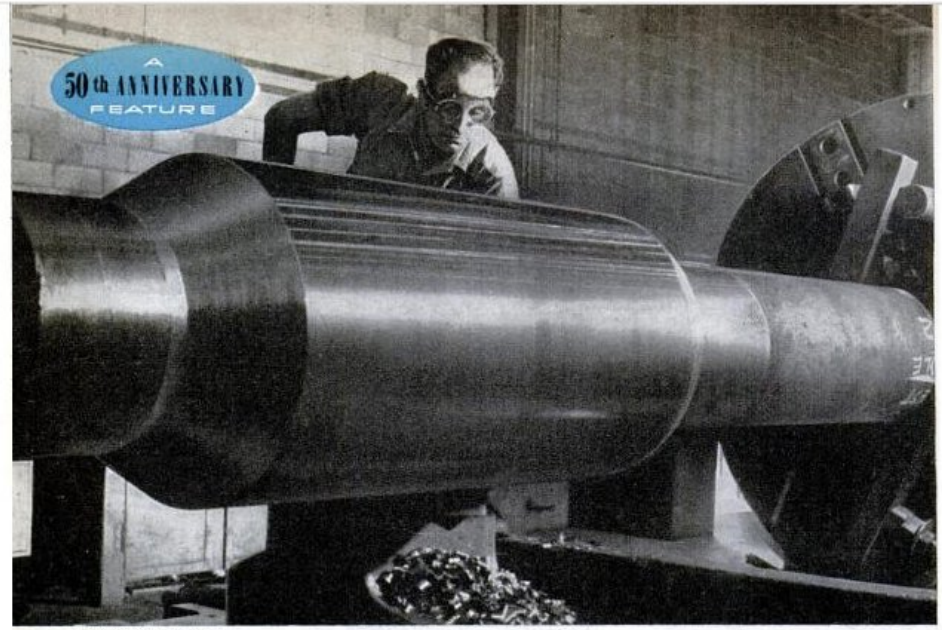
TOOLS THAT MAKE TOOLS

A lot of selective breeding has gone into them since, but basically they remain unchanged. In 1902 a machine tool was described as a nonportable, power-driven tool that shaped metal by removing surplus material in the form of chips.

The first and oldest of these tools was the lathe. By 1902 a more flexible version called the turret lathe was coming into popularity. The next was the drill, which was fine for drilling holes in metal but no[t] enough tolerance 1902. F[or] inch, a boring machine was used. Today drilling and boring are words often used interchangeably, but to the



Machine-tool shop of 50 years ago presented maze of overhead pulleys. This was National Acme Company



U. S. Steel Corp. photo

Giant steel roll soon to take its place in a U. S. Steel rolling mill is machined on a 60-inch lathe in the forging shop at the firm's Homestead District works

By George Scullin

The jet engine and the wrist watch, the power saw and the 1952 automobile— all are products of those modern wonders—

THE

AROUND early March this year, a few newspapers announced casually that the Air Force had been given the green light on the purchase of 20 machine tools. It was just a small story and the editors couldn't get too excited about it. Not even at the size of the machines, four stories high; or their cost, $389,000,000! Stories like that are routine in this year of 1952.

But what if that story, through some slip in the time machine, had appeared before the young editors preparing the first issues of *Popular Mechanics* in 1902? What about it would be strange?

Not the words "Air Force," though man had yet to fly a power-driven aircraft. These farseeing young men were already convinced that man *would* fly, and soon, and that there would be an Air Force. Not the size of the machines. These editors were dedicating their magazine to the conviction that the years to come would produce mechanical wonders beyond anything even dreamed of at the turn of the century. To anticipate these marvels and explain them in words and pictures their readers could understand was the job they had already created for themselves. But we do think they would have been stunned by the $389,000,000.

In 1902 that sum would have bought the year's output of the entire machine-tool industry, would have bought the industry as well, and there would have been enough left over to put a little white fence around the whole thing. In fact, the industry was so small that few people had ever heard of it, and fewer still knew what it was.

Yet this is the tiny industry that has made possible our entire way of life. Without it, we would be living on the products of our bare hands, with a standard of living approaching that of Colonial days.

What are these machines that produce all this magic? Well, they are a weird family. They are the tools that make the tools that make everything else. But, being a family, they also make each other. This makes them the only self-procreating race in the machine world.

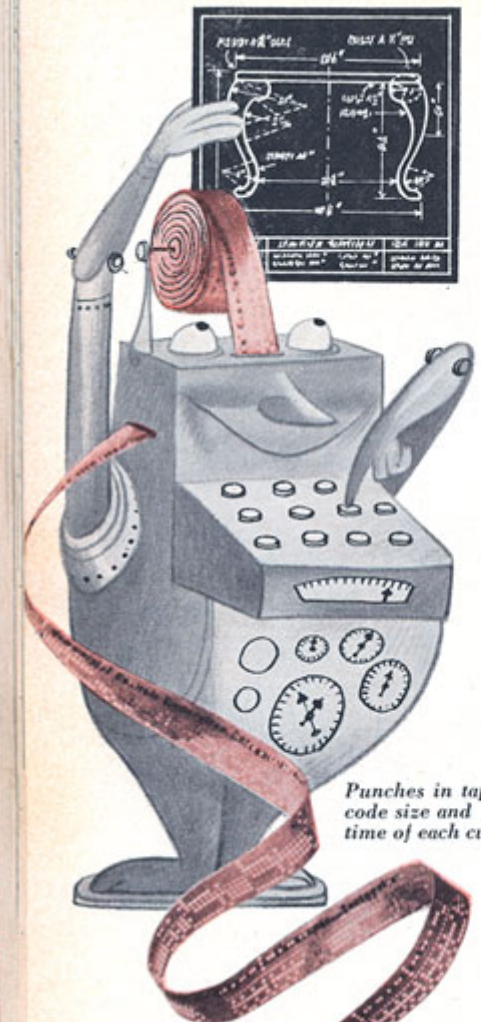
To understand the huge, fantastic, almost-human machine tools of today, let's take a look at their ancestors as the first editors of *Popular Mechanics* knew them.

By Arthur J. Goldberg
Secretary of Labor

How will automation affect your job?

60th ANNIVERSARY SPECIAL

Secretary of labor 1962-1965



Punches in tape code size and time of each cut.

Tape is fed into computer where code is converted to electric signals.

In an electronic lab at MIT, engineers now are

Teaching Power Tools to Run Themselves

By Hartley E. Howe

SO JOE WORKSHOPPER figures he'd like to turn out a set of dining-room chairs—and at the same time break in his new Model 100 Super Tapemaster. Joe whips down to the hardware store and looks over photographs of different designs. He settles on a Swedish pattern popular 'way back in 1955—delicate and handsome, but full of difficult reverse curves.

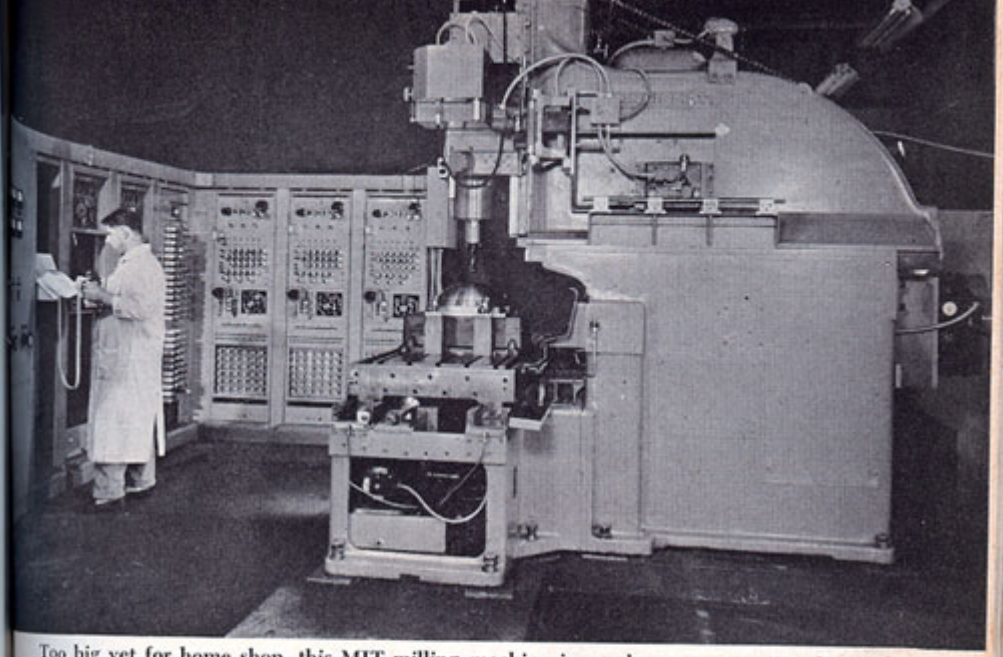
That doesn't worry Joe. He plunks down $10 for a week's rental of a batch of tapes—one each for legs, arms, back and seat.

That night, he clamps a nice piece of birch into his Tapemaster, slips the tape into the control box, flips the switch, and sits back with his pipe and the new issue of *Outdoor Life*.

Forty minutes later, the rumble of the Tapemaster stops and Joe takes a look. One leg is finished. So he clamps on another piece of birch . . .

Sure it's a dream—in 1955. But the engineering basis for Joe's Tapemaster exists right now. Sitting up in the Servomechanisms Laboratory of the Massachusetts Institute of Technology in Cambridge, Mass., is a milling machine that will turn out any metal part at the command of a little roll of tape. Originally a standard, vertical 28″ Cincinnati Hydro-Tel, it now has hitched to it $50,000 worth of electronics.

