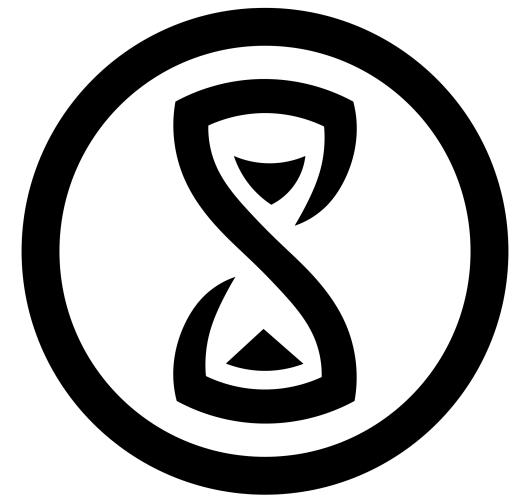




Selbst 3D drucken

rohieb @daniel_bohrer
neo @Karbrueggen
larsan @larsan

BarCamp Braunschweig
24. November 2011



Stratum 0

...selbst 3D drucken.



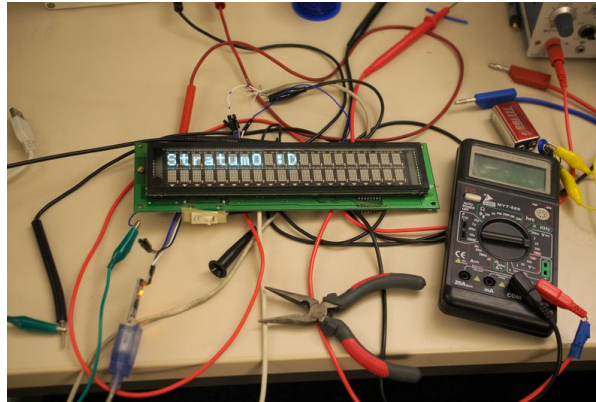
Quelle: <http://www.3ders.org/articles/20111127-reprap-build-party-in-cologne-germany-in-december.html>

stratum0.org



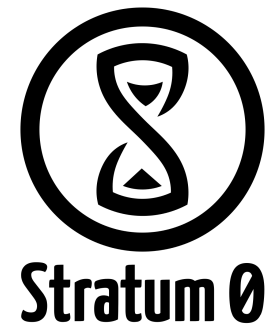
Quelle: <https://stratum0.org/wiki/Datei:MV-2012-01-08.jpg>, CC-BY-SA jh

stratum0.org



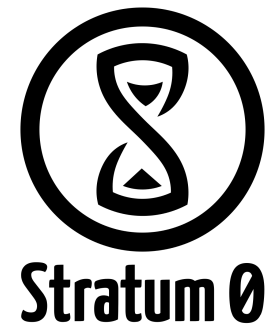
Quelle: <https://stratum0.org>, verschiedene CC Lizenzen.

Über was reden wir eigentlich?!



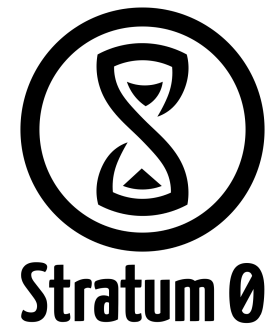
- Was kann gedruckt werden?

Über was reden wir eigentlich?!



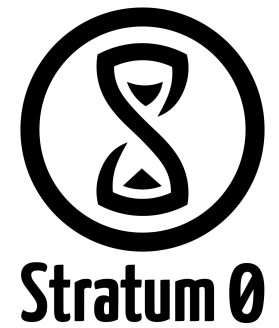
- Was kann gedruckt werden?
- Workflow

Über was reden wir eigentlich?!



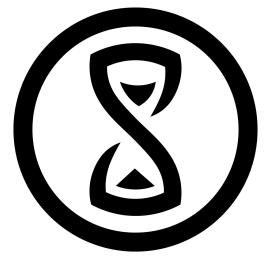
- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck

Über was reden wir eigentlich?!



- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck
- Was für Materialien gibt es zum Drucken?

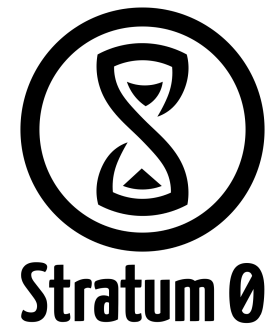
Über was reden wir eigentlich?!



Stratum 0

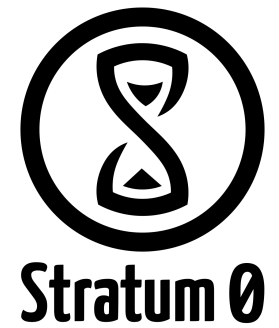
- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck
- Was für Materialien gibt es zum Drucken?
- Was für Drucktechniken gibt es?

Über was reden wir eigentlich?!



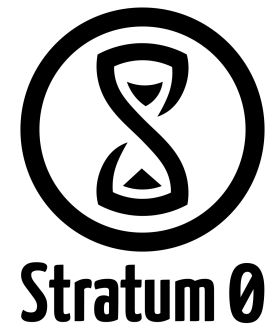
- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck
- Was für Materialien gibt es zum Drucken?
- Was für Drucktechniken gibt es?
- Community

Über was reden wir eigentlich?!



- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck
- Was für Materialien gibt es zum Drucken?
- Was für Drucktechniken gibt es?
- Community
- Anlaufstellen im Netz

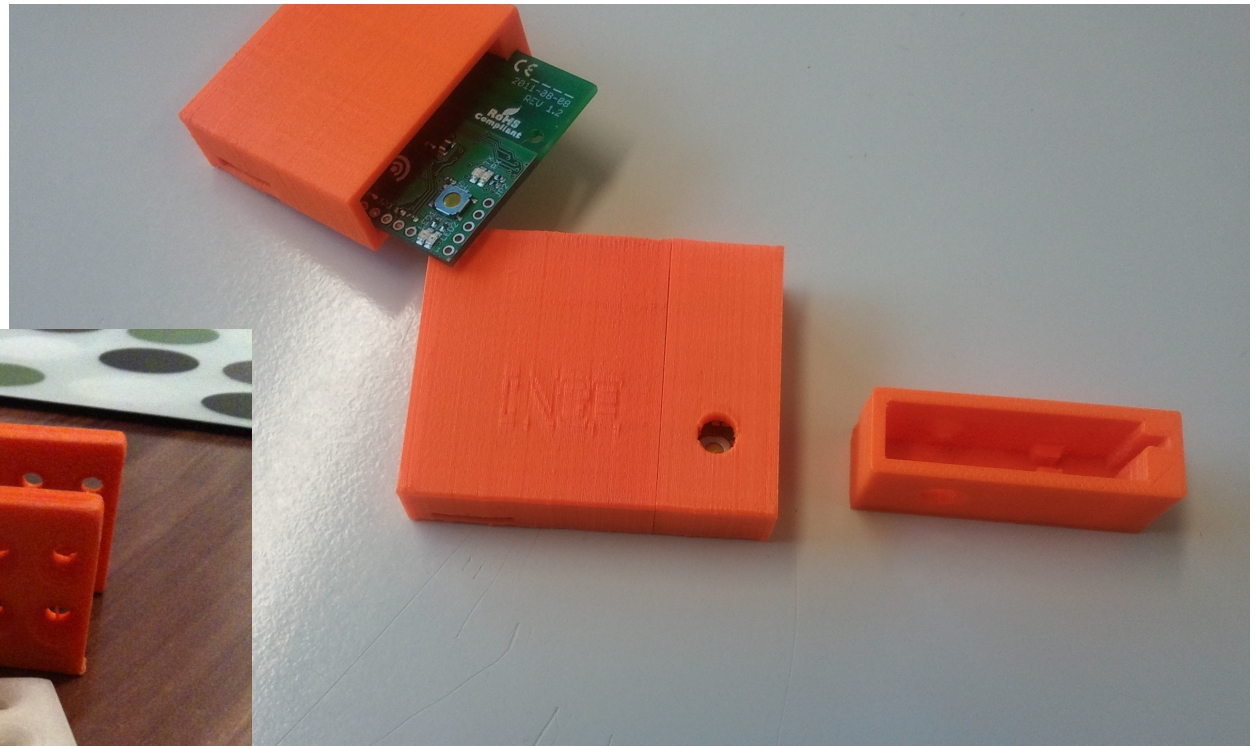
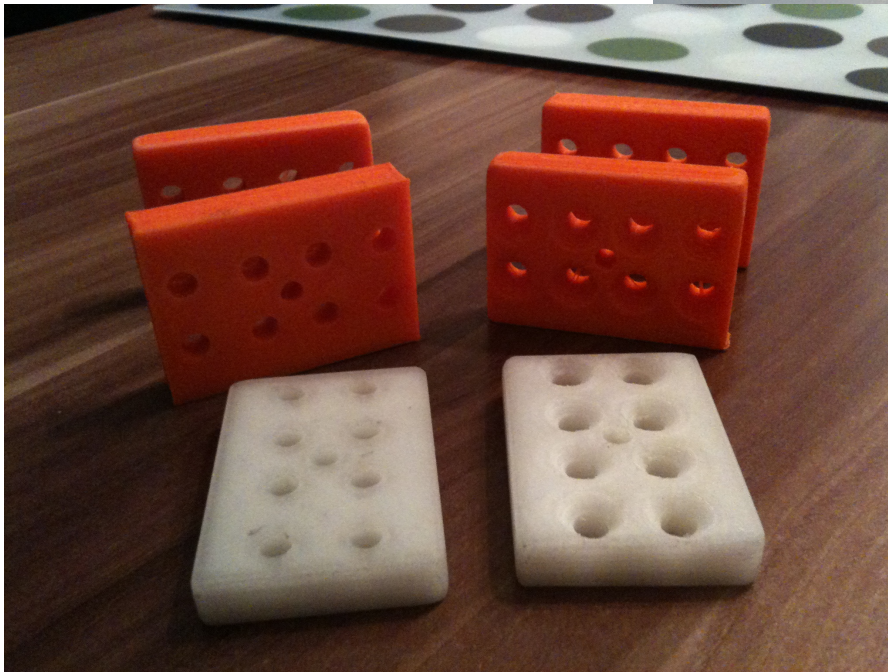
Über was reden wir eigentlich?!



