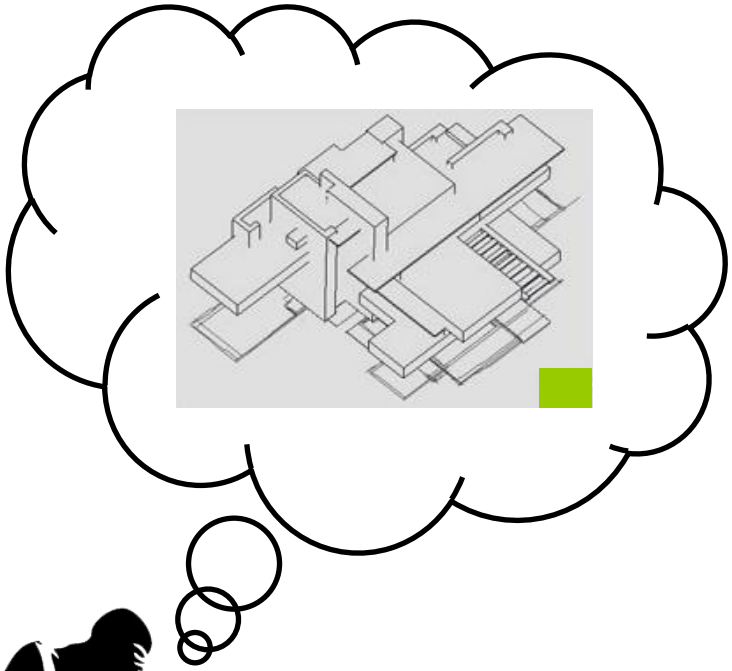
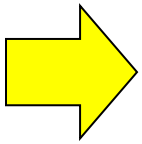
OpenSCAD建模软件介绍