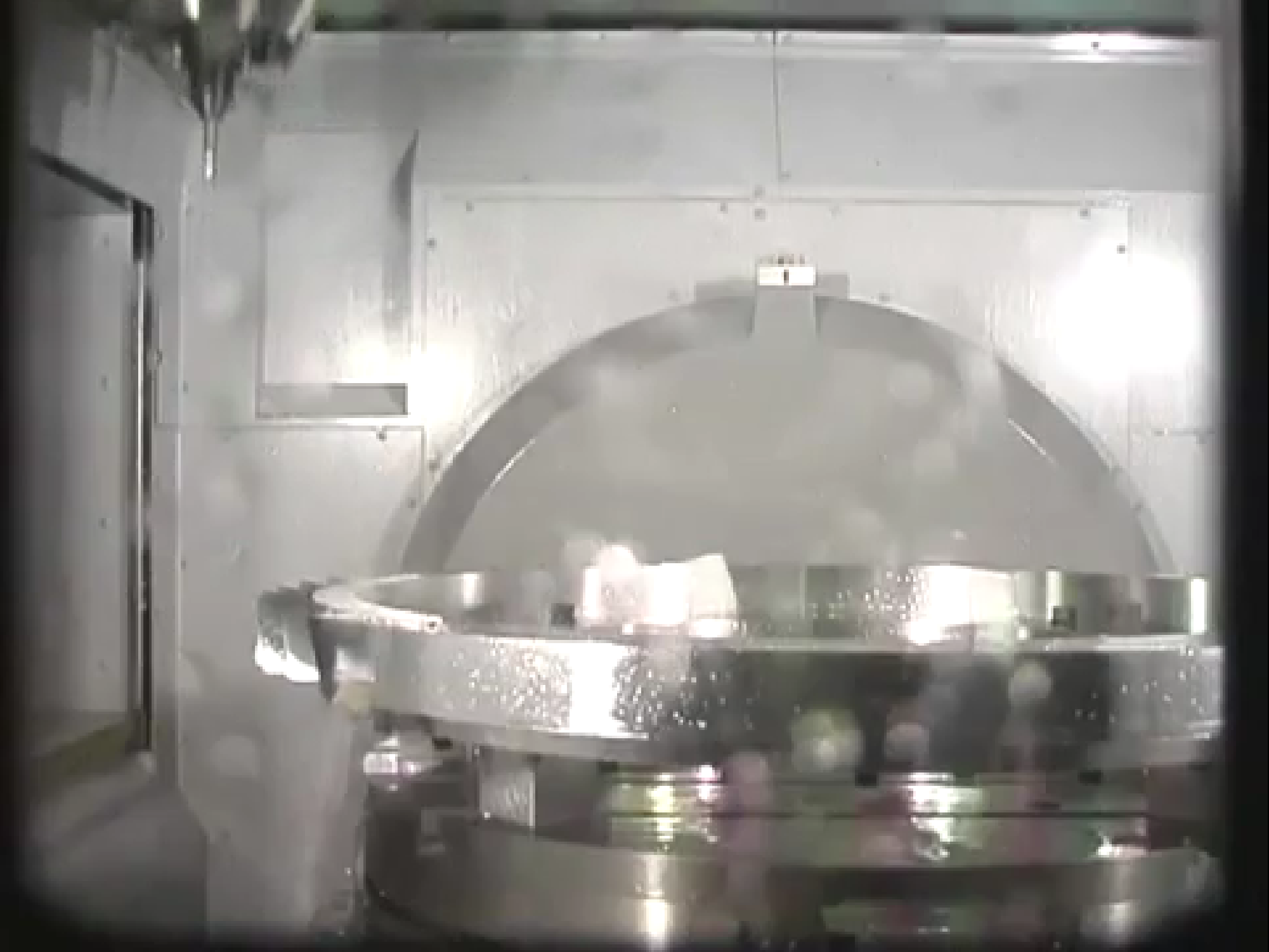
To conceive, design and build the MIT machine took some quarter-million



Too big yet for home shop, this MIT milling machine is run by computer-control at left.

Signals control three-dimensional movement of cutter head, time each cut.

Popular Science 1957

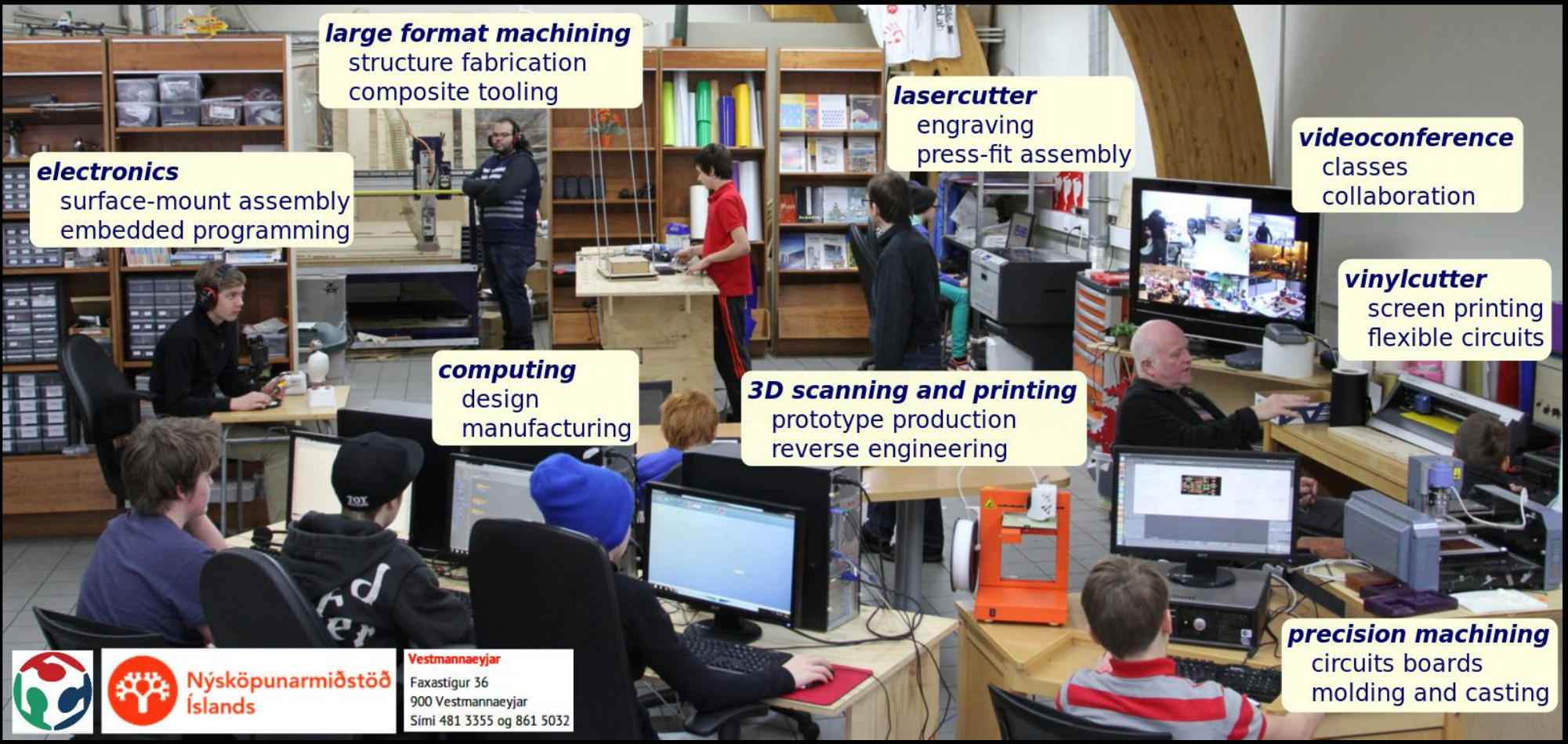


Same mill, different computer at NASA Ames 2014

You can personally use

digital fabrication tools

in a fab lab


large format machining
structure fabrication
composite tooling
lasercutter
engraving
press-fit assembly
videoconference
classes
collaboration
electronics
surface-mount assembly
embedded programming
vinylcutter
screen printing
flexible circuits
computing
design
manufacturing
3D scanning and printing
prototype production
reverse engineering
precision machining
circuits boards
molding and casting
Nýsköpunarmiðstöð Íslands
Vestmannaeyjar
Faxastígur 36
900 Vestmannaeyjar
Sími 481 3355 og 861 5032


Milling prosthetics, Jens Dyvik

Fabfi wireless mesh network, Jalalabad


Kayak, Sam Calisch

Территория фонда ИЗОЛЯЦИЯ остается захваченной.

IZOLYATSIA
PLATFORM FOR CULTURAL INITIATIVES

ru | ua | en

FOUNDATION
PROJECTS
AGENDA
NEWS
JOIN US
EDUCATIONAL PROGRAM
VISIT US
MEDIA
COLLECTION
BOOKSHOP

Previous projects
Current projects

Ukr
in I
TEN
MOVIES
CU
OF
Five Minutes To
Residency of Tulio Pinto
It's
Pul

IZOLYATSIA IN EXILE

People are even concerned:

Donetsk fablab occupied

Maybe 3d printers are political after all

On Monday morning 9th June 2014 the premises of the foundation were forcibly occupied by the DPR (Donetsk People's Republic), a terrorist organisation operating
ign authority within the city of Donetsk.

At around 09:00 hrs local time a group of armed separatists entered onto private property demanding the appropriation of the site and its buildings for the benefit of the DPR and its activities.

rented accommodation are

NEWS

24 june 2014
SOS IZOLYATSIA. Акция солидарности.
>>>

17 june 2014
Appeal to the President of Ukraine
>>>

12 june 2014
13 июня - пресс-конференция Фонда ИЗОЛЯЦИЯ
>>>

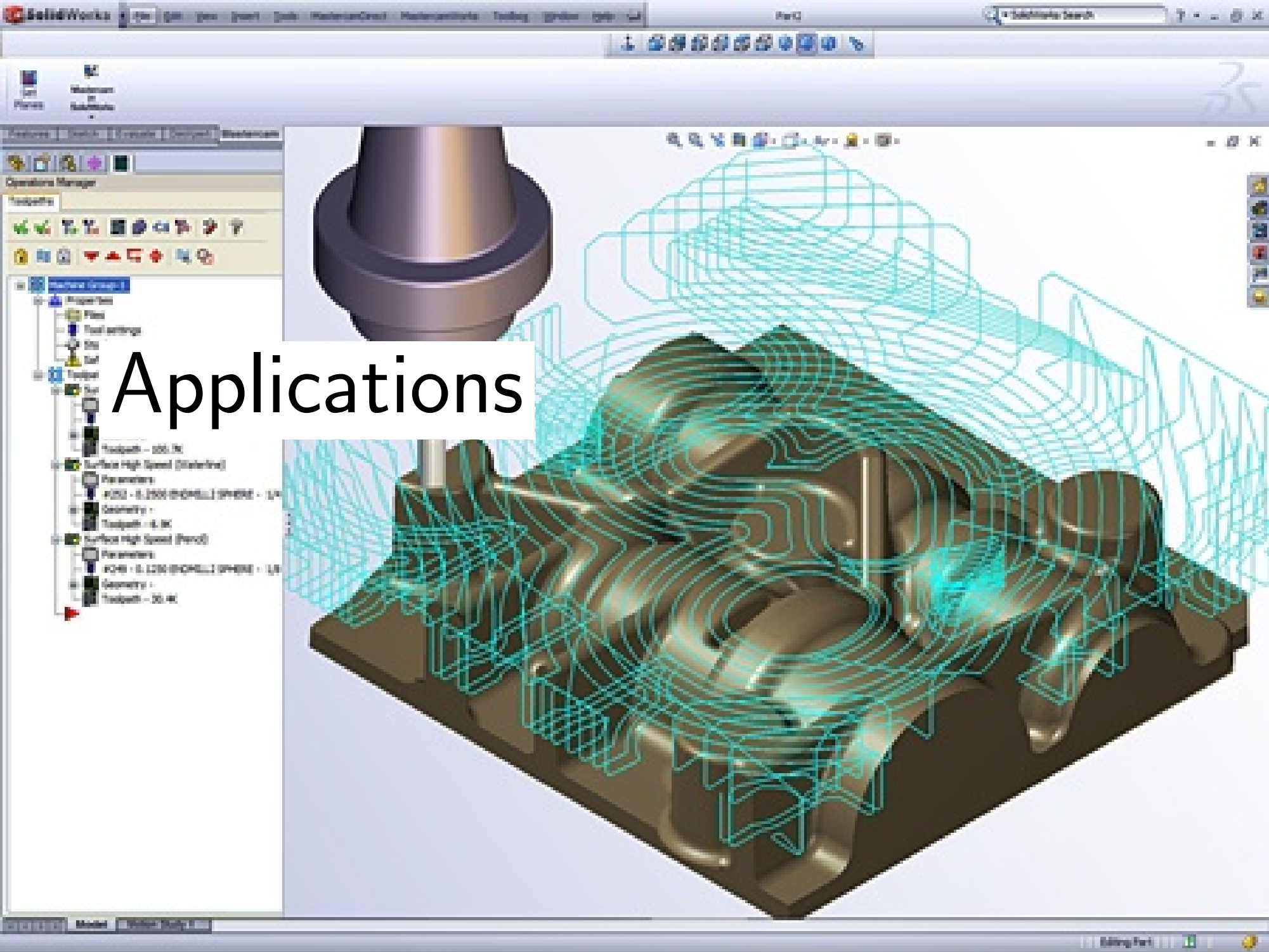
11 june 2014
An open letter to the "prime-minister" of the DPR
>>>