- Was kann gedruckt werden?
- Workflow
- Vom Design zum Druck
- Was für Materialien gibt es zum Drucken?
- Was für Drucktechniken gibt es?
- Community
- Anlaufstellen im Netz
- Fragen?

Was kann gedruckt werden?

- Gehäuse
- Bauteile
- Ersatzteile



CC-BY-SA Daniel Willmann, Source: <http://www.thingiverse.com/image:132242>

Wolf-Bastian Poettner, Source: <http://yfrog.com/nxtn7cmj>

Was kann gedruckt werden?

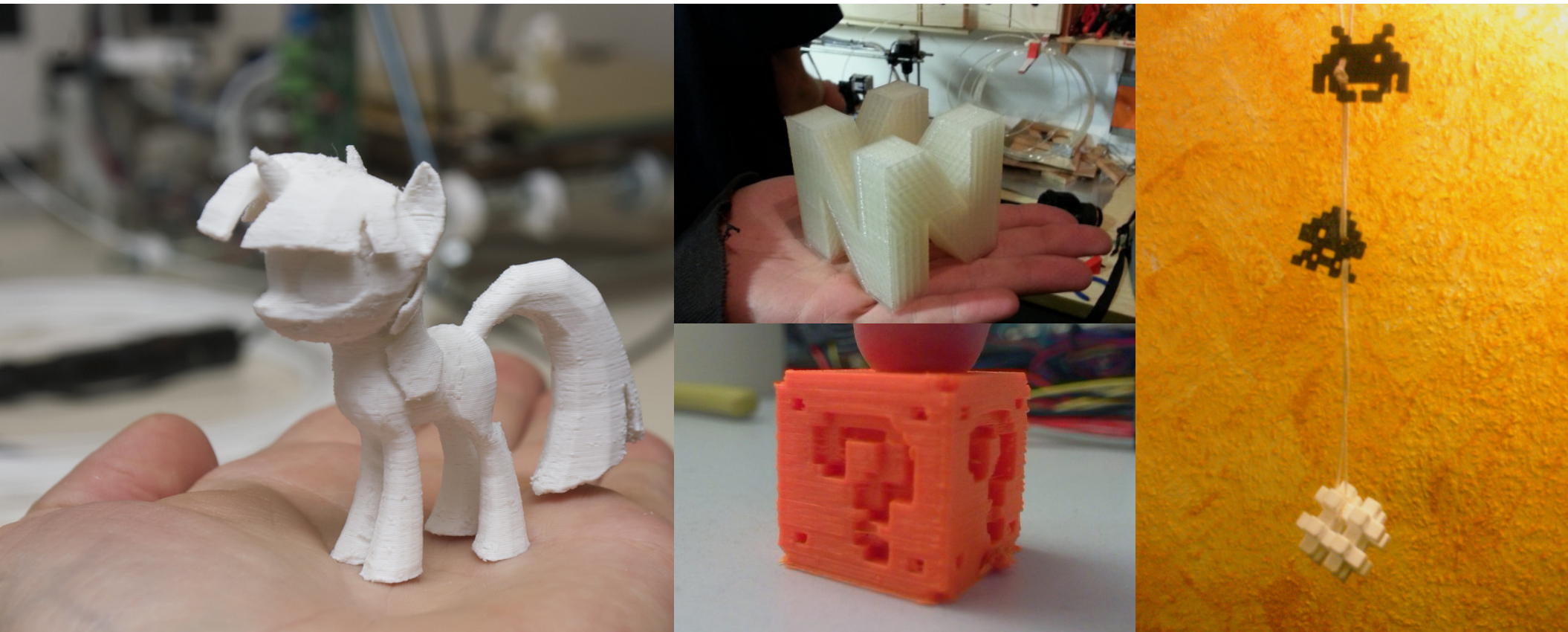
- Mate-Tags



CC-BY-SA Daniel Willmann, Source: <http://www.thingiverse.com/image:139061>, <http://www.thingiverse.com/image:117110>

Was kann gedruckt werden?

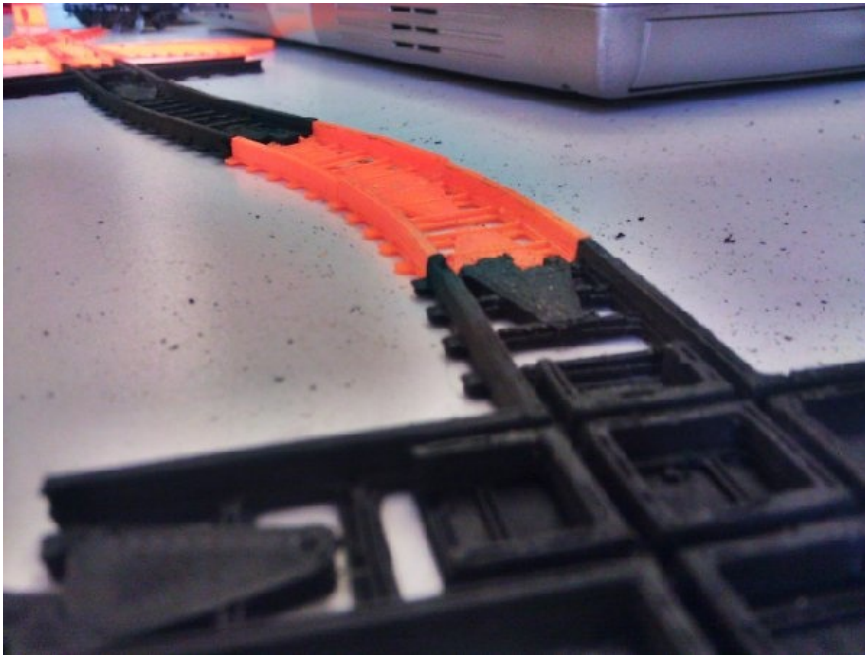
- (Spiel-)Figuren und anderer Nonsens



CC-BY-SA DooMMasterR: <https://secure.flickr.com/photos/doommeer/8143557116/>, CC-BY rohieB: <https://yfrog.com/kj1vgmgwj>, <http://www.thingiverse.com/image:144329>, unknown: <http://twitpic.com/b7nat1>

Was kann gedruckt werden?

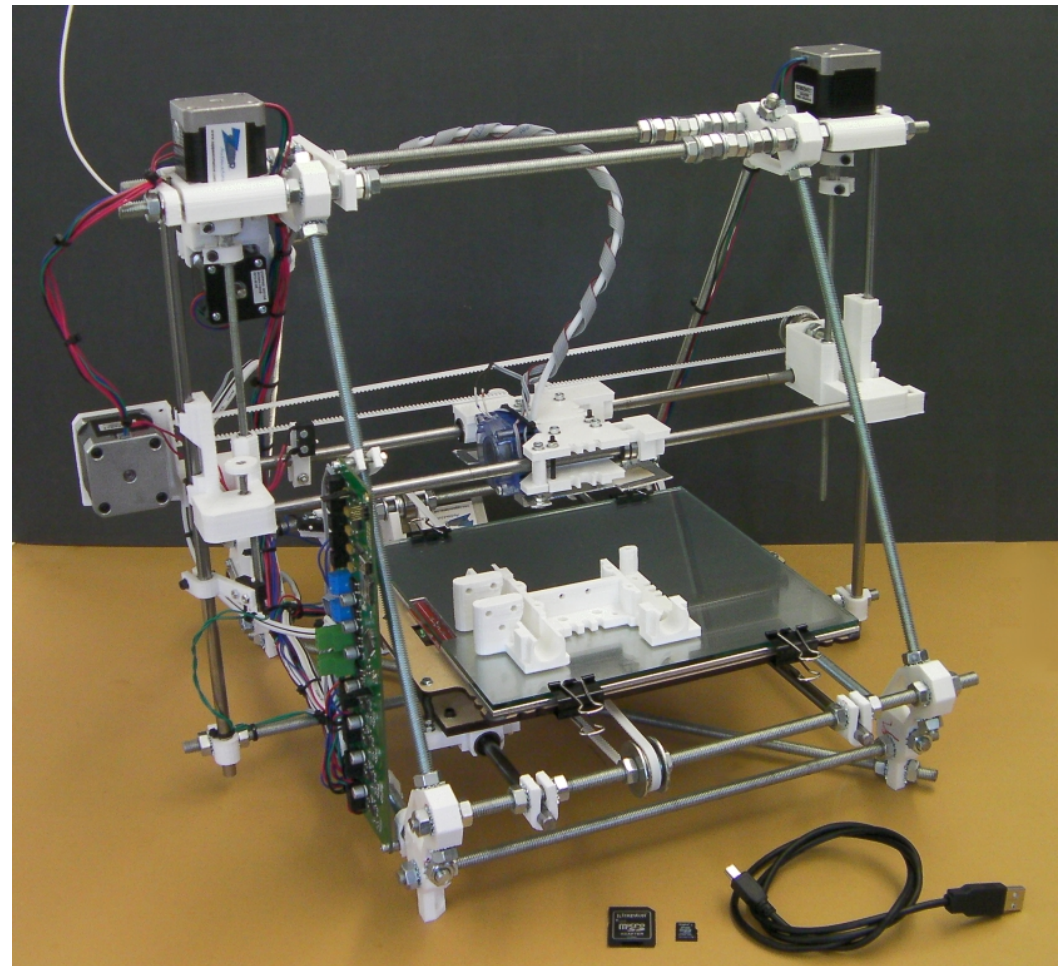
- Modellbahn-Schienen!
- <https://stratum0.org/wiki/RepRails>



CC-BY-SA Lena Schimmel: https://stratum0.org/wiki/Datei:RepRails_gedruckt_1.jpg, https://stratum0.org/wiki/Datei:RepRails_gedruckt_2.jpg

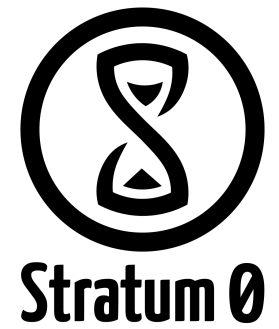
Was kann gedruckt werden?