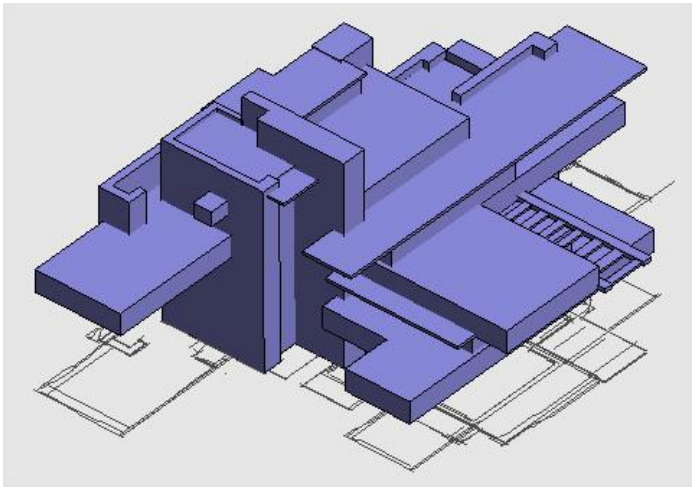
吴文明
计算机与信息学院

3D建模

什么是3D建模设计？

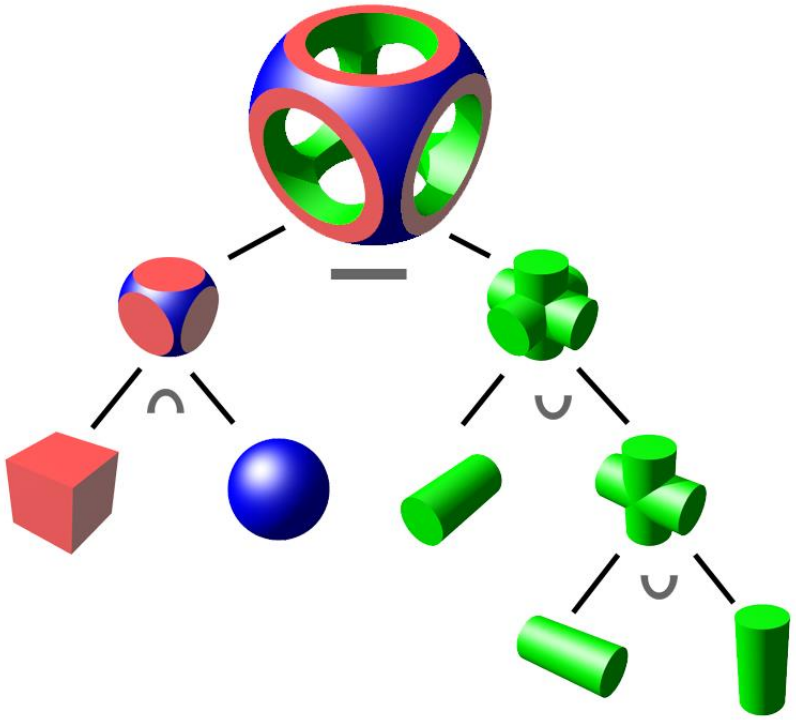




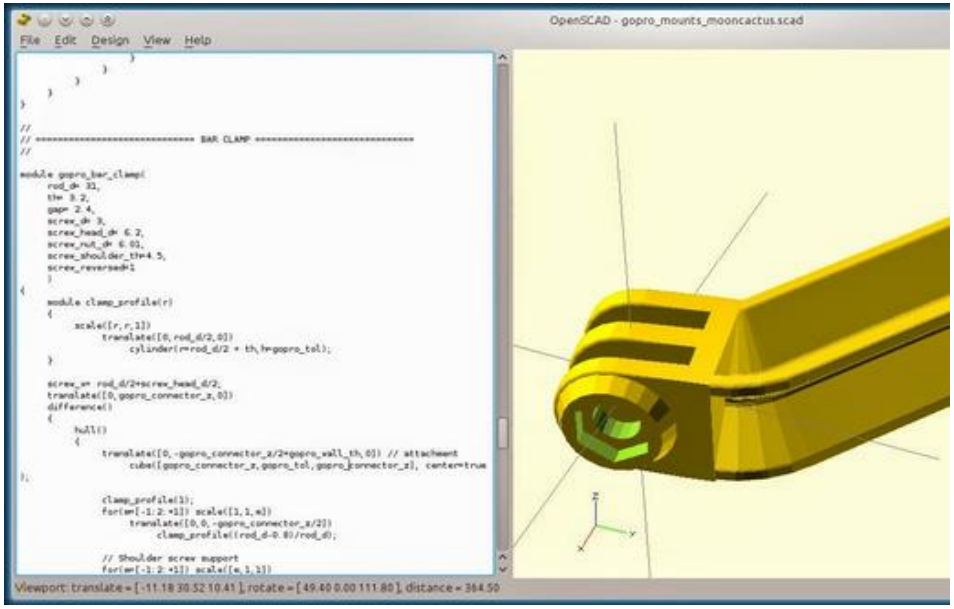


将物体的数字化模型构建出来

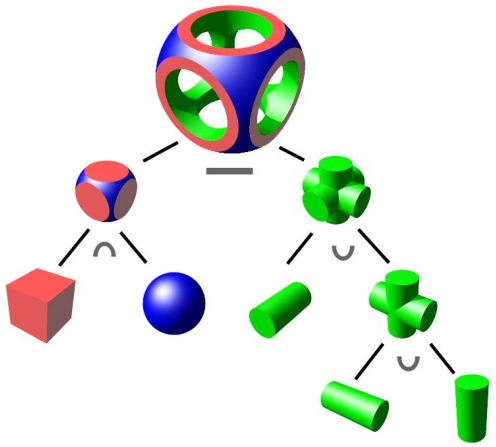
建模设计的关键：理念和思路

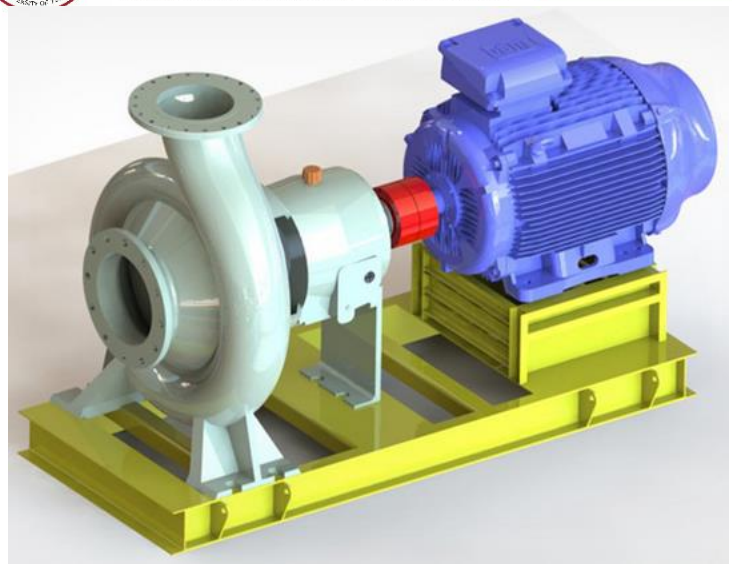