09 june 2014
IZOLYATSIA in exile
>>>

Open hours:
During events

But using them

still kind of sucks

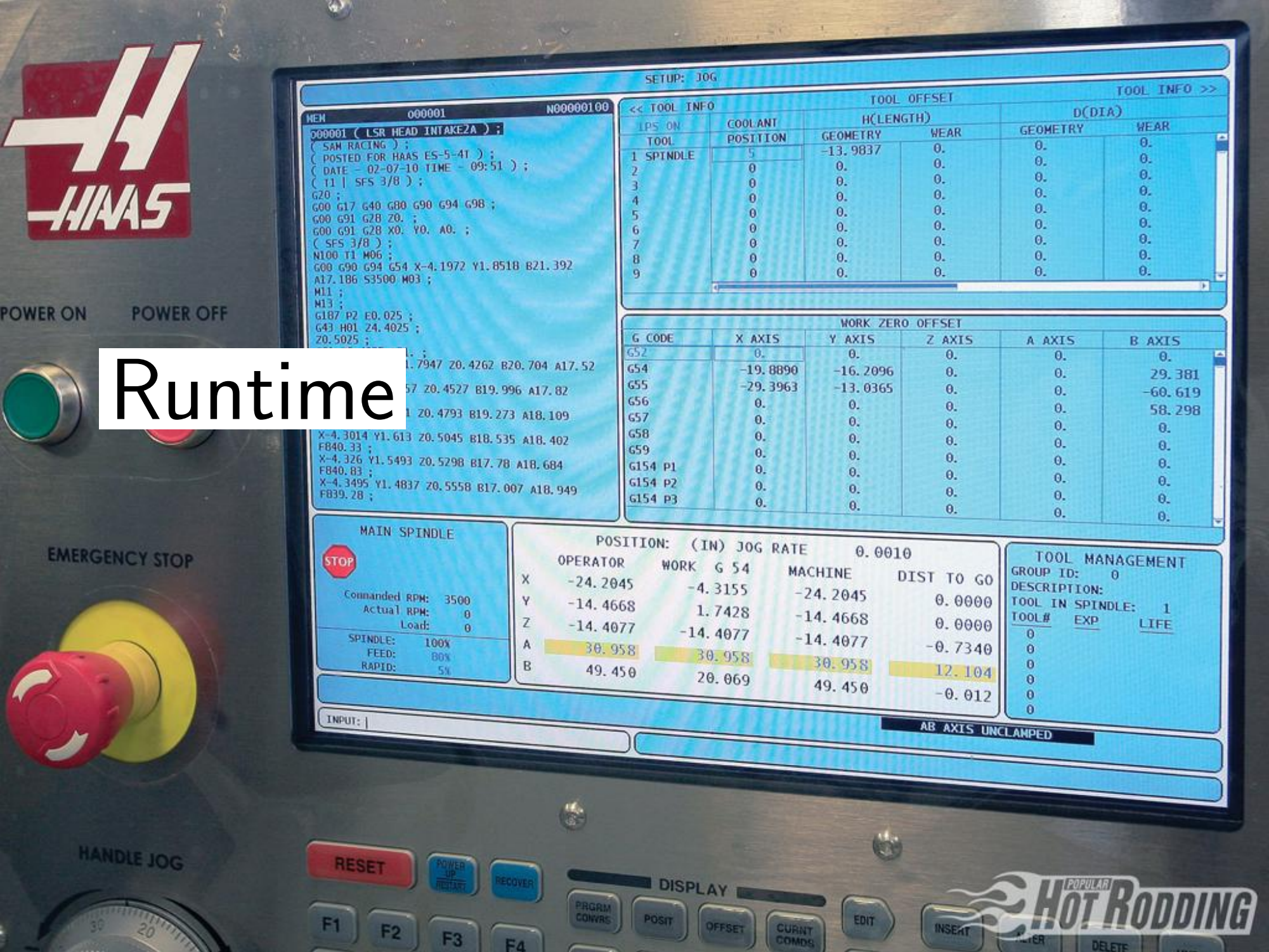

Applications

G-code	Functions
G0	Rapid positioning
G1	Linear interpolation
G2	Clockwise circular / helical interpolation
G3	Counterclockwise circular / helical interpolation
G4	Dwell
G10	Coordinate system origin setting
G12	Clockwise circular pocket
G13	Counterclockwise circular pocket
G15	Polar Coordinate moves in G0 and G1
G16	Cancel polar Coordinate moves in G0 and G1
G17	XY plane select
G18	XZ plane select
G19	YZ plane select
G20	
G21	
G28	161 to 5166)
G30	Return machine home (parameters 5181 to 5186)
G28.1	Reference axis
G31	Straight Probe
G40	Cancel cutter radius compensation
G41	Start cutter radius compensation left
G42	Start cutter radius compensation right
G43	Apply tool lenght offset (plus)
G49	Cancel tool lenght offset
G50	Reset all scale factors to 1.0
G51	Set axis data input scale factors

Controls

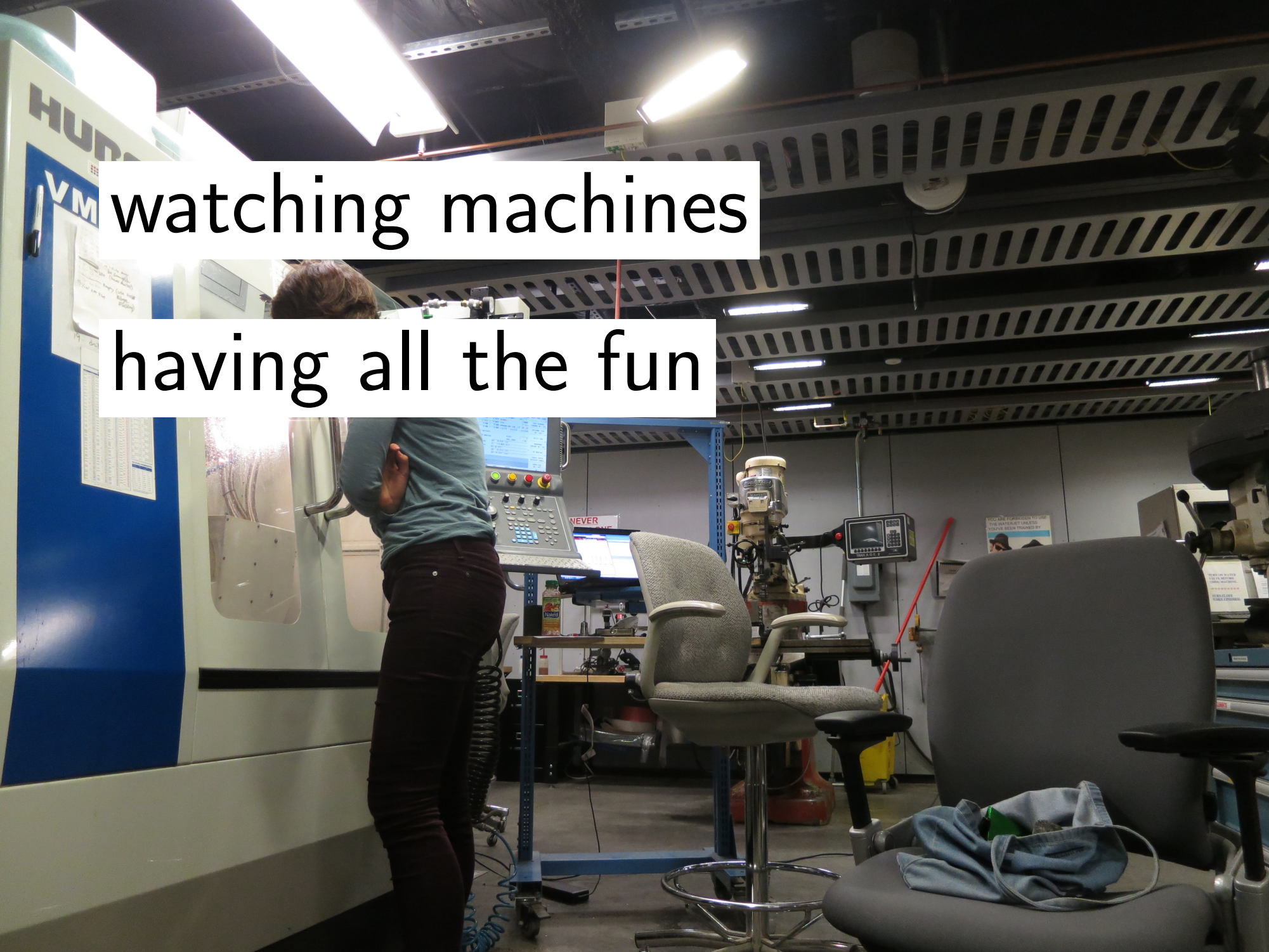
G-code	Functions
G53	Move in absolute machine coordinate system
G54 à G59	Use fixture offset 1 to 6, G59 to select a general fixture number
G61	Exact Stop mode
G64	Constant Velocity mode
G73	Canned cycle - drilling - fast pullback
G80	Cancel canned cycle mode
G81	Canned cycle - drilling
G82	Canned cycle - drilling with dwell
G83	Canned cycle - peck drilling
G84	Canned cycle - right hand rigid taping (not yet implemented)
G85	Canned cycle - boring, no dwell, feed out
G86	Canned cycle - boring, spindle stop, rapid out
G87	Canned cycle - back boring (not yet implemented)
G88	Canned cycle - boring, spindle stop, manual out
G89	Canned cycle - boring, dwell, feed out
G90	Absolute distance mode
G91	Incremental distance mode
G92	Offset coordinates and set parameters
G92.1	Reset G92 offset and parameter
G92.2	Reset G92 offset but leave parameters untouched
G92.3	Recall G92 from parameters
G93	Inverse time feed mode
G94	Feed per minute mode
G95	Feed per revolution mode
G98	Initial level return after canned cycles
G99	R-point level return after canned cycles