- 3D-Drucker
 - (okay, bisher nur teilweise)



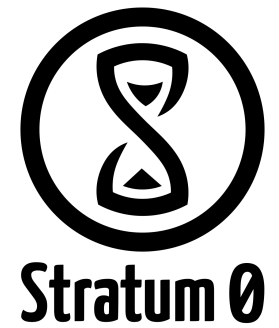
Source: <http://reprap.org/wiki/File:Reprappro-Mendel.jpg>

Workflow



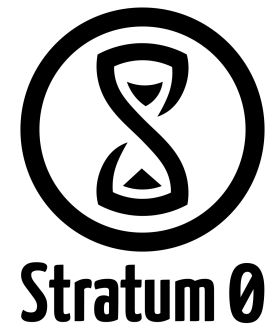
- 3D-Modell erstellen

Workflow: 3D-Modell



- Software?
 - Die meisten 3D-Programme sind geeignet
 - einfaches Dateiformat: STL
 - Solid Edge, SolidWorks, Cinema 4D, ...?
 - Blender

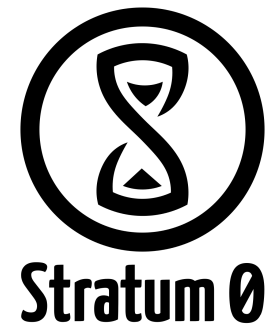
Workflow: 3D-Modell



```
include <Write.scad>
$fn=100;
module name_tag () {
  difference() {
    union () {
      cylinder(r1=19.5, r2=15, h=26);
      rotate([0, 0, -45]) writecylinder(name, [0,0,0], 18, 14, h=8, t=3.5, font="orbitron.dxf");
      rotate([0,0,-45]) translate([0,-12,13]) rotate([90,0,0]) linear_extrude(height=6)
      scale(0.25) translate([-25,0,0]) import("stratum0-lowres.dxf");
    }
    cylinder(r1=17.5, r2=13, h=26.1);
    cylinder(r=17.5, h=1, center=true);
  }
  difference () {
    cylinder(r1=24.5, r2=20, h=26);
    cylinder(r1=20, r2=15.5, h=26.1);
    cylinder(r=20, h=1, center=true);
  }
  translate([0,0,-1]) cube([50,50,50]);
}
}

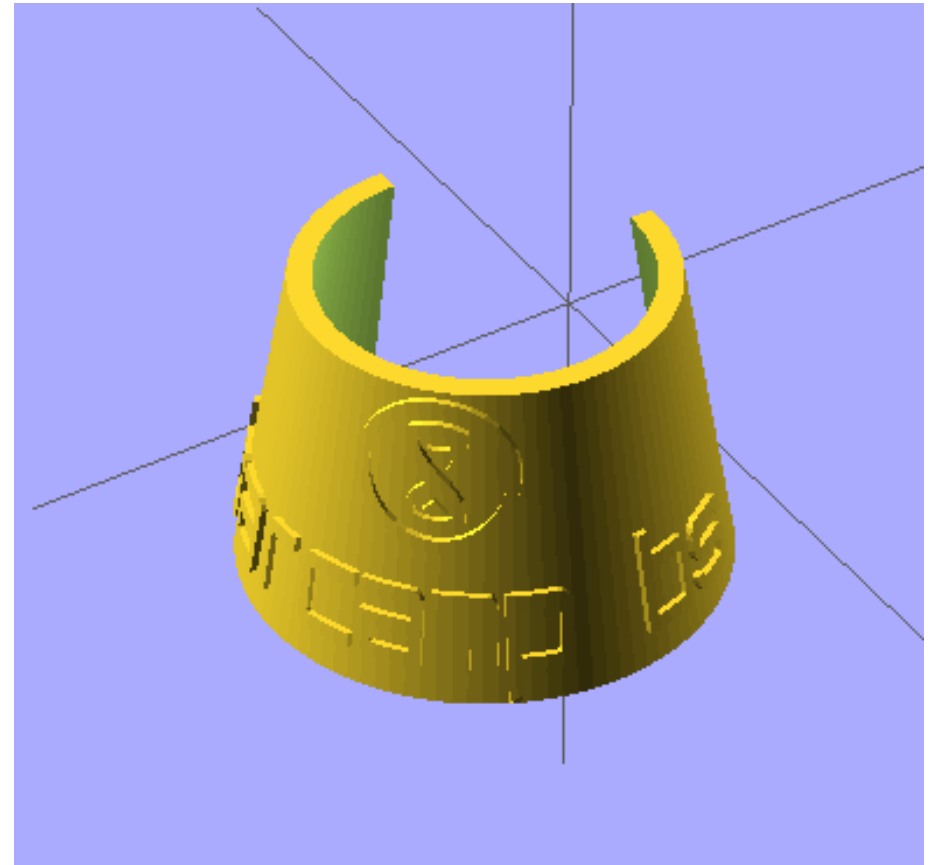
//translate([-22, 22, 0]) rotate(-90) name_tag(name="Yournamehere");
//translate([ 22, 22, 0]) rotate(180) name_tag(name="Yournamehere");
//translate([-22, -22, 0]) name_tag(name="Yournamehere");
translate([ 22, -22, 0]) rotate(90) name_tag(name="barcamp bs");
```

Workflow: 3D-Modell

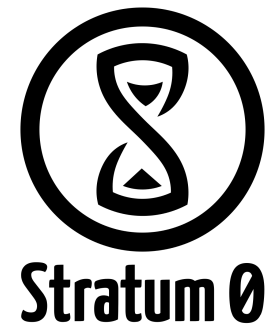


```
include <Write.scad>
$fn=100;
module name_tag () { difference() { union () {
cylinder(r1=19.5, r2=15, h=26);
rotate([0, 0, -45]) writecylinder(name, [0,0,0], 18,
14, h=8, t=3.5, font="orbitron.dxf");
rotate([0,0,-45]) translate([0,-12,13])
rotate([90,0,0]) linear_extrude(height=6) scale(0.25)
translate([-25,0,0]) import("stratum0-lowres.dxf"); }
cylinder(r1=17.5, r2=13, h=26.1);
cylinder(r=17.5, h=1, center=true);
difference () {
cylinder(r1=24.5, r2=20, h=26);
cylinder(r1=20, r2=15.5, h=26.1);
cylinder(r=20, h=1, center=true); }
translate([0,0,-1]) cube([50,50,50]); } }

//translate([-22, 22, 0]) rotate(-90)
name_tag(name="Yournamehere");
//translate([ 22, 22, 0]) rotate(180)
name_tag(name="Yournamehere");
//translate([-22, -22, 0])
name_tag(name="Yournamehere");
translate([ 22, -22, 0]) rotate(90)
name_tag(name="barcampmatetag");
```

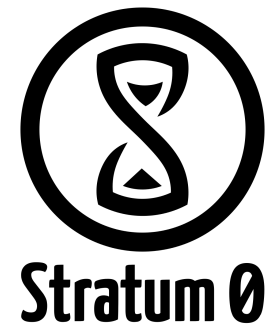


Workflow: 3D-Modell



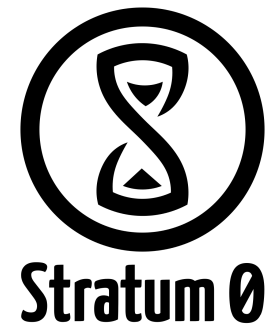
- Primitive:
 - cylinder
 - cube
 - sphere
 - ...
- Operationen:
 - translate
 - rotate
 - union
 - difference
 - ...

Workflow



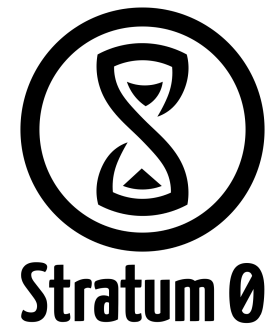
- 3D-Modell erstellen
 - STL

Workflow

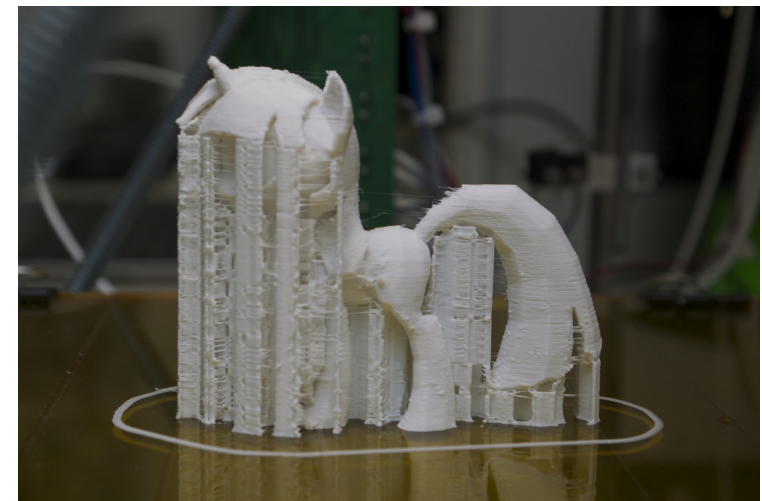


- 3D-Modell erstellen
 - STL
- Slicen

Workflow: Slicen

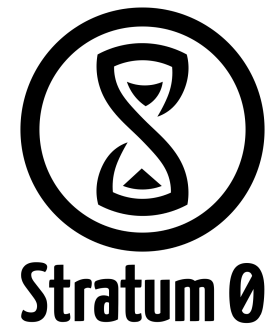


- STL → GCode
- Software: Slic3r, skeinforge, ...
- Kennt die Druckerparameter:
 - Druckbares Volumen, Filament, Düse, ...
- Setzt die Werte für:
 - Schichtdicke, Geschwindigkeit, Temperatur, ...
- Berechnet:
 - Support-Material
 - Füllmuster



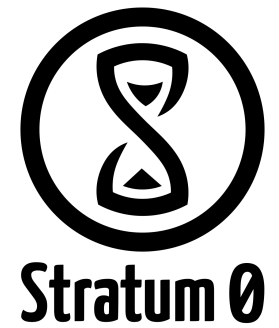
CC-BY-SA DooMMaster: <https://secure.flickr.com/photos/doommeer/8143518431>

Workflow



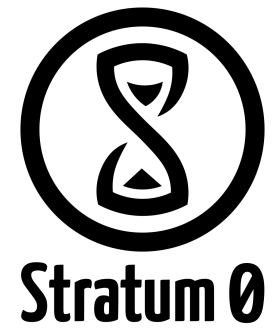
- 3D-Modell erstellen
 - STL
- Slicen
 - GCode