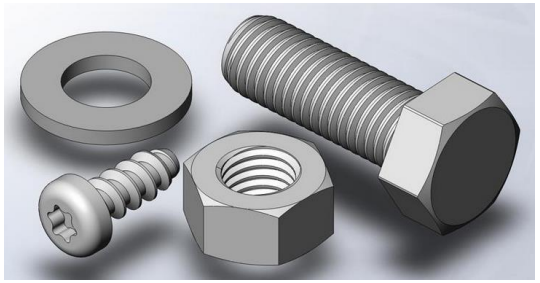
OpenSCAD

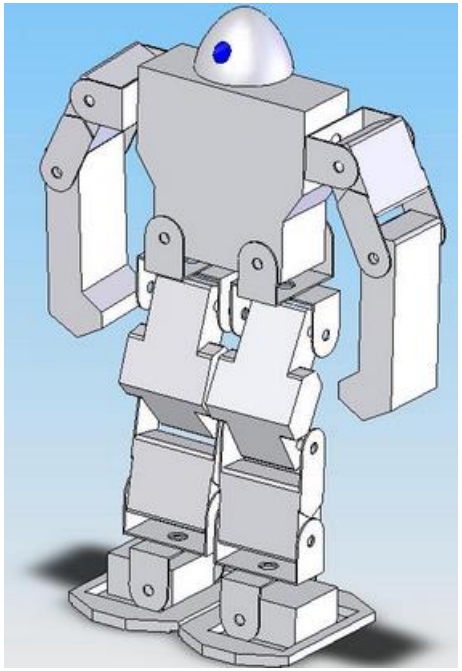


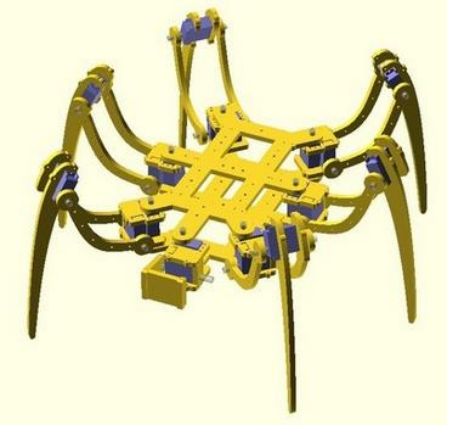
CSG-tree



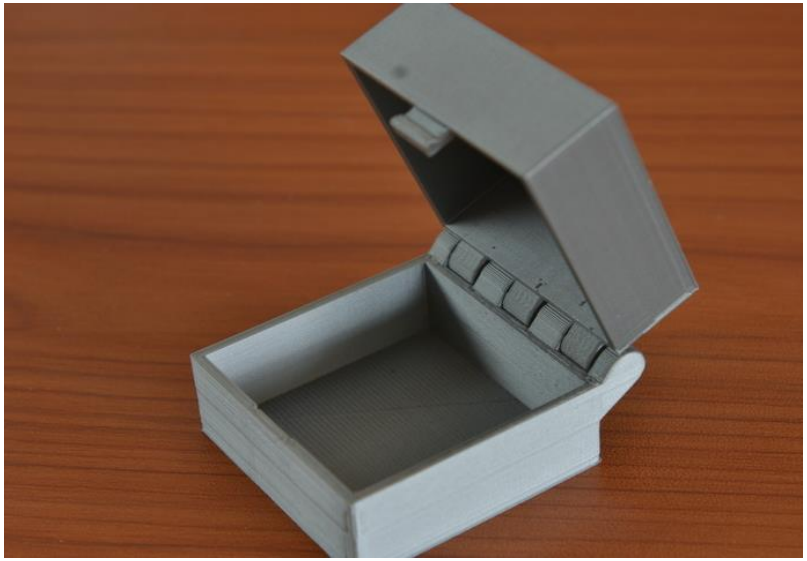


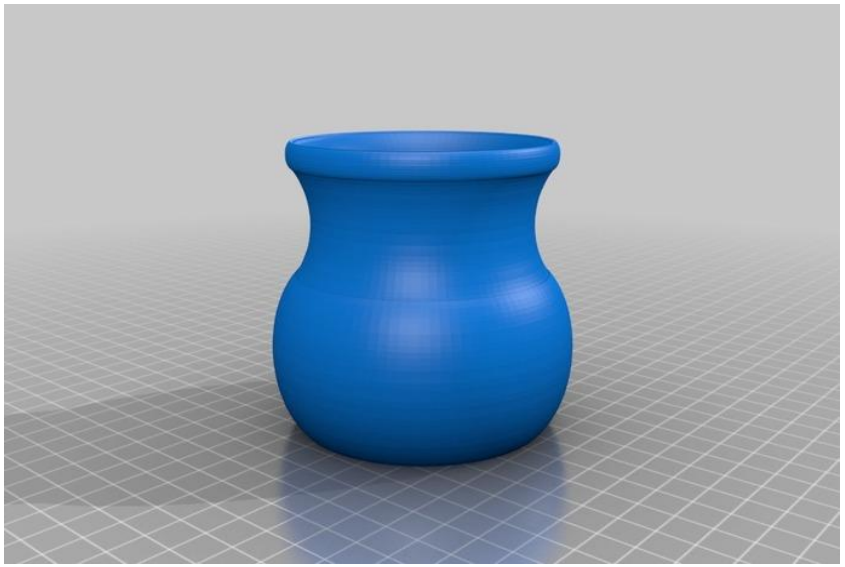




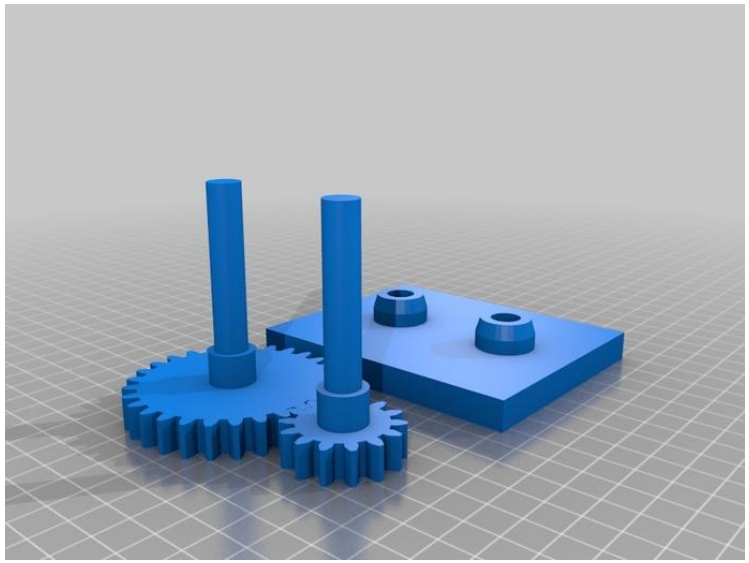