Interfaces



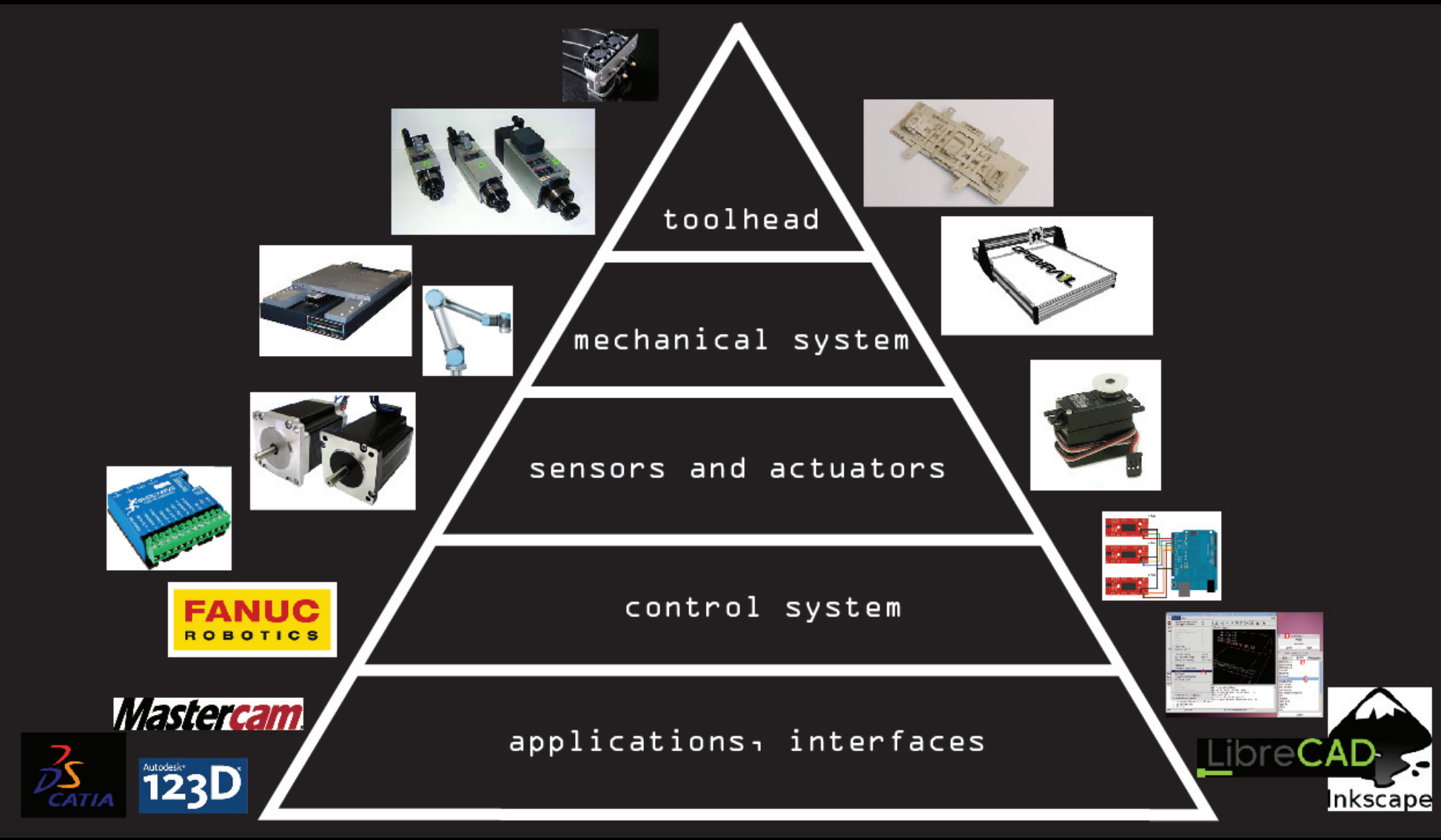
Runtime


Toolhead


watching machines
having all the fun

What really are

these machines?


toolhead
mechanical system
sensors and actuators
control system
applications, interfaces
FANUC
ROBOTICS
Mastercam
CATIA
Autodesk
123D
LibreCAD
Inkscape