Workflow

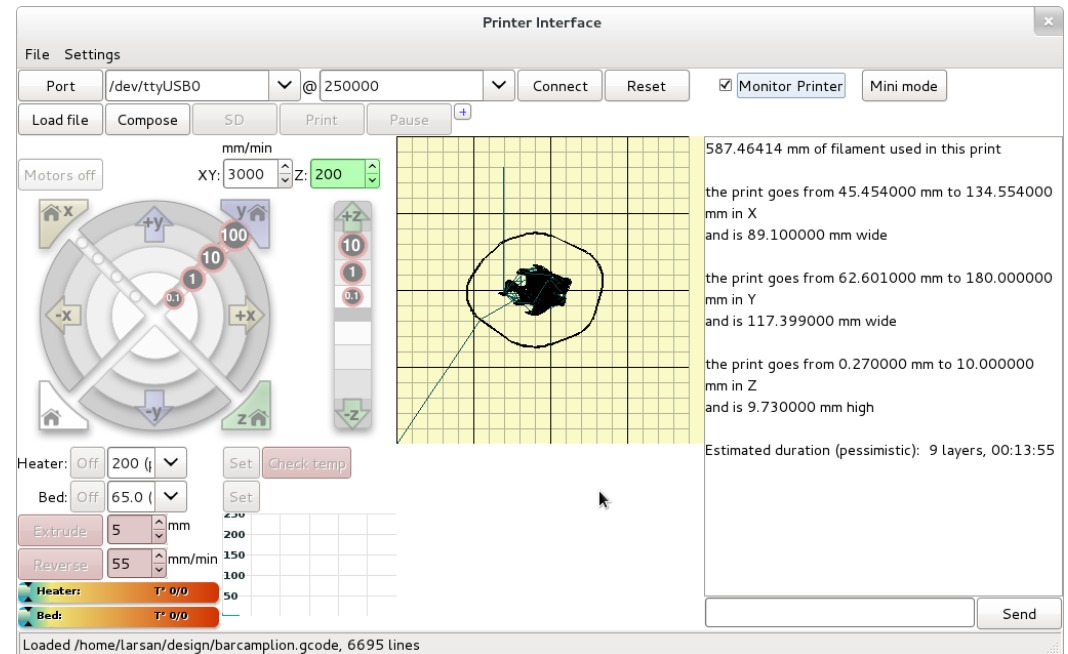


- 3D-Modell erstellen
 - STL
- Slicen
 - GCode
- Drucken

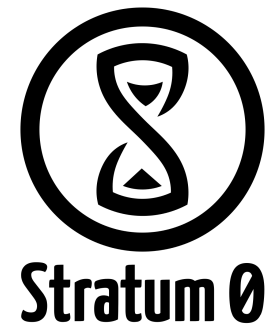
Workflow: Drucken



- Pronterface
 - Verbindung zum Drucker
 - gibt GCode weiter
 - manuelle Kontrolle der Motoren
 - Eingriff in den Druck

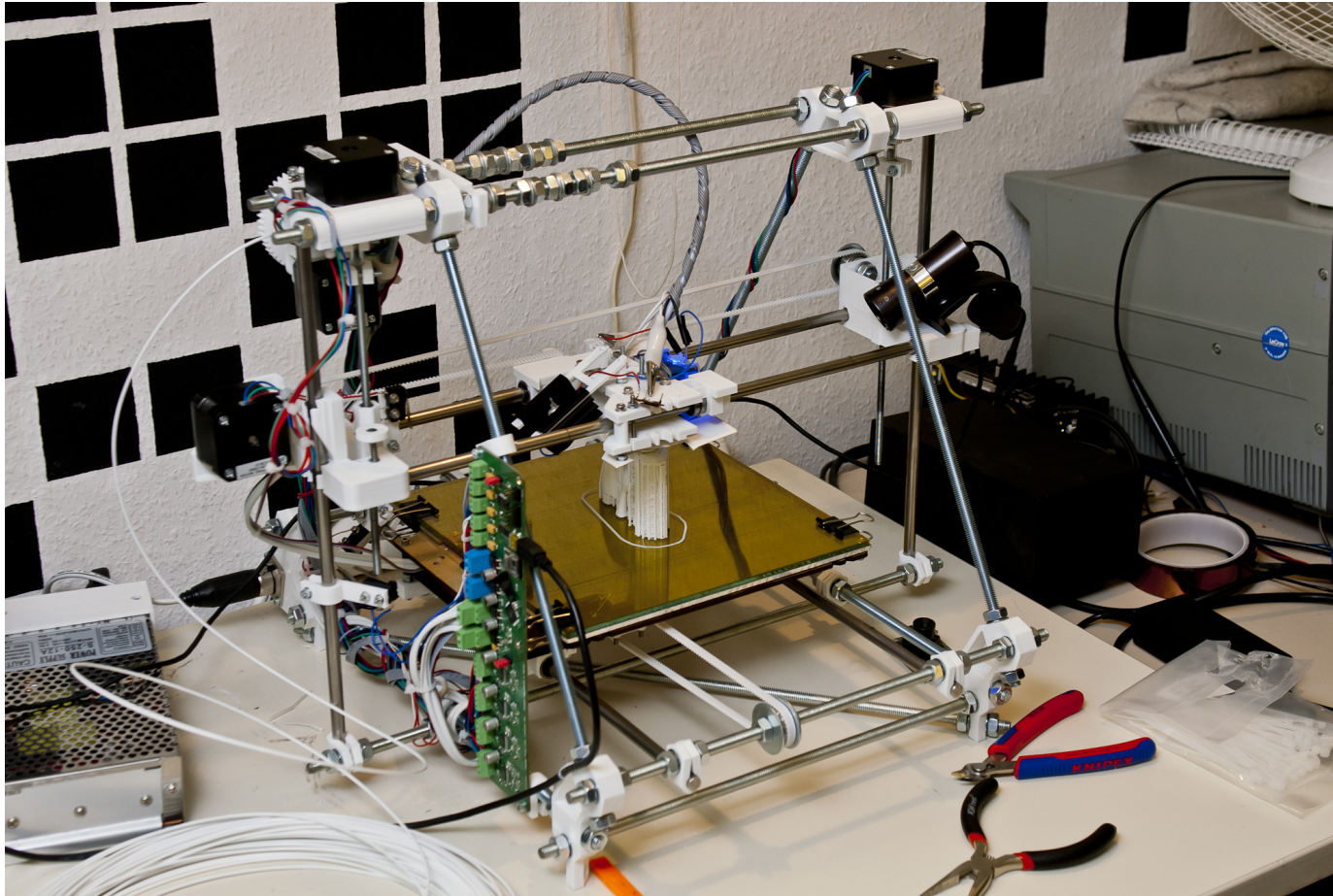


Workflow

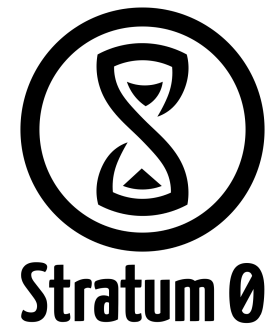


- 3D-Modell erstellen
 - .stl
- Slicen
 - .gcode
- Drucken
 - .atom

Drucken



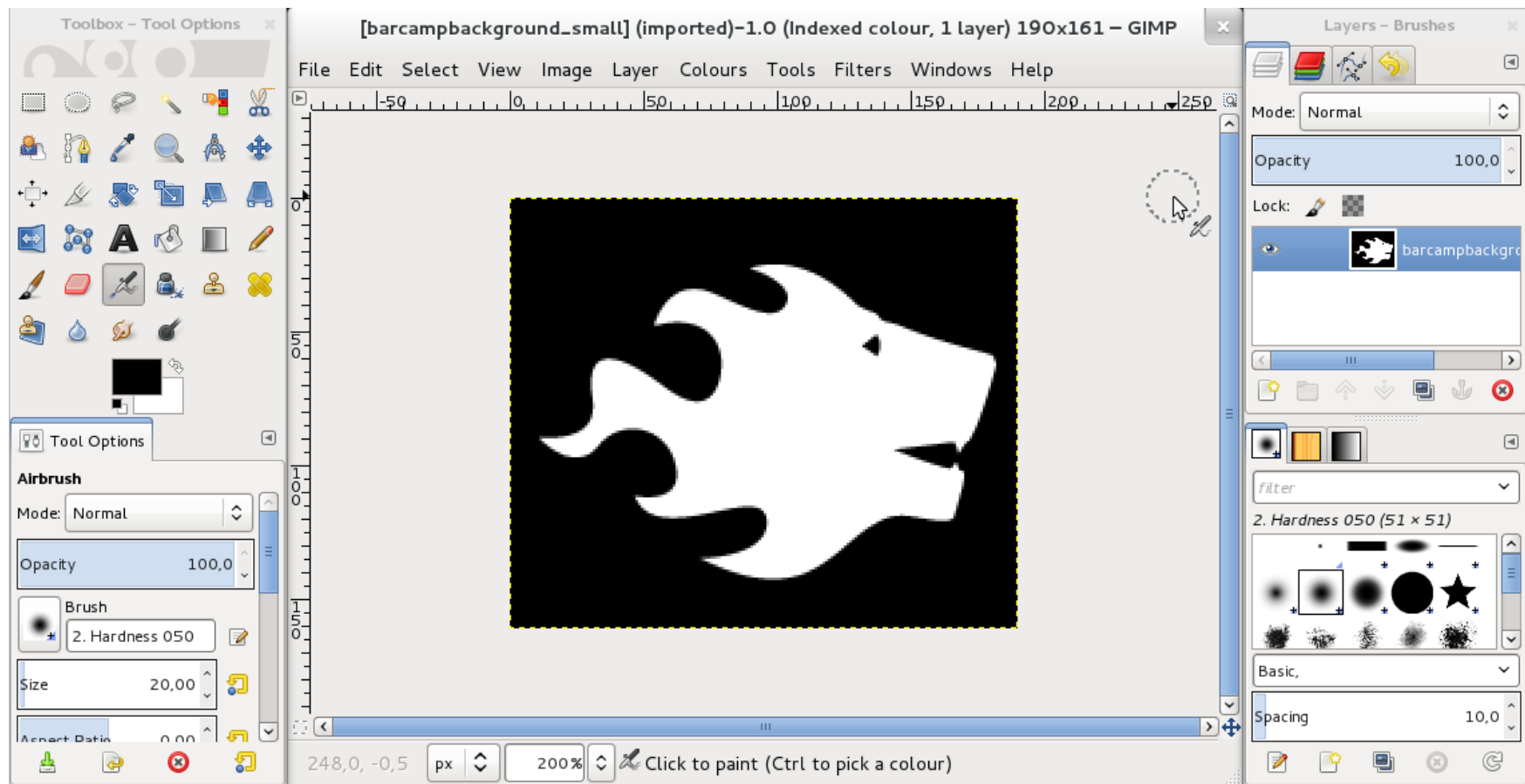
Drucken (live und in Farbe)