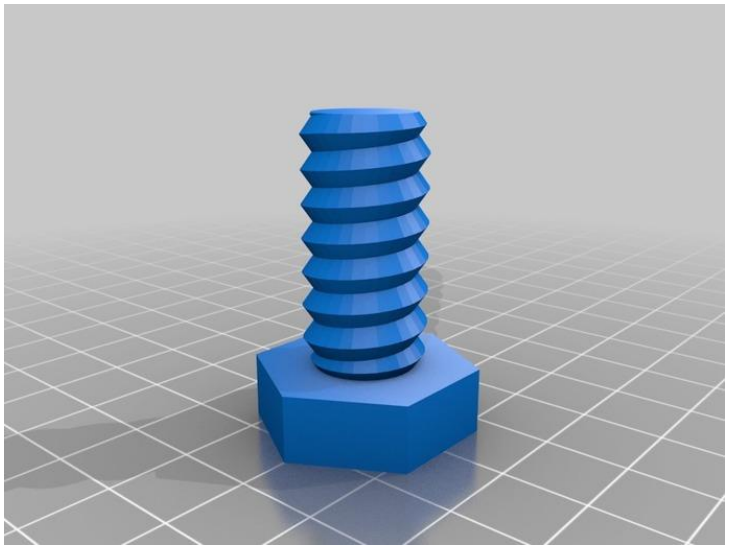
OpenSCAD

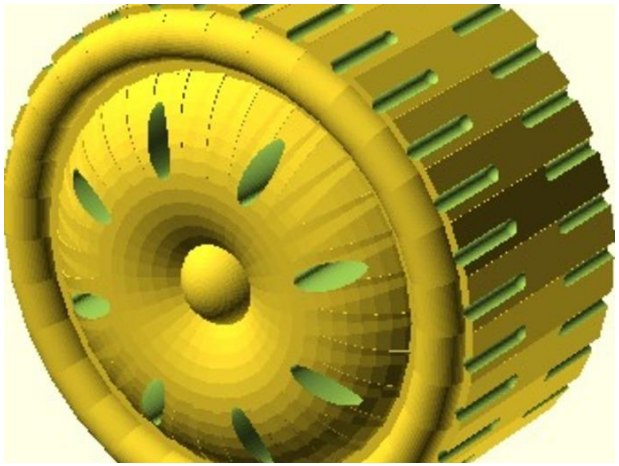


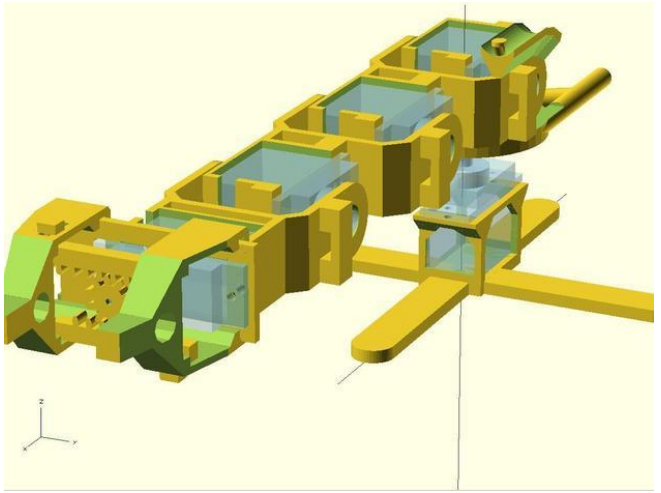


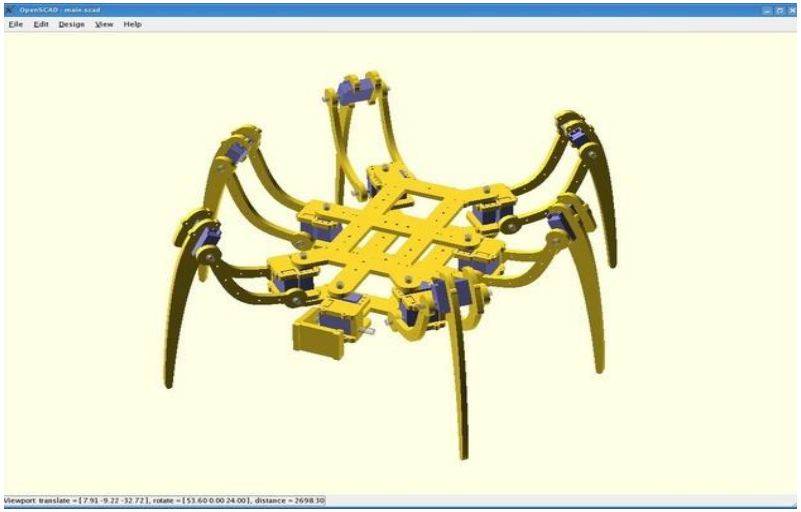

261 / PH1 x 60
261 / PH0 x 50
Made in Germany

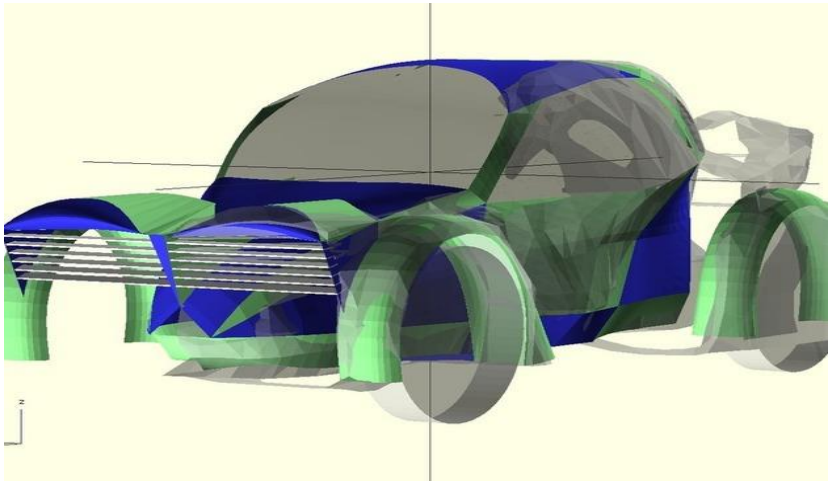


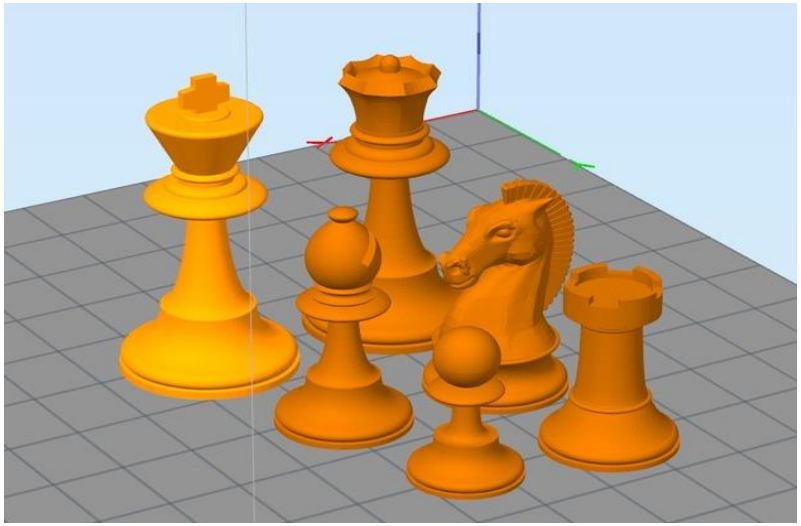