Even if they are incrementally

improving, digital fabrication

machines are still

not very accessible

Finicky, bad interfaces

Limited applications

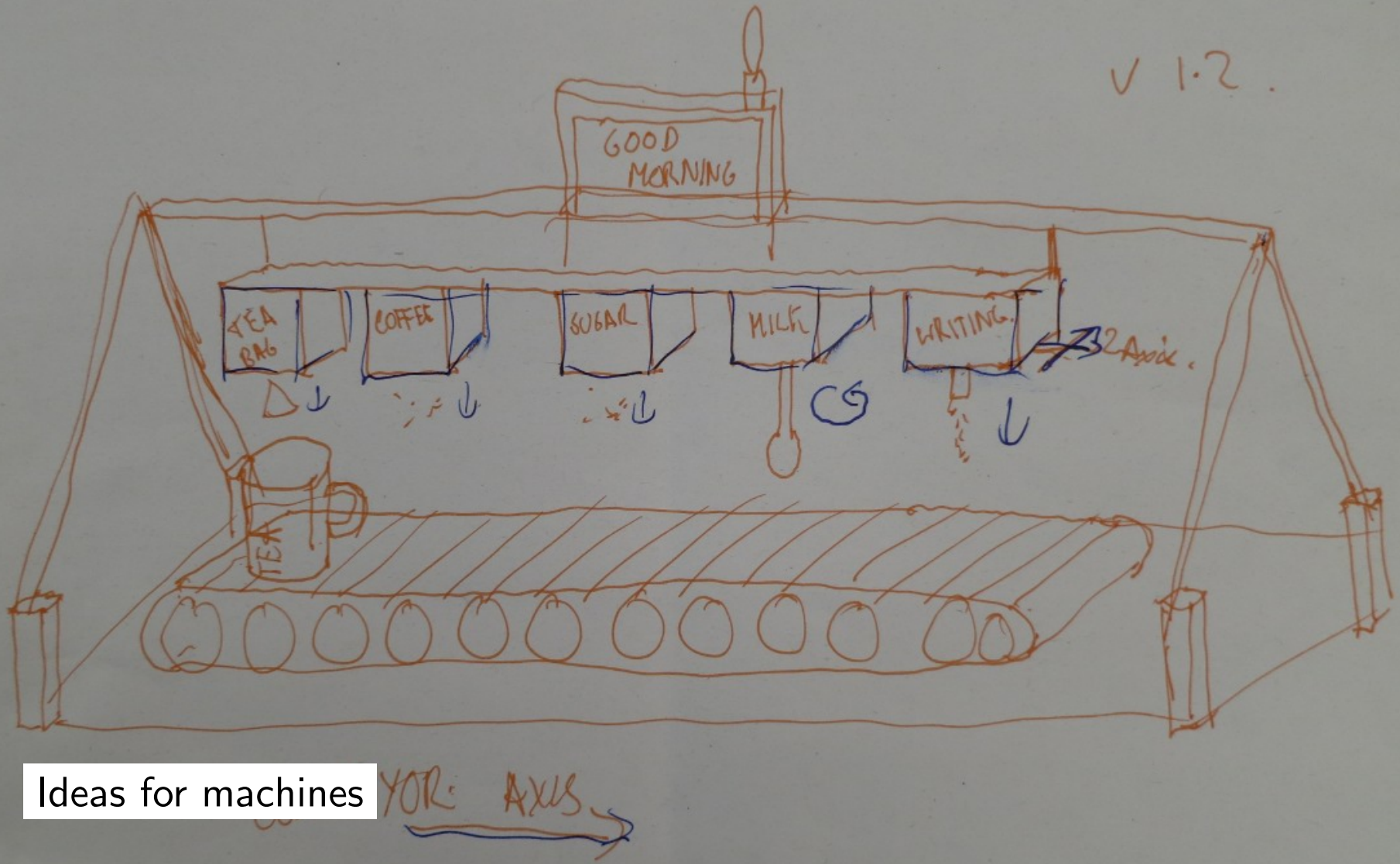
Expensive

Controlled by a couple of corps

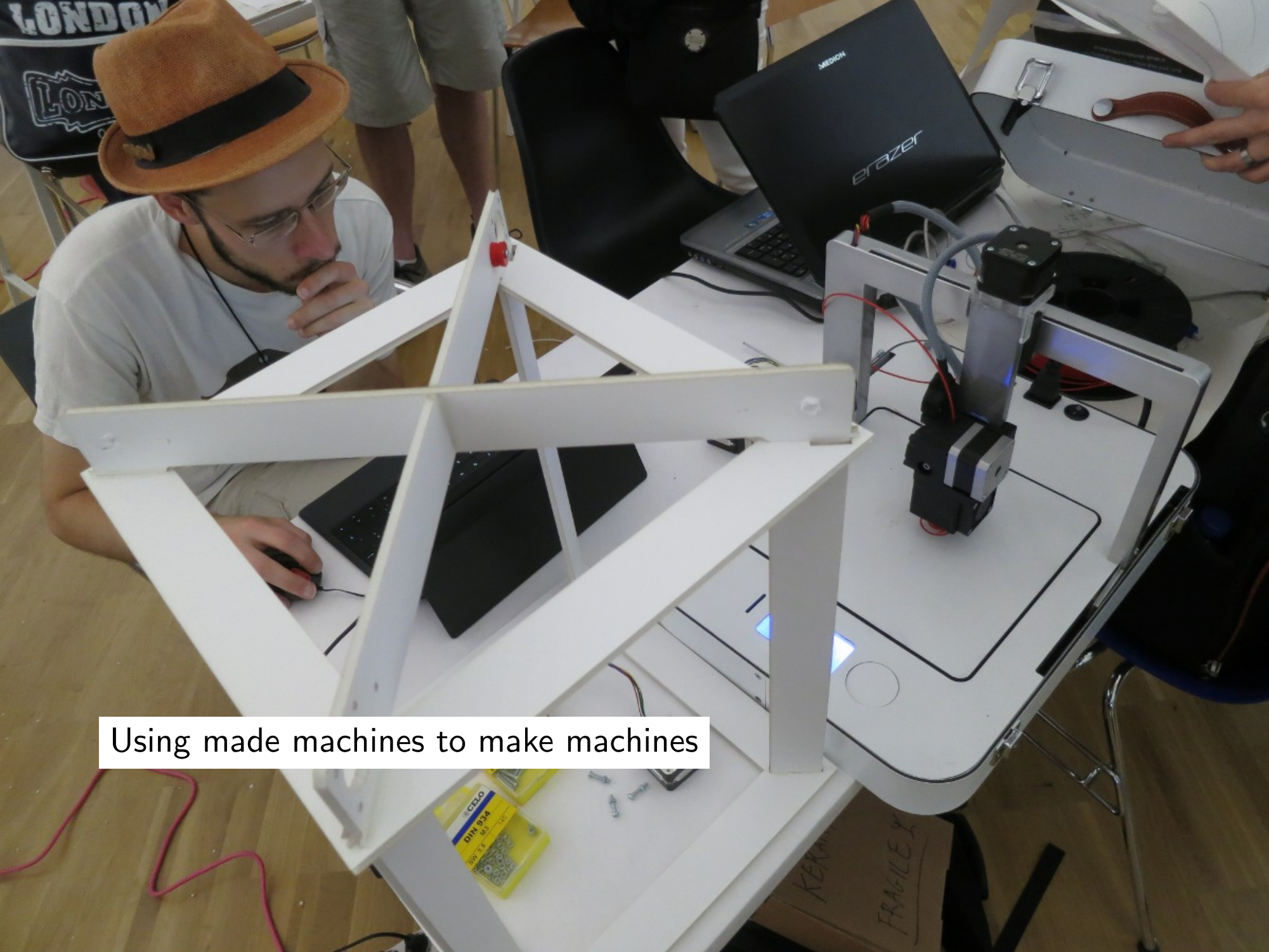
Can we just

build them ourselves?