- Toolchain:
 - Gimp: Grafik bearbeiten/zuschneiden
 - Inkscape: Grafik vektorisieren
 - OpenSCAD: 2D-Grafik linear extrudieren
 - Slic3r: Modell in Pfade des Druckers umwandeln
 - Pronterface: drucken

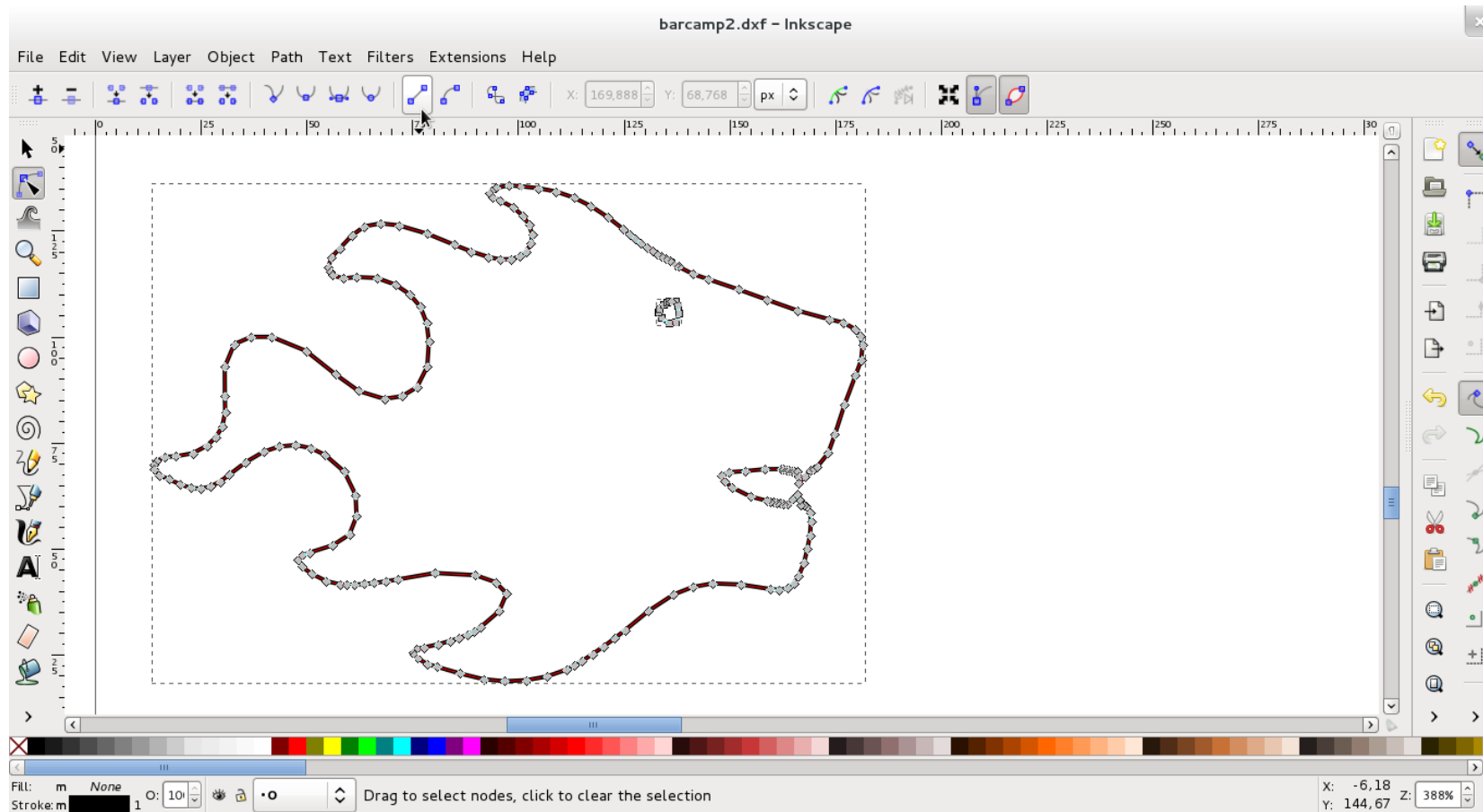
Drucken: 3D-Modell

- Gimp

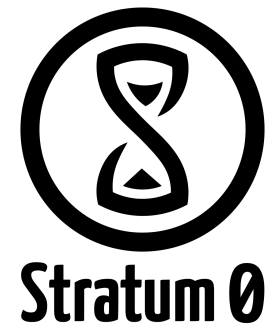


Drucken: 3D-Modell

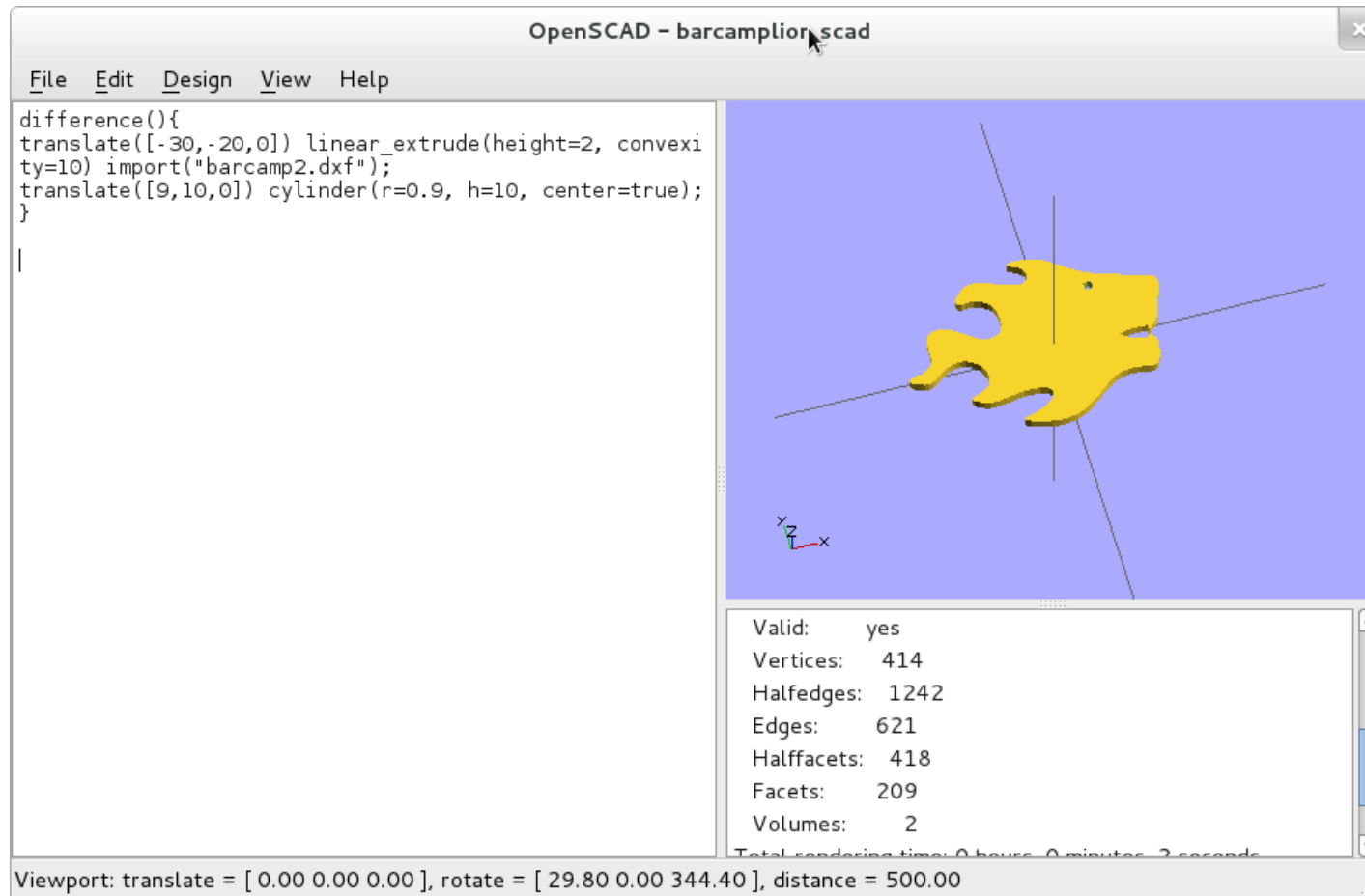
- Inkscape



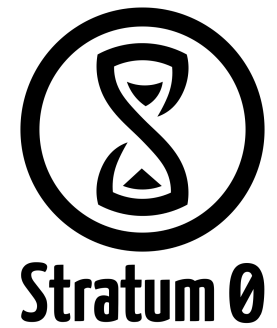
Drucken: 3D-Modell



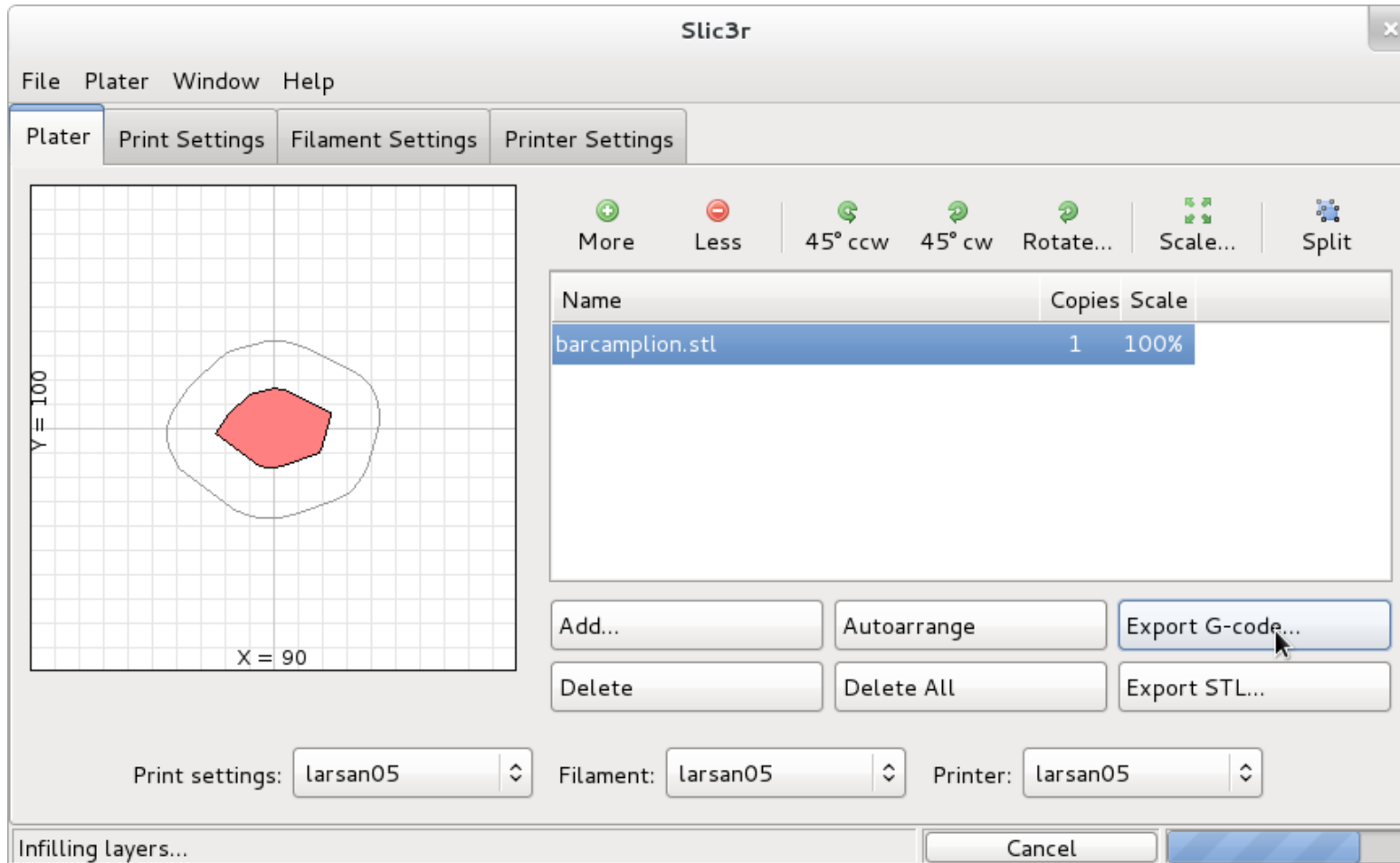
- OpenSCAD



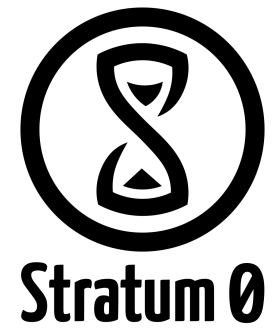
Drucken: Slicen



- Slic3r



Drucken: Drucken



- Pronterface

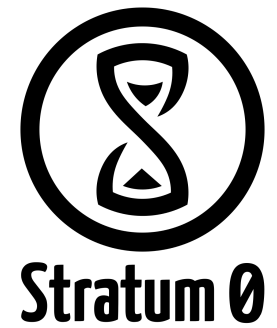
The screenshot shows the Pronterface software interface. At the top, it displays "File Settings" with a port of "/dev/ttyUSB0" and a baud rate of "@ 250000". There are buttons for "Connect", "Reset", "Monitor Printer", and "Mini mode". Below this, there are buttons for "Load file", "Compose", "SD", "Print", and "Pause".

The main interface is divided into several sections:

- Motors off**: A button to turn off the motors.
- Speeds**: A circular control panel with arrows for X, Y, and Z axes, and a central speed dial with values 0.1, 1, 10, and 100.
- XY: 3000 mm/min** and **Z: 200 mm/min**: Speed settings for the XY and Z axes.
- 3D Model**: A central window showing a 3D model of a printed part on a grid.
- Print Statistics**: A list of statistics on the right side:
 - 587.46414 mm of filament used in this print
 - the print goes from 45.454000 mm to 134.554000 mm in X and is 89.100000 mm wide