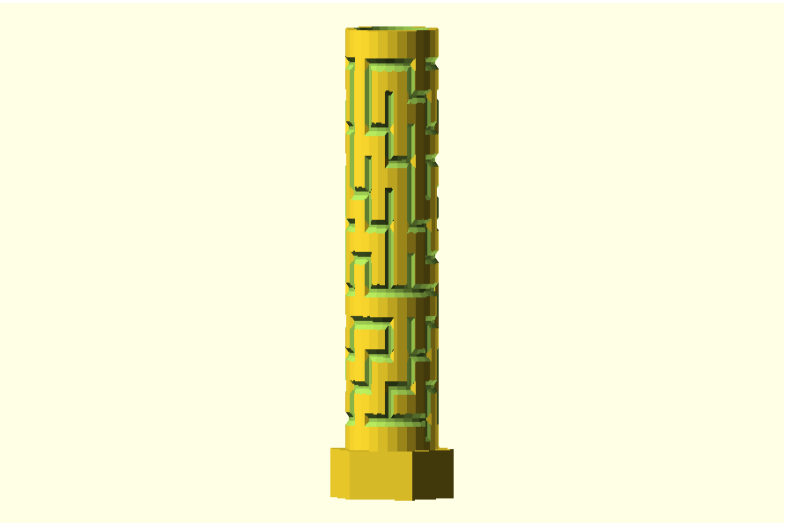


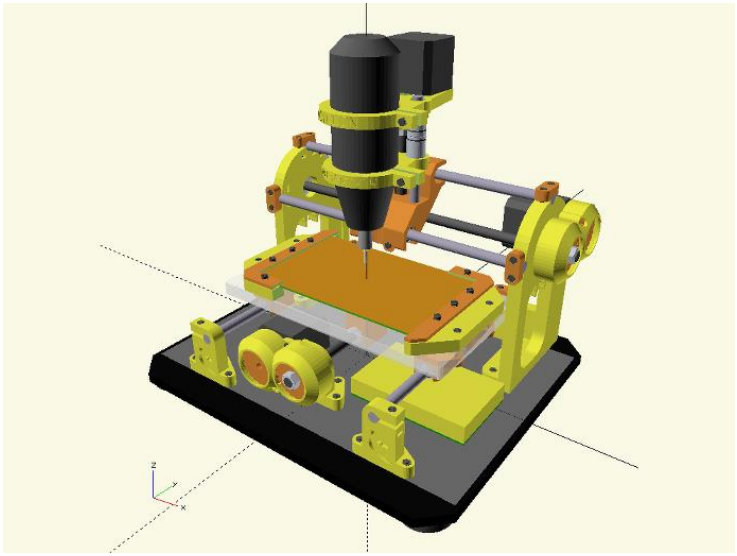


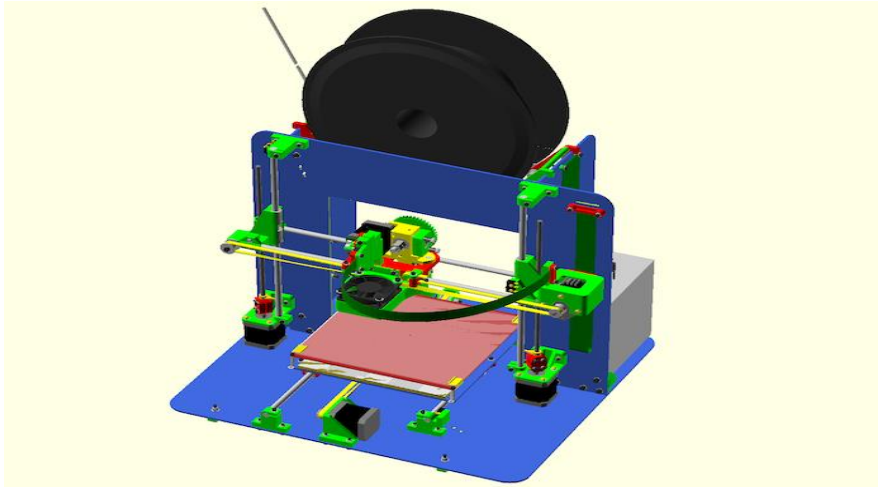

OpenSCAD - main.scad
File Edit Design View Help
Viewport: translate = [7.91 -9.22 -32.72], rotate = [53.60 0.00 24.00], distance = 2698.30