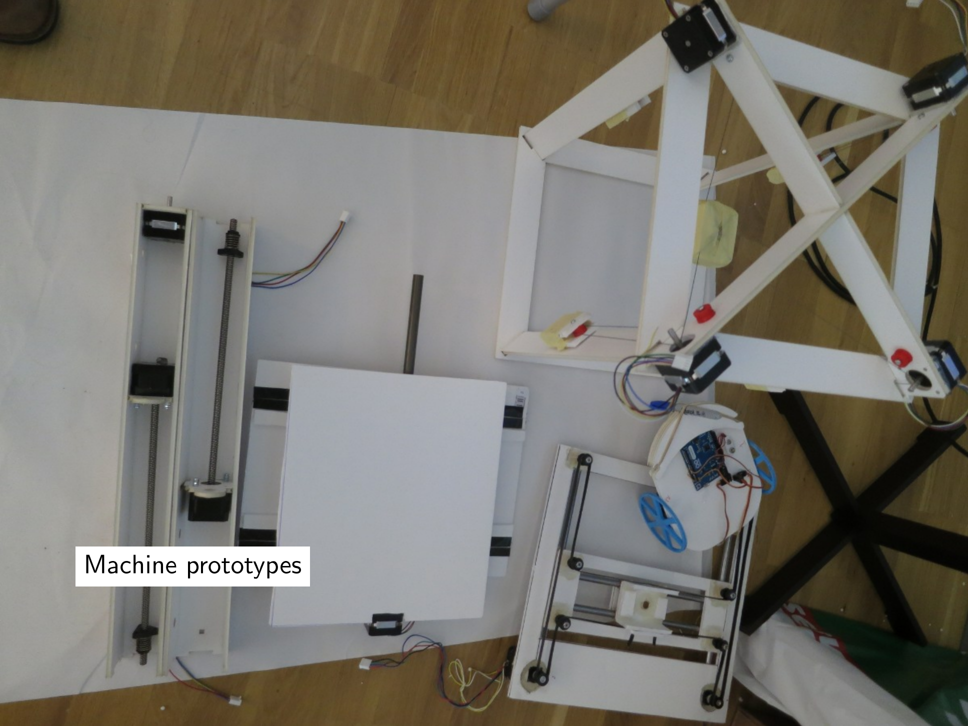
Teaching machine design and building



Ideas for machines



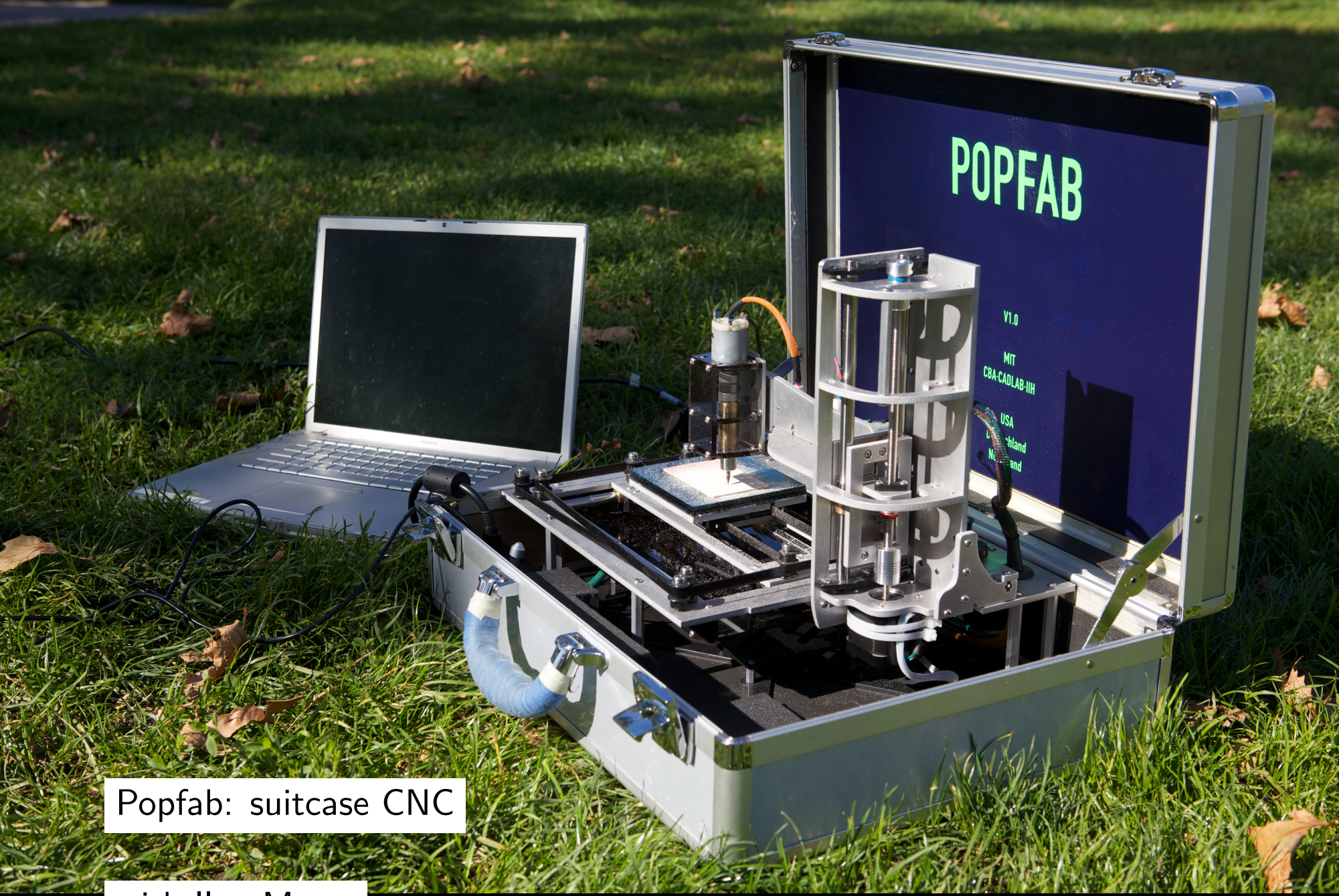
Using made machines to make machines


Machine prototypes

Machine testing

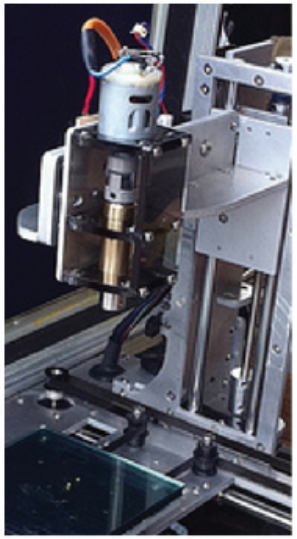
Start building your own

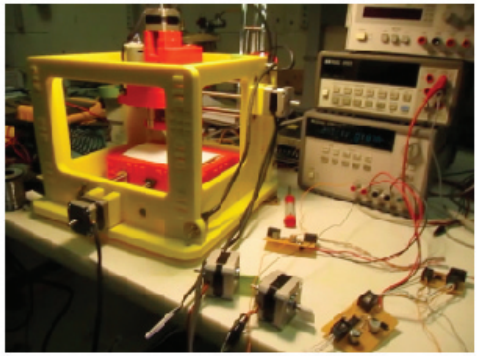
machine solutions

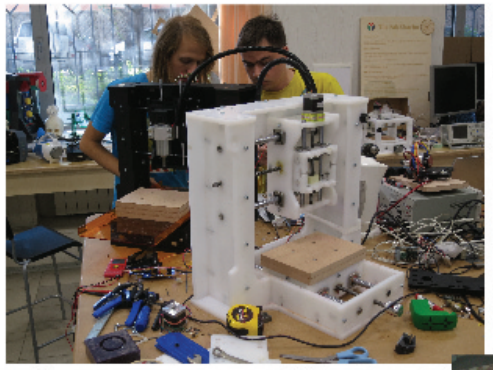


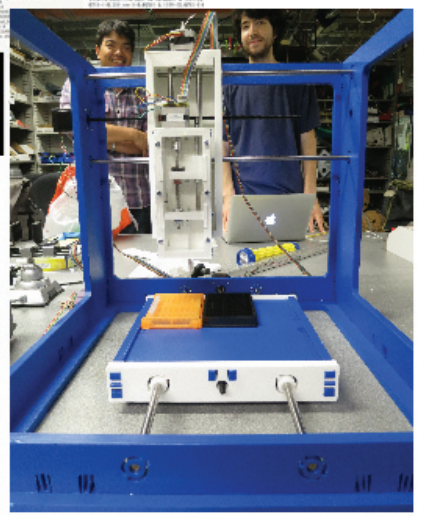
Popfab: suitcase CNC

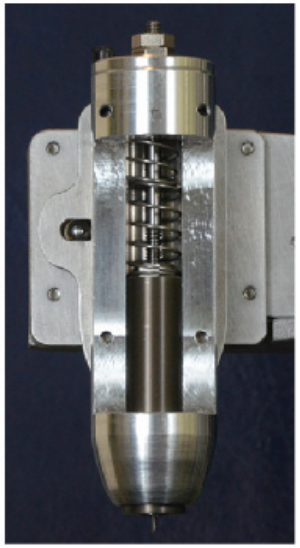
with Ilan Moyer

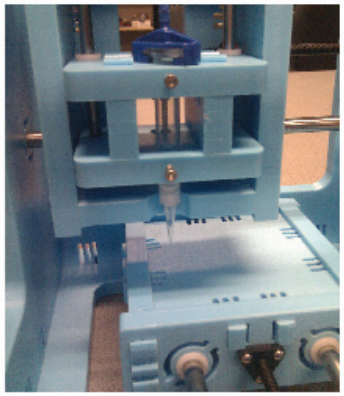


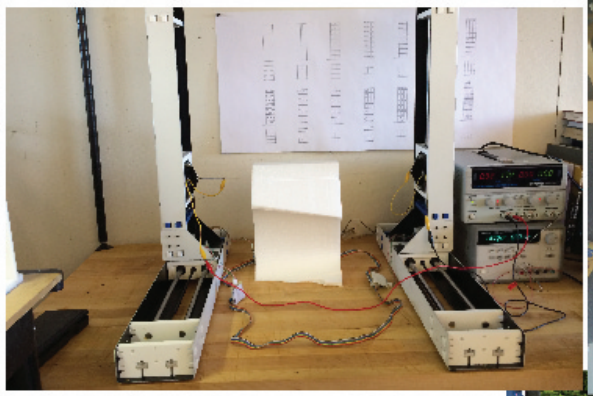


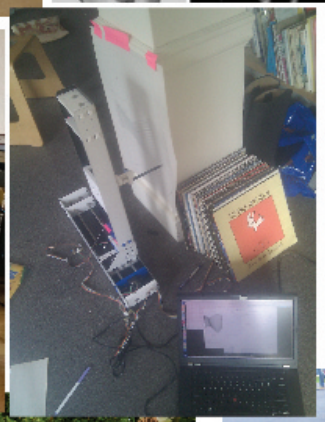


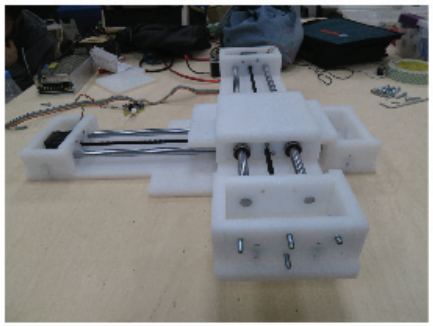


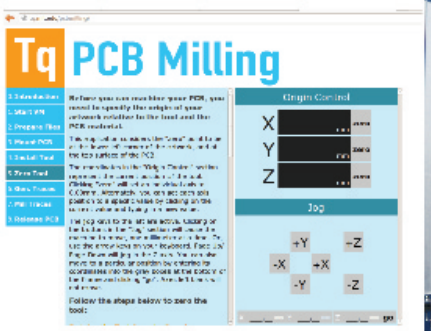