 - the print goes from 62.601000 mm to 180.000000 mm in Y and is 117.399000 mm wide
 - the print goes from 0.270000 mm to 10.000000 mm in Z and is 9.730000 mm high
 - Estimated duration (pessimistic): 9 layers, 00:13:55
- Temperature**: Heater and Bed temperature controls, both currently at 0/0.
- Extrude**: A button to extrude filament, currently set to 5 mm.
- Reverse**: A button to reverse the extruder, currently set to 55 mm/min.

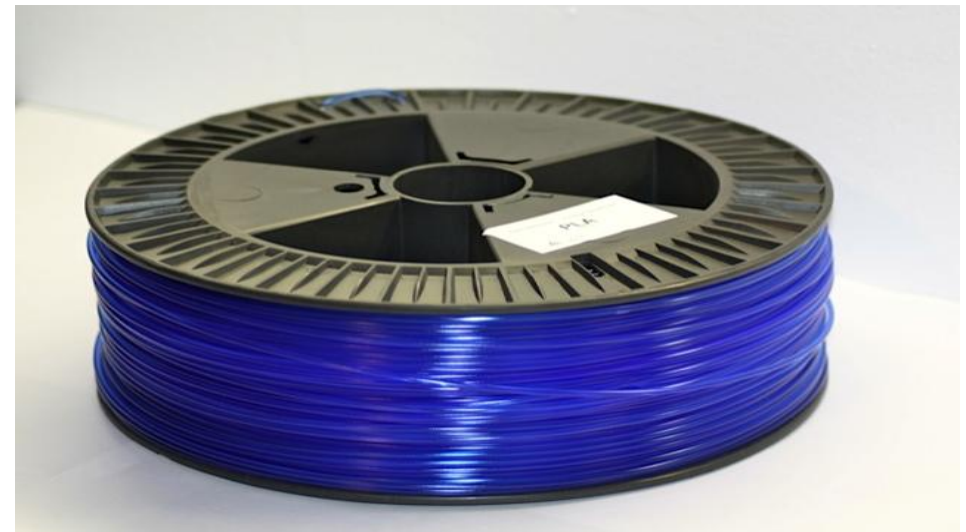
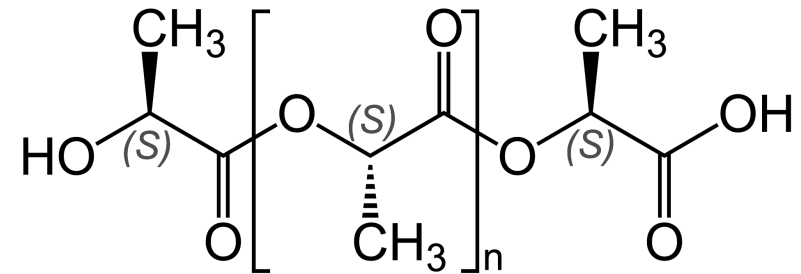
At the bottom, it shows "Loaded /home/larsan/design/barcamplion.gcode, 6695 lines" and a "Send" button.

Material



PLA (Polylactide)

- verkettete Milchsäure
 - organisch
 - kompostierbar
- verformbar bei ~170-200°C
- aktuell bei uns genutztes Material

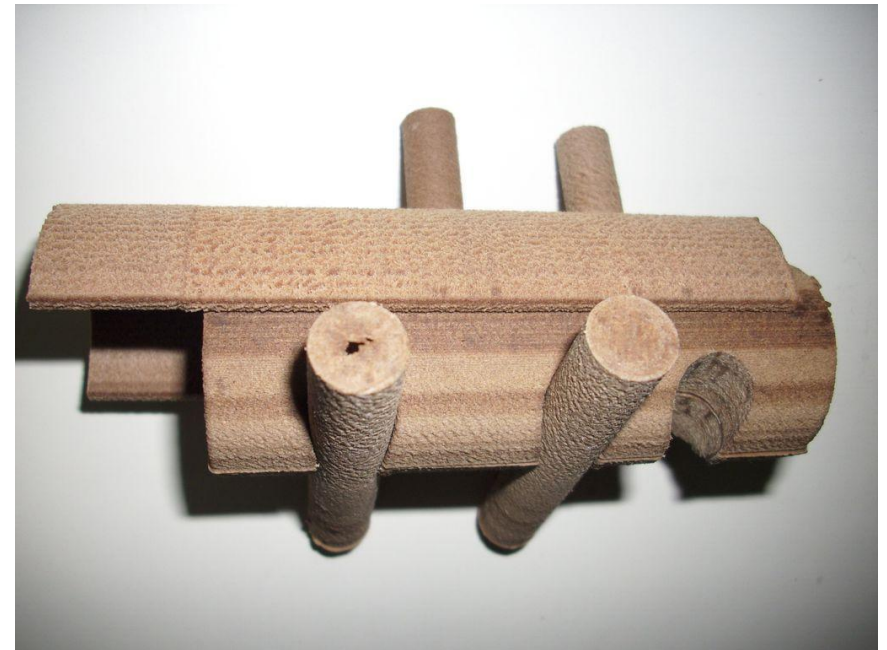


Source: <https://grf.de/de/catalog/pla-kunststoff-blau-transparent>

Material

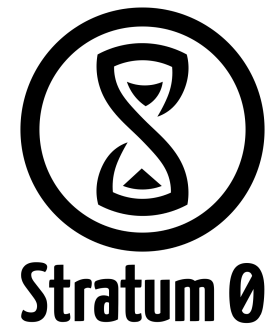
Andere Stoffe in Verbindung mit Trägermasse:

- Soft PLA
 - gummiartig
 - z. B. für Stempel geeignet
- Holz
 - „sieht aus und riecht wie Holz“
- Metal Clay
 - muss im Brennofen gebrannt werden



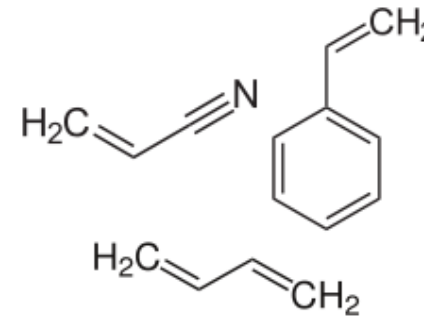
Source: <https://grf.de/de/catalog/spezial-material/druckbarer-holzdraht>

Material



ABS (Acrylnitril-Butadien-Styrol)

- verformbar bei $\sim 230^{\circ}\text{C}$
- ursprünglich in der Industrie genutzt
- mehr Schwierigkeiten beim Druck
 - beheiztes Bett
 - anderer Extruder nötig
- weniger Umweltverträglichkeit

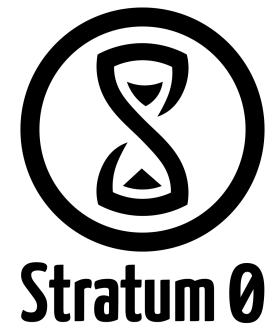


Schokolade?!