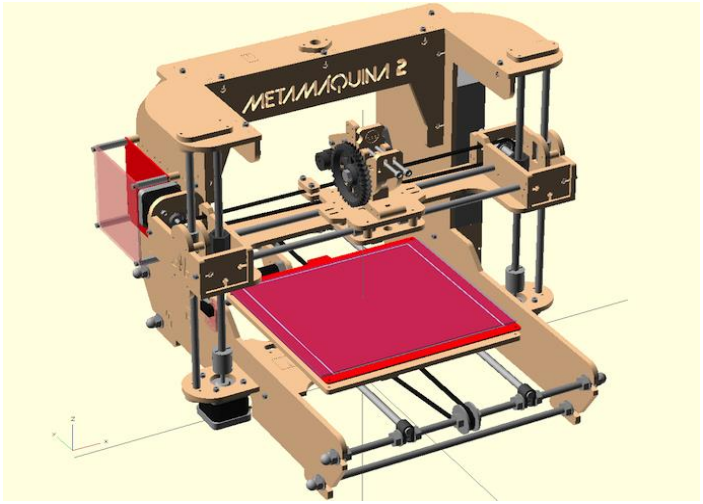


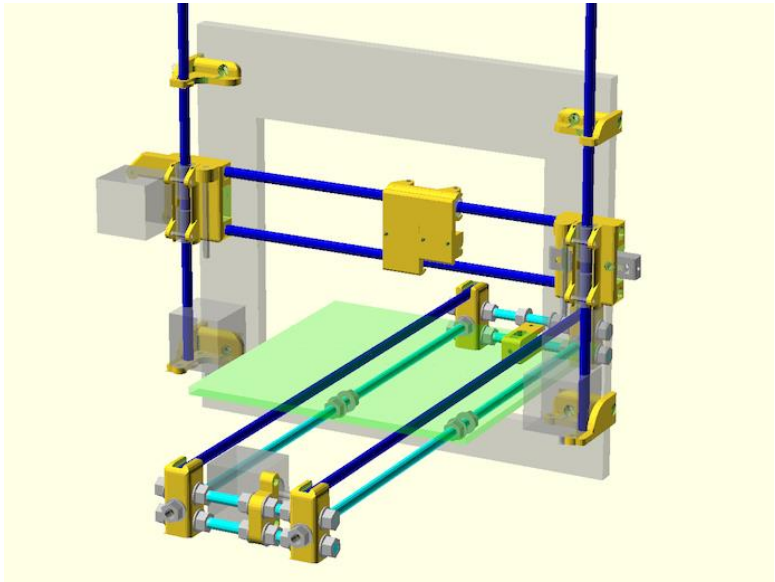


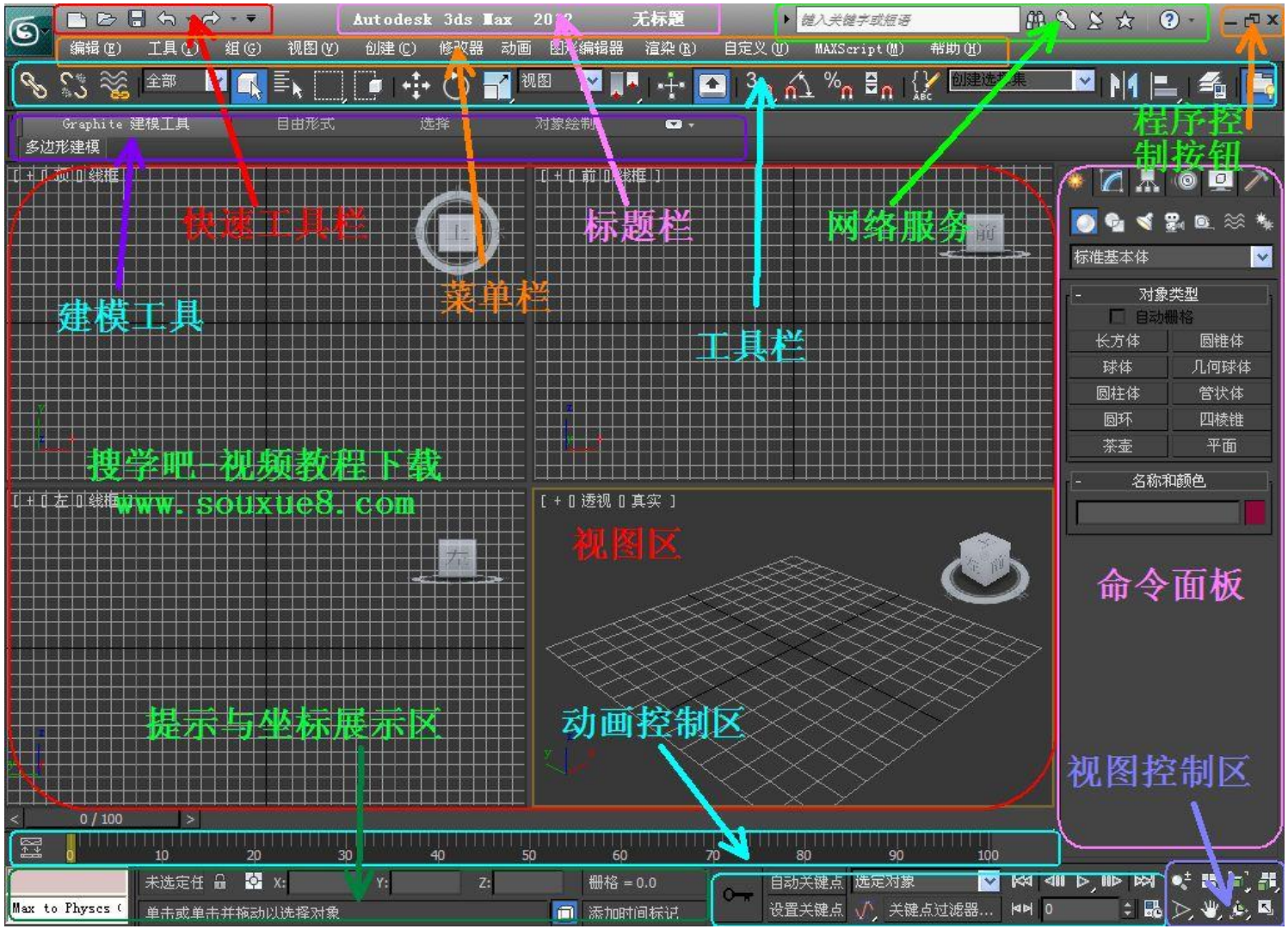







METAMAQUINA 2




Autodesk 3ds Max 20?? 无标题
编辑(E) 工具(T) 组(G) 视图(V) 创建(C) 修改器 动画 图形编辑器 渲染(R) 自定义(U) MAXScript(M) 帮助(H)
Graphite 建模工具 自由形式 选择 对象绘制
多边形建模
程序控制按钮
快速工具栏
标题栏
网络服务
菜单栏
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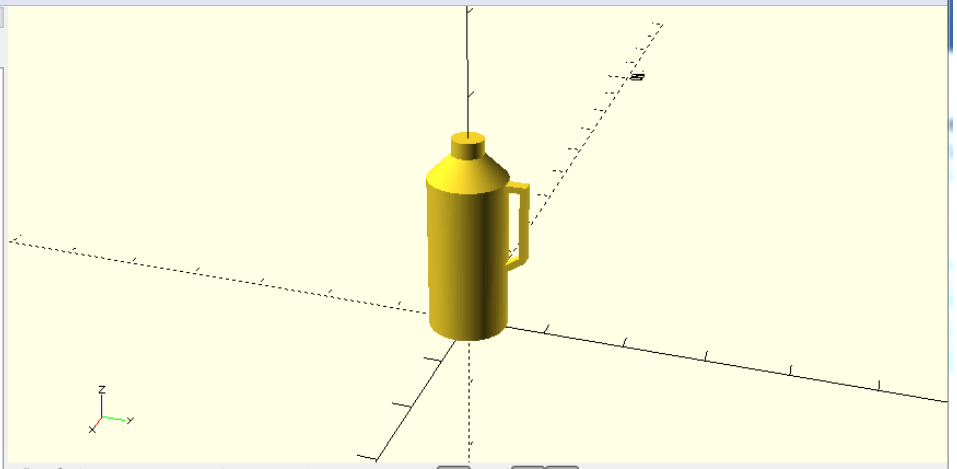
对象类型
自动栅格
长方体
圆锥体
球体
几何球体
圆柱体
管状体
圆环
四棱锥
茶壶
平面
名称和颜色
0 / 100
未选定任
单击或单击并拖动以选择对象
添加时间标记
自动关键点
设置关键点
关键点过滤器...

ex4.scad - OpenSCAD

File Edit Design View Help

Editor

```
1  $fn=100;
2  module bottle()
3  {
4      cylinder(h=20,r=5);
5  translate([0,0,20])
6  cylinder(h=3,r1=5,r2=2);
7  translate([0,0,22])
8  cylinder(h=3,r=2);
9
10 }
11
12 module ring()
13 {
14     rotate_extrude(convexity=10)
15     translate([5,0,0])
16     circle(0.2);
17 }
18
19 module hand()
20 {
21     translate([0,0,-0.75])
22     linear_extrude(1.5)
23     difference()
24     {