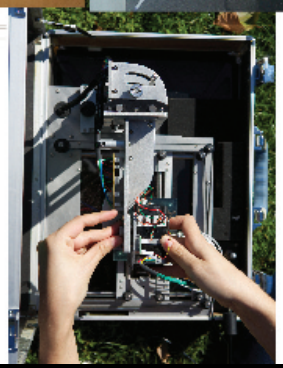


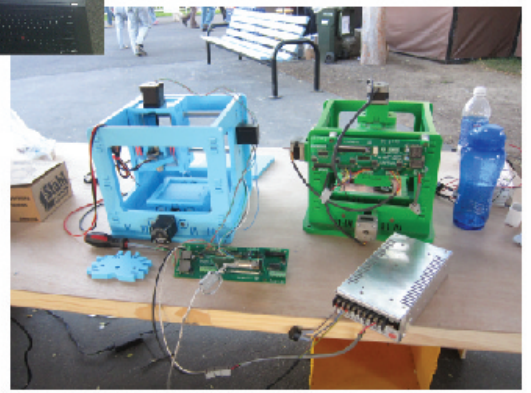


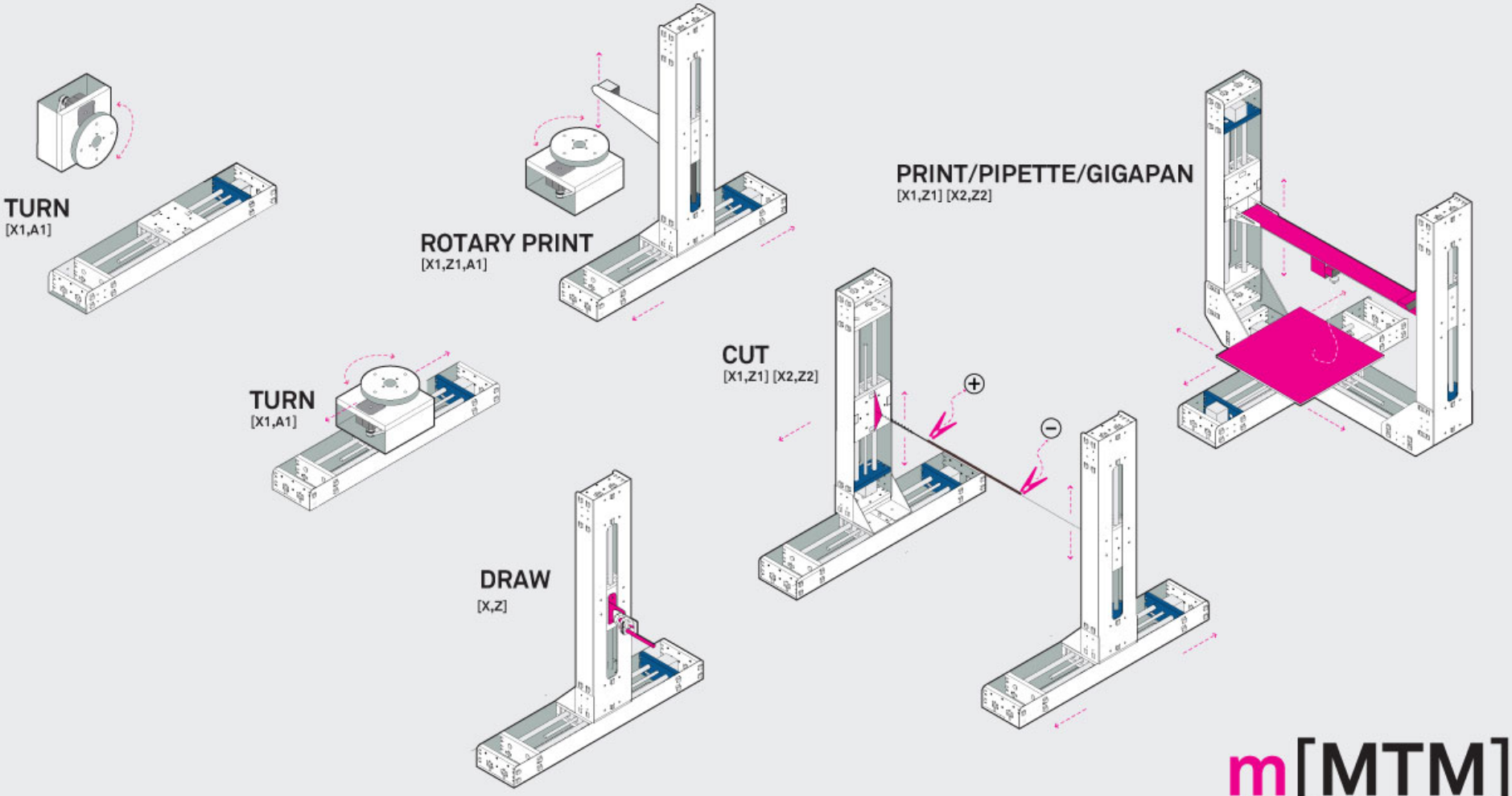





Tq PCB Milling
Origin Control
X
Y
Z
Jog
+Y
-Z
-X
+X
-Y
-Z

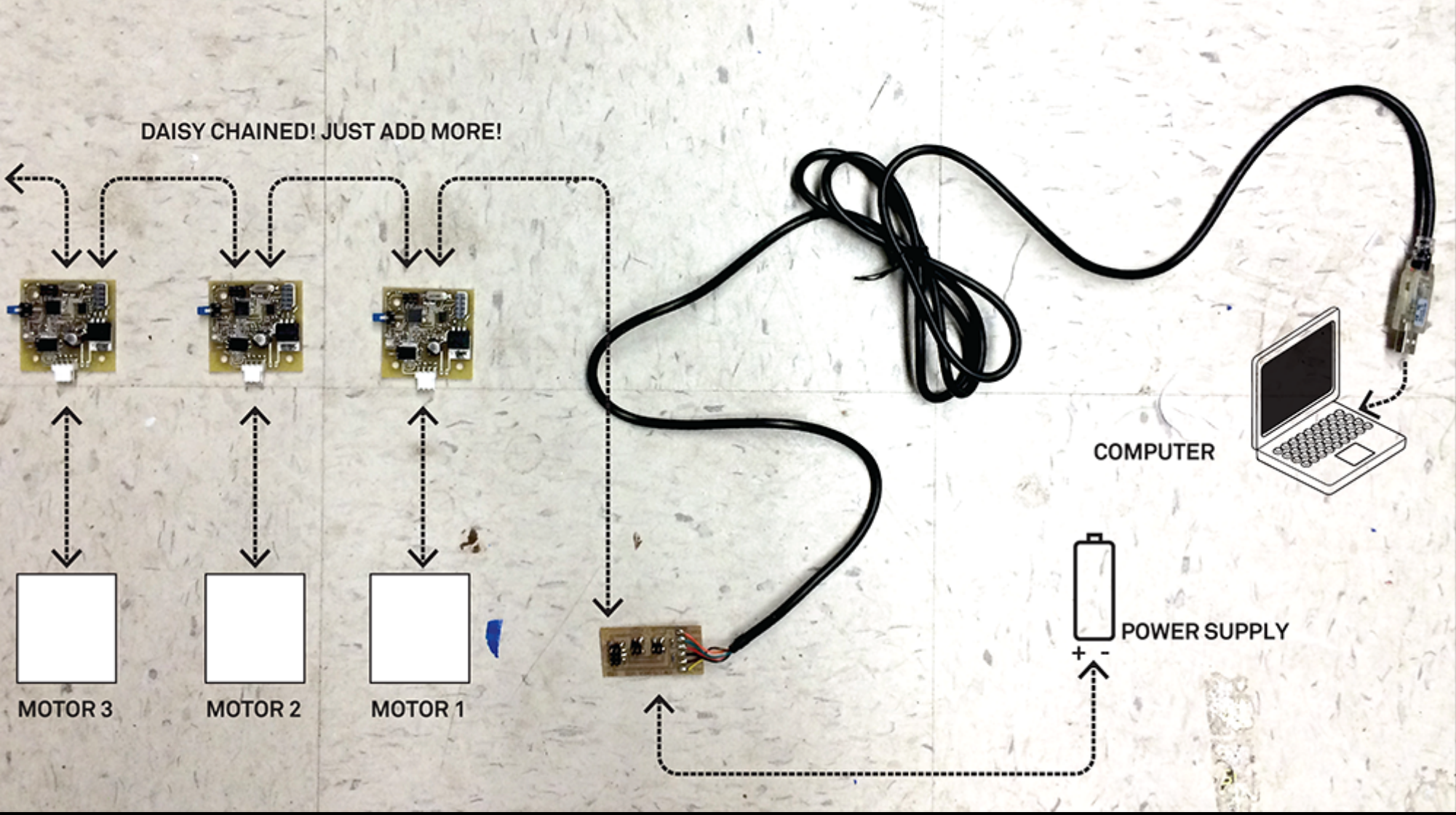




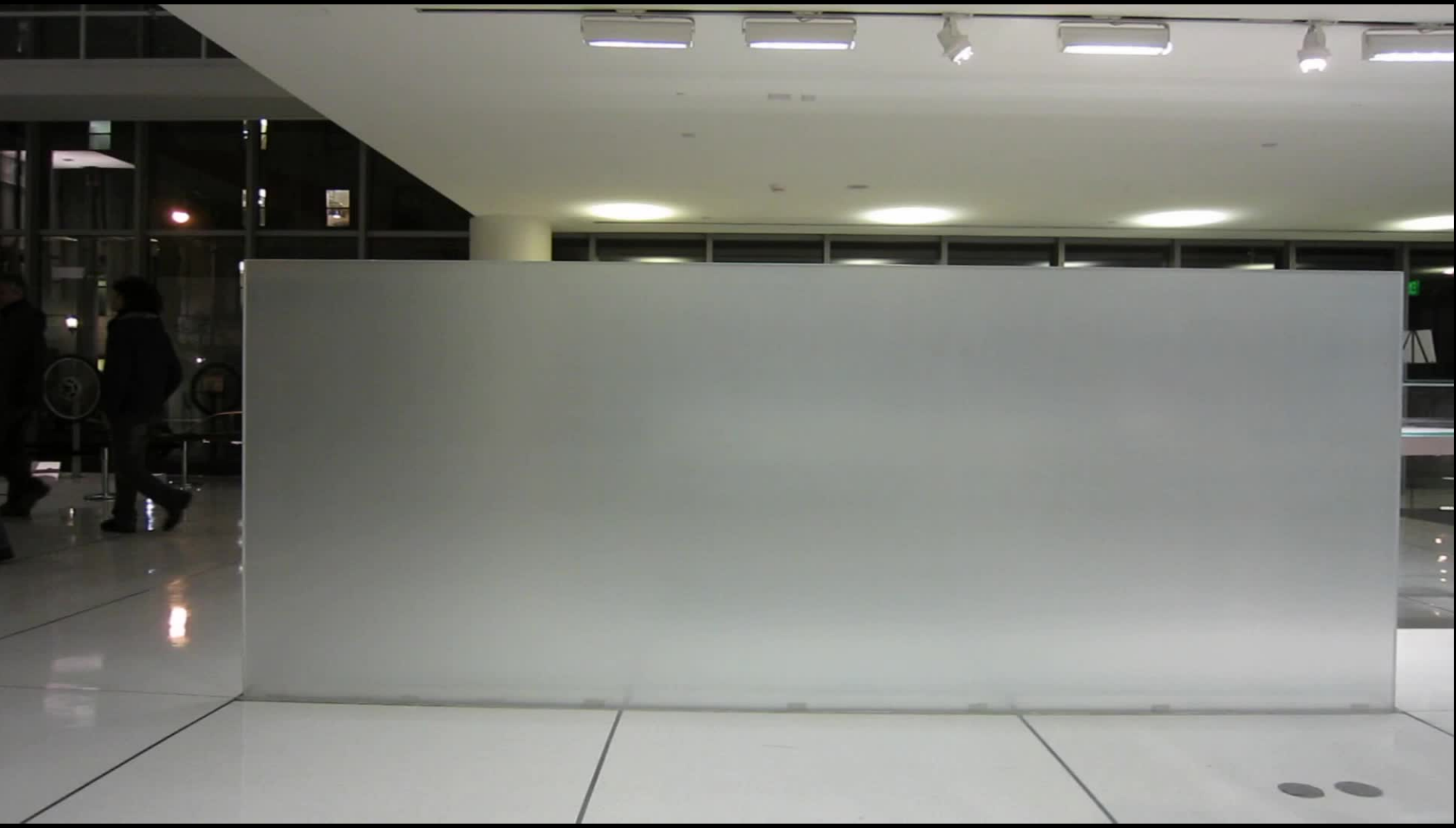


Modular Machines that Make

with James Coleman



Gestalt virtual machine network



Personal fabrication tools


Taktia: handheld digital fabrication tools


5-axis shopbot handibot
handibot
ShopBot
handi
bot

Without the capability to

make tools, the ecosystem

cannot grow

How else can we build?

What about other forms of access to precision manufacturing?


Shenzhen
强电子世界
新年换新机
电信版iPhone4s
天翼好网络
华强电子世界
租880元
小型办公室
租880元
18126273366
此三面翻广告位招租：13
广讯通信市场