- Schmelzpunkt: $\sim 33.8^{\circ}\text{C}$
 - verschiedene Kristallstrukturen
- http://reprap.org/wiki/Chocolate_Extrusion



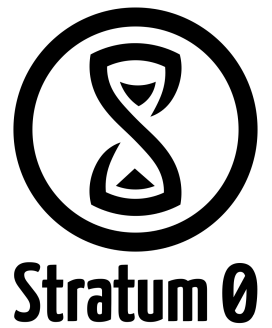
Drucktechniken



- Alle gängigen: Schicht für Schicht.
- Filamentextruder
 - 1,75 oder 3 mm Filament
 - 0,35 mm Düse
 - Kosten: Drucker ab 400€, Filament ~20€/kg
- Stereolithografie
 - Aushärten eines Polymers mittels UV
 - Kosten: Drucker vierstellig, Fluid ~80€/l
- Sintern, etc...

Laaaaangweilig.

2005



- Initiales Treffen
- Finanzielle Unterstützung



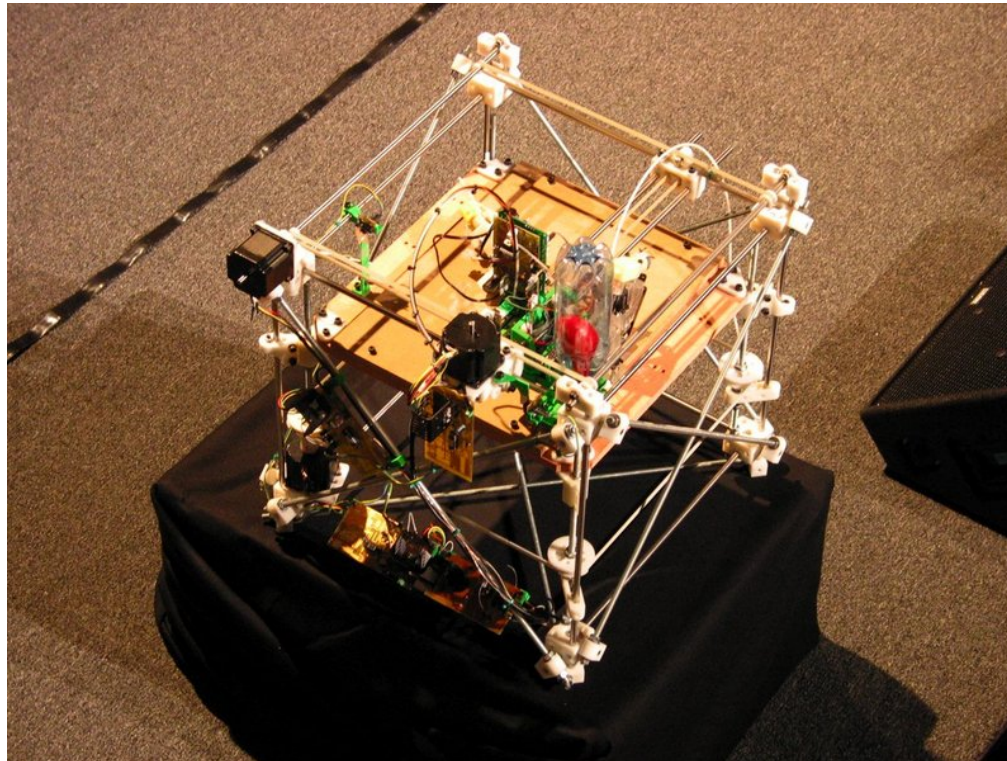
UNIVERSITY OF
BATH

EPSRC

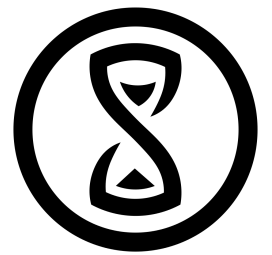
Engineering and Physical Sciences
Research Council

2006

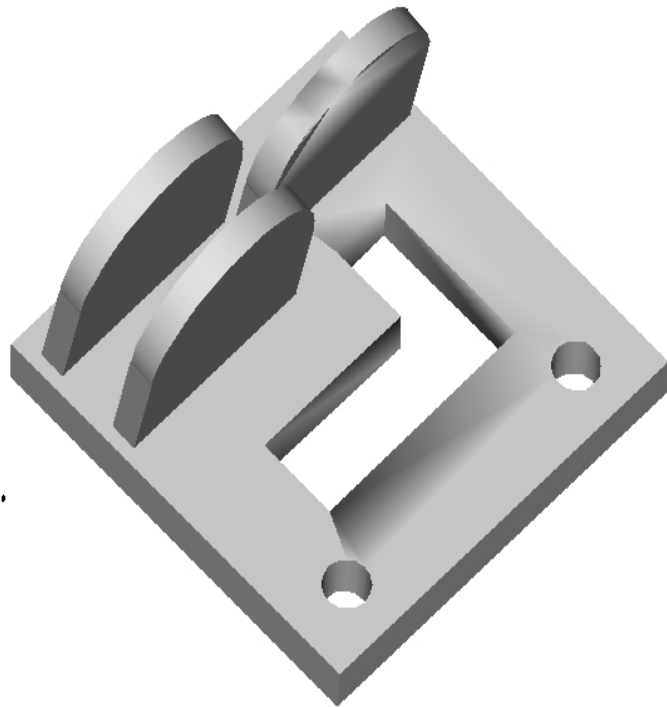
Beginn der eigenen Reproduktion



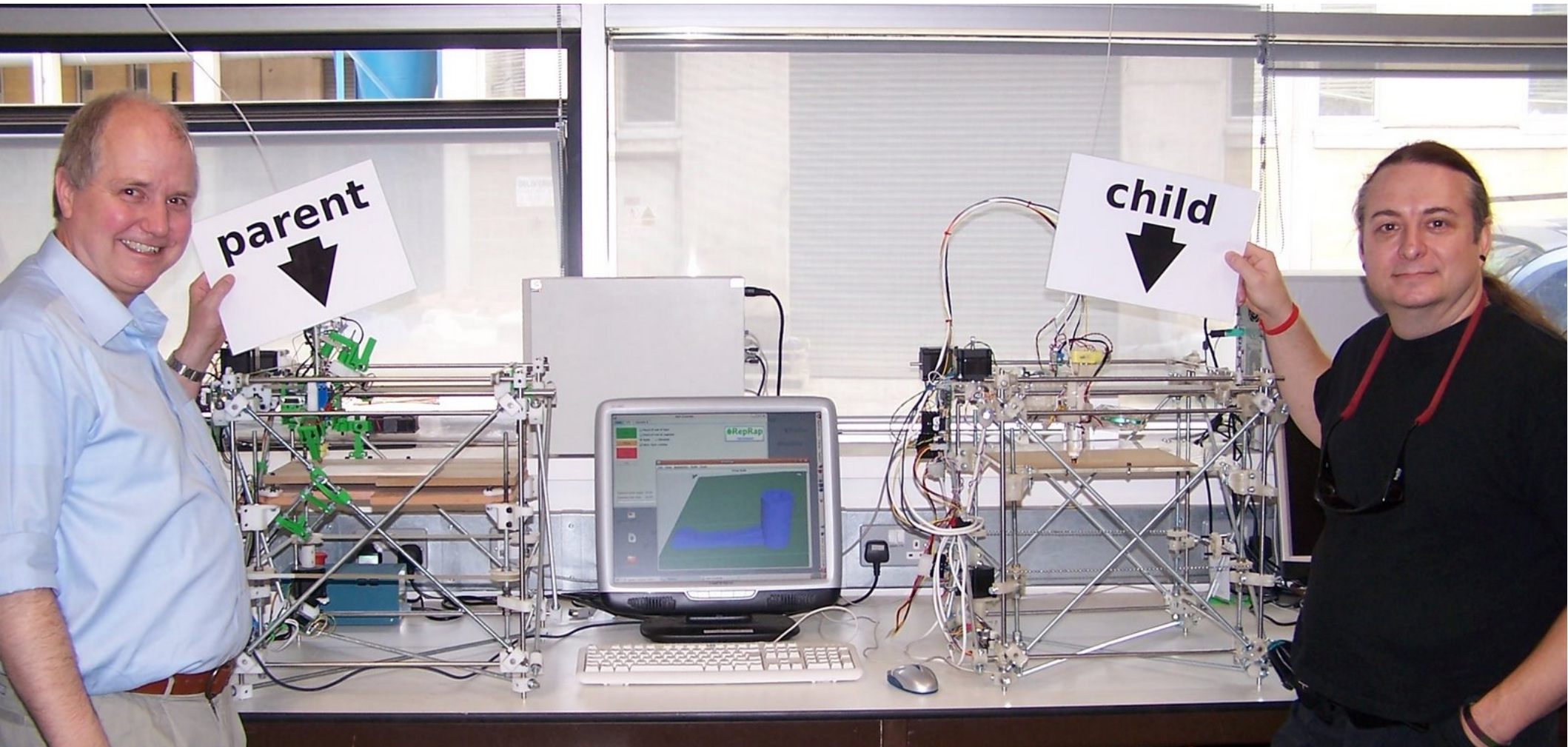
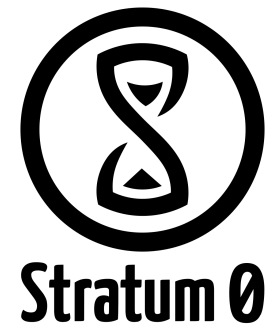
2008