25     polygon(points=[[0,0],[3,0],[3,-10],[0,-12]],
26     paths=[[0,1,2,3,0]]);
27     polygon(points=[[0,-0.8],[2.2,-0.8],[2.2,-9.5],[0,-11]],
28     paths=[[0,1,2,3,0]]);
29     }
30 }
31
32 bottle();
33 translate([0,4.5,20-0.2])
34 rotate([90,0,90])
35 hand();
36
37
38
```



Console

```
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 7
Geometry cache size in bytes: 51120
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized CSG tree has 4 elements
Compile and preview finished.
Total rendering time: 0 hours, 0 minutes, 0 seconds
```

Viewport: translate = [0.00 1.25 12.50], rotate = [63.40 0.00 108.30], distance = 140.47

OpenSCAD 2015.03

什么是OpenSCAD

- Open Solid Computer-Aided Design
  - 开源实体3D计算机辅助设计
- 功能
  - 构建实体CAD模型
- 特点
  - 安装文件小巧，方便携带
  - 操作简单，极易入门
  - 非交互（脚本代码方式）

三大技术

1. 交互技术：
   边构思、边打样、边修改，边显示

2. 图形变换
   平移、旋转、缩放、镜面等

3. 实体造型
   CSG

基本几何体

2D：

圆 circle(r=radius)
正方形 square(size,center)
长方形 square([width,height],center)
多边形 polygon([points],[paths])