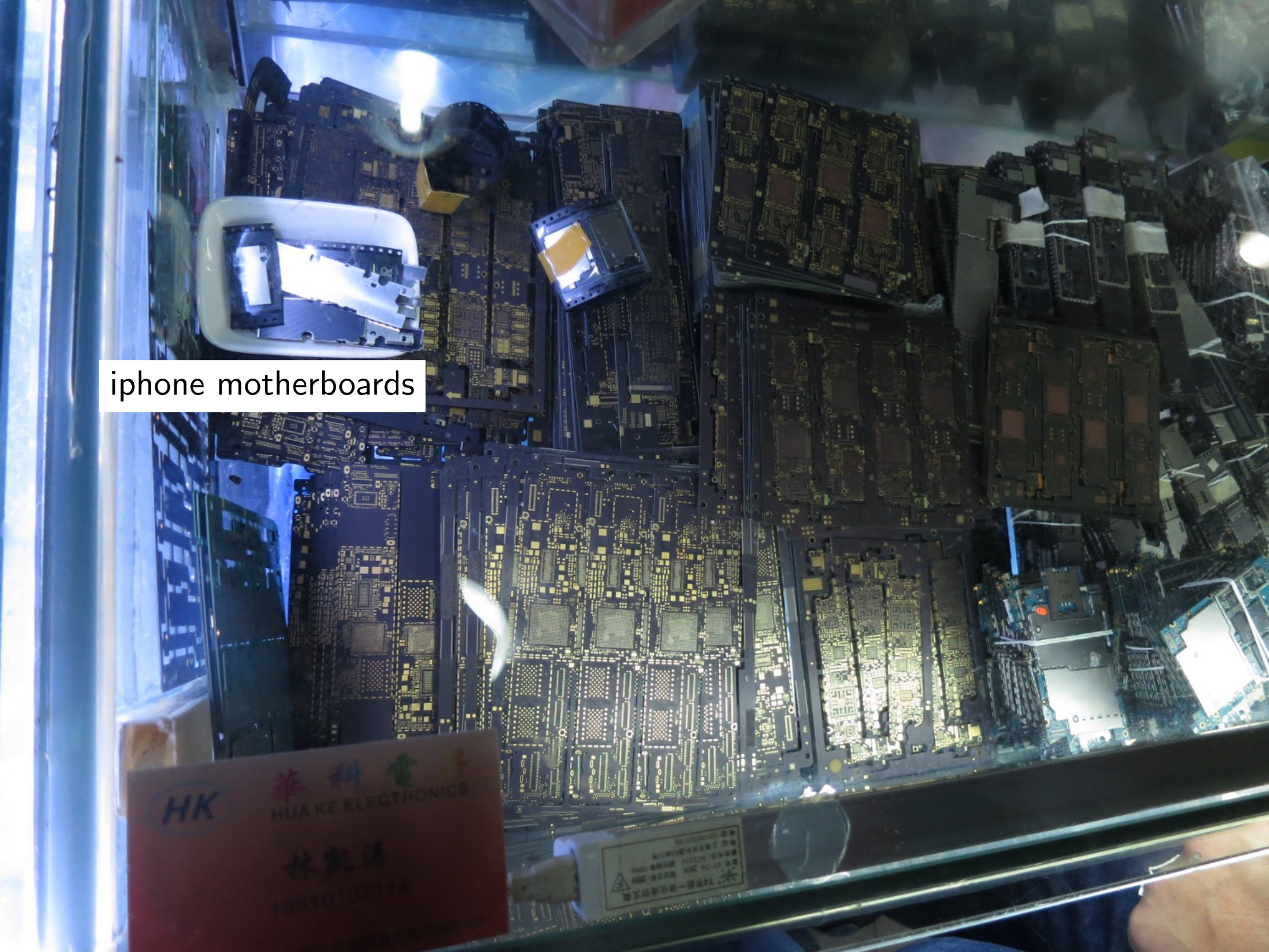
Strange liminal electronics

tool and die shops

and grey markets

Huaqiangbei cell phone market


iphone ICs


iphone motherboards
HK
華科電子
HUA KE ELECTRONICS

Access to precision tools

and the capability to use them

Milling school at Shenzhen U


Milling school at Shenzhen U

And odd remixing of mass

manufacture and desirements

Shanzhai phone


Shanzhai phone with Will's phone
-112 AT&T
4:04 PM
84%
Safari
Tuesday
15
Calendar
Photos
Camera
Notes
Maps
App Store
Hype Machine
WhatsApp
Phone
Messages
Sparrow
Music
Torch
Ebook...
Video ...
Video ...
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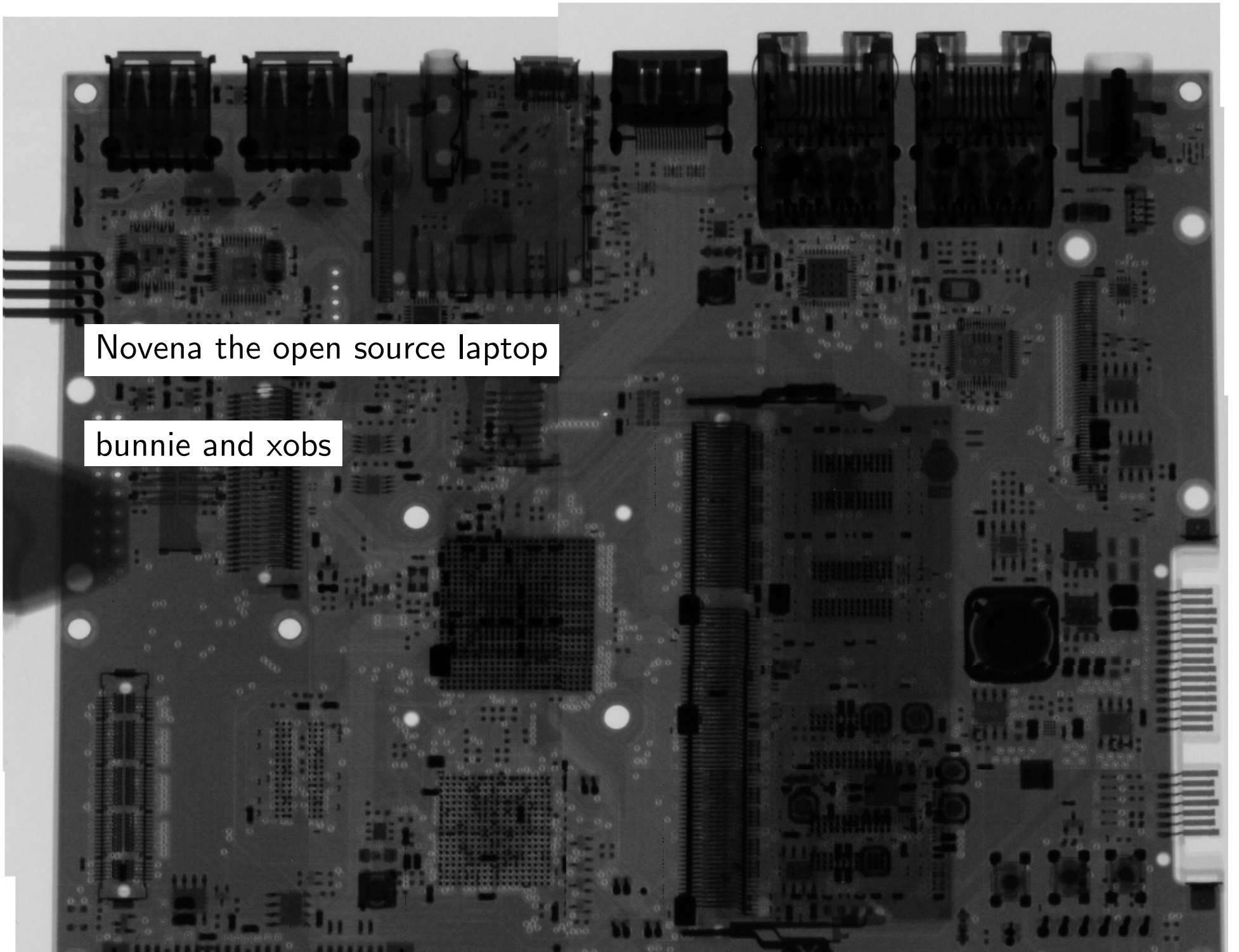
Mess...
Phone...
Call logs

Inside Shanzhai


More Shanzhai
PROSHCE
TSOTTAGRL

Factories are changing

Personal fabrication is growing


Novena the open source laptop
bunnie and xobs

Novena

Singapore
Hackable
Technology

02:24

A new open-hardware computing platform, flexible and powerful, designed for use as a desktop, laptop, or standalone board.

Novena is a 1.2GHz, Freescale quad-core ARM architecture computer closely coupled with a Xilinx FPGA. It's designed for users who care about Free Software and open source, and/or want to modify and extend their hardware: all the documentation for the PCBs is open and free to download, the entire OS is buildable from source, and it comes with a variety of features that facilitate rapid prototyping.

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of $250,000 goal

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Funded on	funded	pledges

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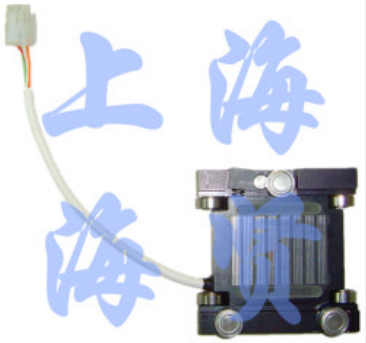

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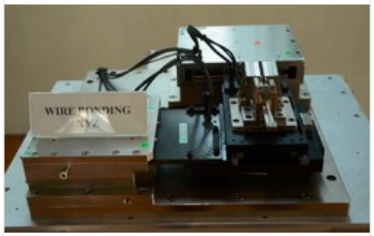

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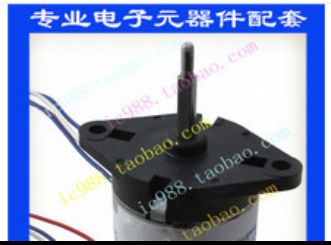
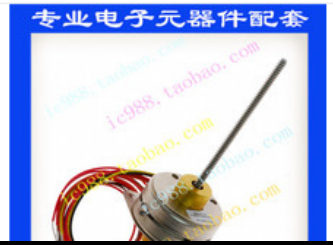
XY table,linear table,linear motor,xy工作台，XY平台

polyspline 广东 东莞





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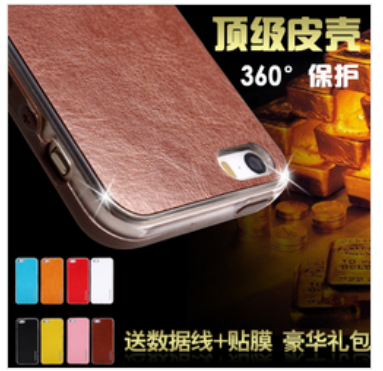

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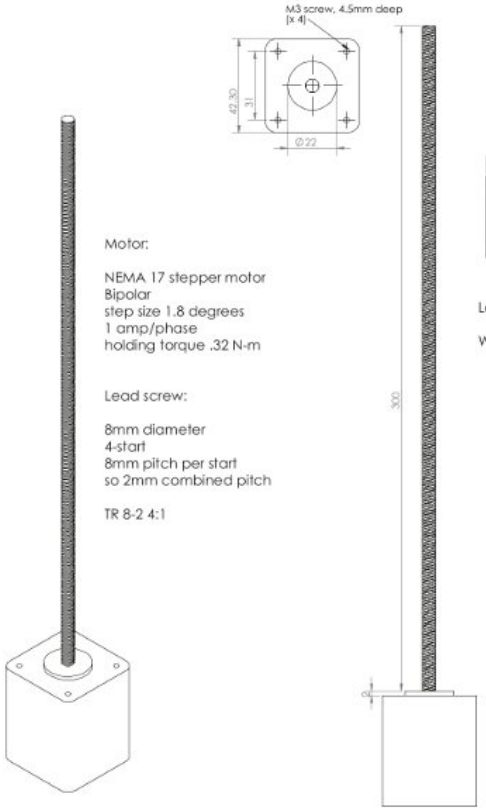


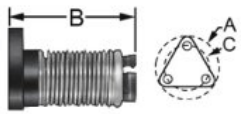
Motor:

NEMA 17 stepper motor
Bipolar
step size 1.8 degrees
1 amp/phase
holding torque .32 N-m

Lead screw:

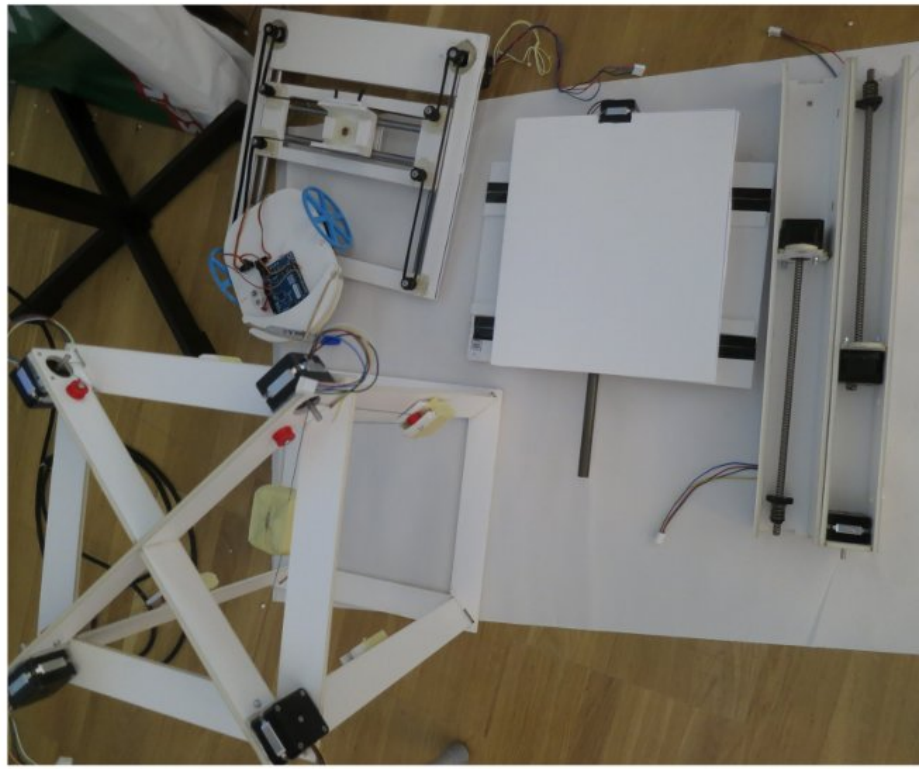
8mm diameter
4-start
8mm pitch per start
so 2mm combined pitch

TR 8-2 4:1



Lead screw nut:

Wear-compensating (with spring)



I made my machine,
it is just right for me


thank you
HOPE X
James Coleman
Ilan Moyer
Jonathan Ward
David Mellis
Jie Qi
Nadya Peek: peek@mit.edu