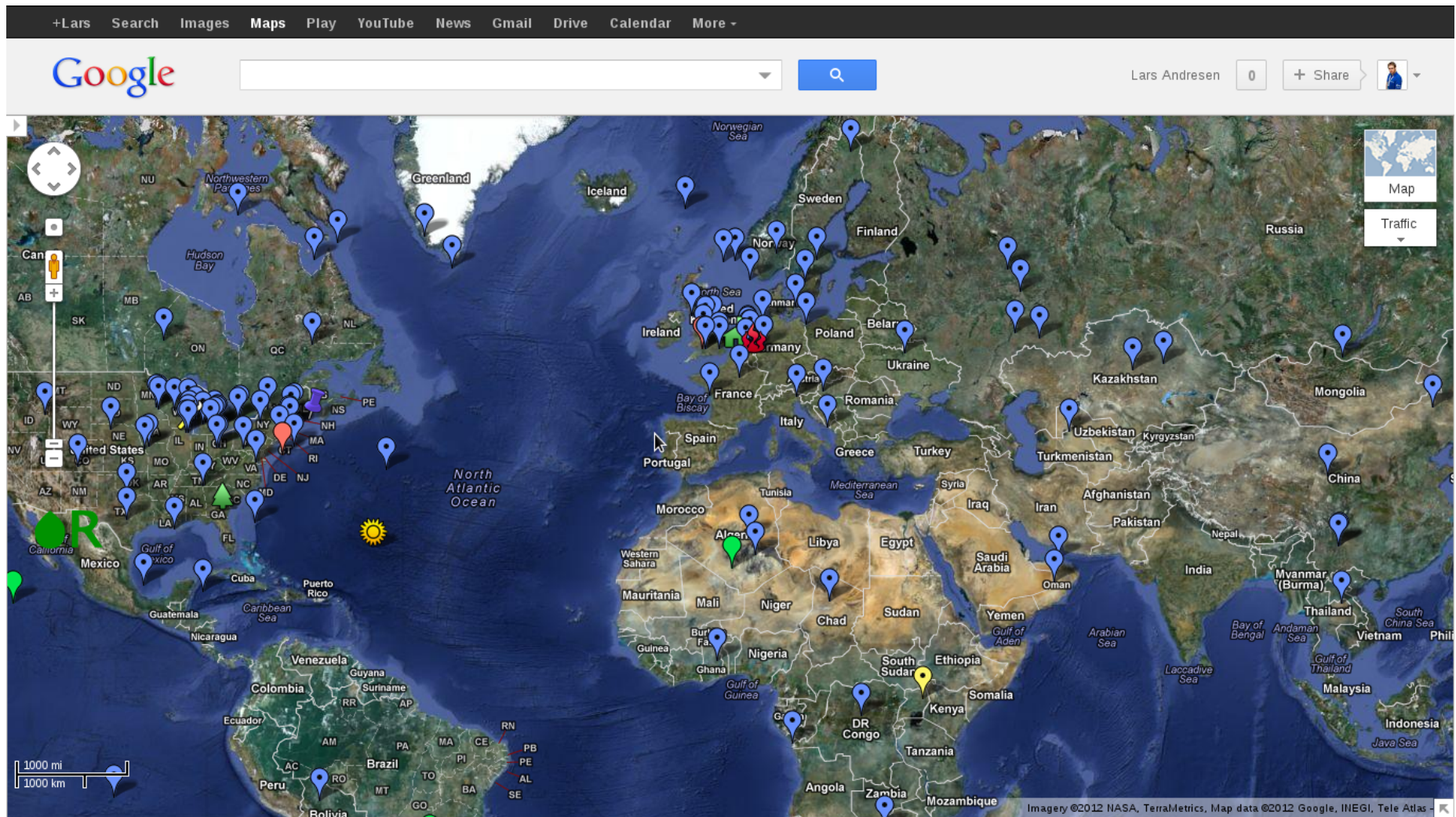
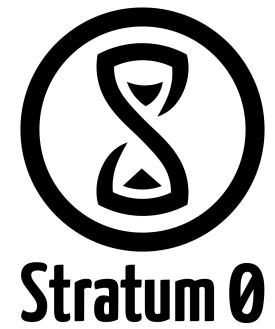
Stratum 0



2008

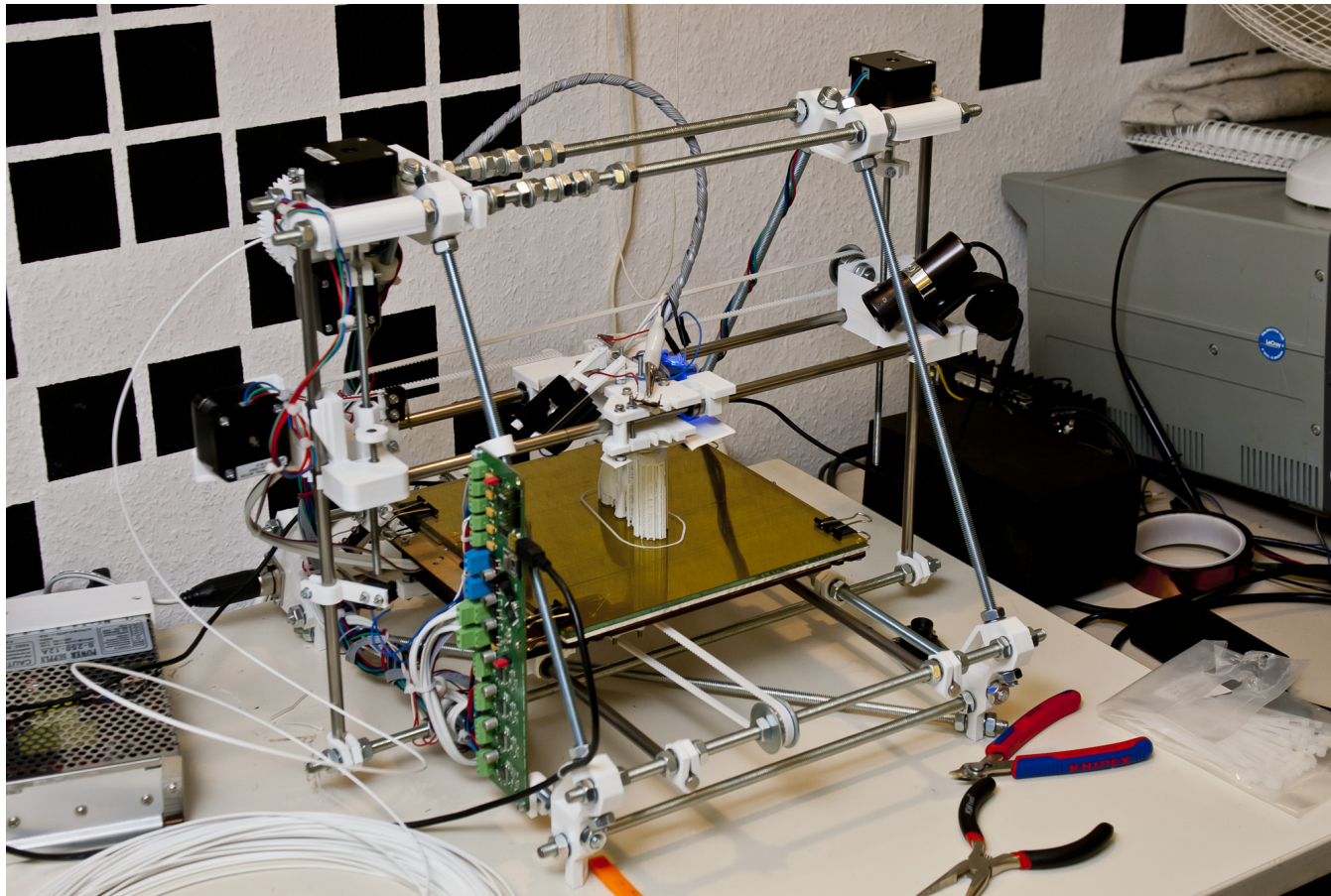


2008



2009

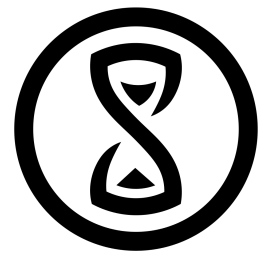
- neuer Drucker: RepRap Prusa Mendel (unser Modell)





- ca. 30.000 Drucker

Software: GPL-lizenziert



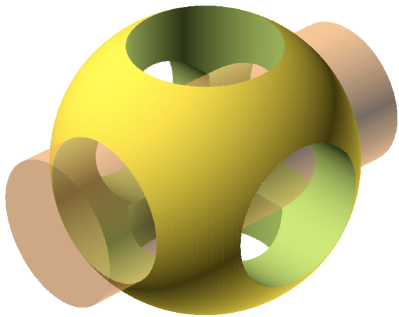
Stratum 0



Slic3r.org



Reprap.org



Openscad.org



Blender.org



Fragen?

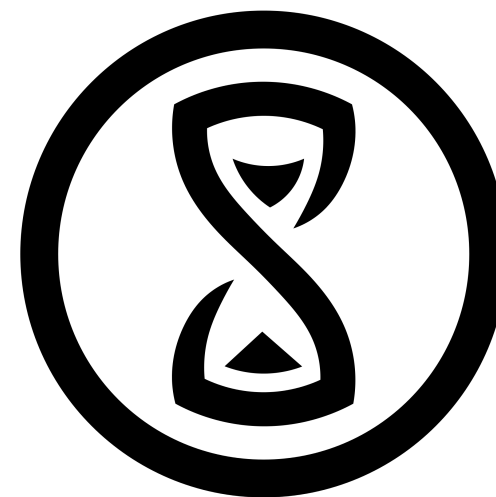


https://stratum0.org/wiki/BarCamp_Braunschweig_2012

Twitter: @stratum0

IRC: #stratum0 @ freenode.net

<https://stratum0.org>



Stratum 0