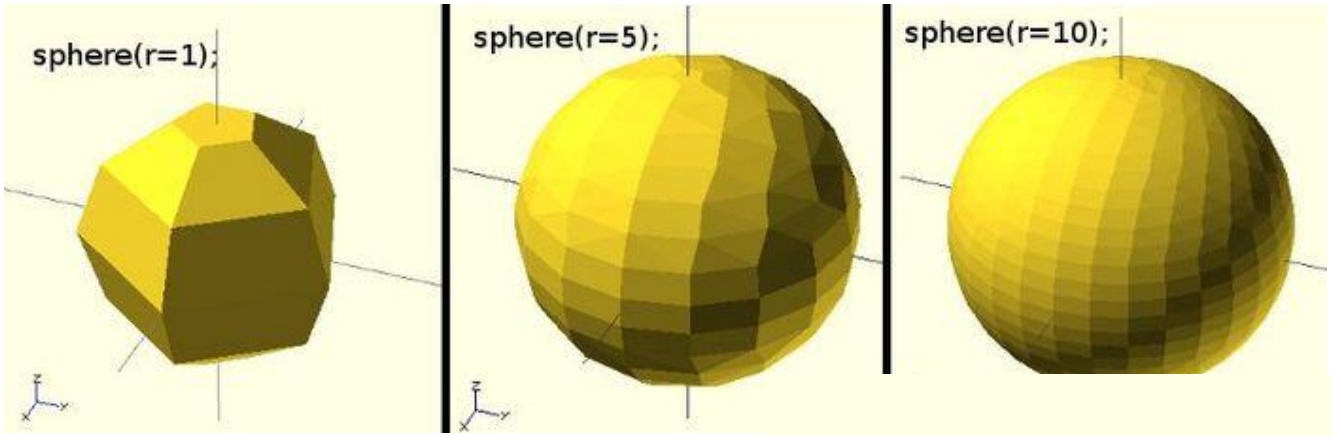
ex0

3D：

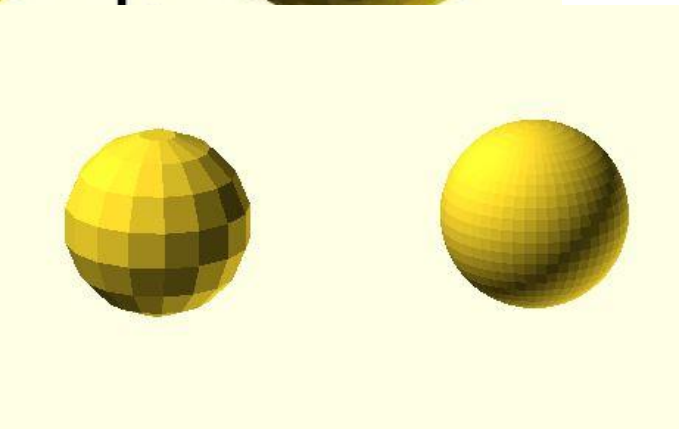
正方体 cube(size, center)
长方体 cube([width,depth,height], center)
球 sphere(r=radius)
椭球 resize([x,y,z]) sphere(r=radius)；
圆柱 cylinder(h,r,center)
圆台 cylinder(h,r1,r2,center) r2=0表示圆锥
多面体 polyhedron([points], [triangles], convexity)

曲面几何体

OpenSCAD中的球是一个多面体，具体形状取决于球的半径和其他参数的设置：$fa, $fs and $fn（耗时的原因之一）




```
sphere(5);
translate([20,0,0])
sphere(5,$fn=50);
```



变换

平移： translate([x,y,z])
旋转： rotate([x,y,z])
比例缩放： scale([x,y,z])
更改大小： resize([x,y,z],auto)
镜面： mirror([x,y,z])
颜色： color("colorname")
……

```
rotate([0, 0, 90])
color("green")
cube([10, 20, 30]);
```

布尔运算

三大布尔运算（耗时原因之一）

联合：union()

求差：difference()

求交：intersection()

CSG

2D->3D

线性挤出

linear_extrude(height,center,convexity,twist,slices)

旋转挤出

rotate_extrude(convexity)

ex2

其他命令

循环：
for (i = [start:end]) { … }
for (i = [start:step:end]) { … }
for (i = […,…,…]) { … }

条件
if (…) { … }

模块
module name(…) { … }

子对象
children([idx])

module

载入文件
import("….stl")

包含文件
include <….scad>

其他运算 （变换）
offset(r|delta,chamfer)
hull()
minkowski()

数学函数
sin()、acos()、sqrt()…

动画演示

时间参数：$t

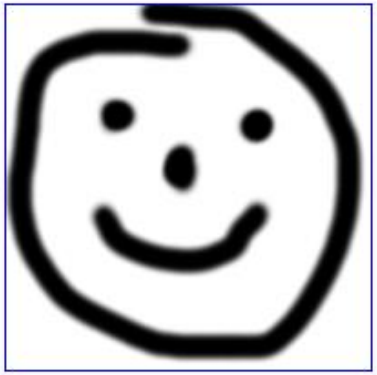
maze

animation

图片导出

```
surface(file = "smiley.png", center = true);

surface(file = "smiley.png", center = true, invert = true);
```



OpenSCAD CheatSheet v2015.03

Syntax

var = value;
module name(…) { … }
name();
function name(…) = …
name();
include <….scad>
use <….scad>

2D

circle(radius | d=diameter)
square(size,center)
square([width,height],center)
polygon([points])
polygon([points],[paths])
text(t, size, font,
halign, valign, spacing,
direction, language, script)

3D

sphere(radius | d=diameter)
cube(size, center)
cube([width,depth,height], center)
cylinder(h,r|d,center)
cylinder(h,r1|d1,r2|d2,center)
polyhedron(points, triangles, convexity)

Transformations

translate([x,y,z])
rotate([x,y,z])
scale([x,y,z])
resize([x,y,z],auto)
mirror([x,y,z])
multmatrix(m)
color("colorname")
color([r,g,b,a])
offset(r|delta,chamfer)
hull()
minkowski()

Boolean operations

union()
difference()
intersection()

Modifier Characters

* disable
! show only
highlight / debug
% transparent / background

Mathematical

abs
sign
sin
cos
tan
acos
asin
atan
atan2
floor
round
ceil
ln
len
let
log
pow
sqrt
exp
rands
min
max

Functions

concat
lookup
str
chr
search
version
version_num
norm
cross
parent_module(idx)

Other

echo(…)
for (i = [start:end]) { … }
for (i = [start:step:end]) { … }
for (i = […,…,…]) { … }
intersection_for(i = [start:end]) { … }
intersection_for(i = [start:step:end]) { … }
intersection_for(i = […,…,…]) { … }
if (…) { … }
~~assign (…) { … }~~
import("….stl")
linear_extrude(height,center,convexity,twist,slices)
rotate_extrude(angle,convexity)
surface(file = "….dat",center,convexity)
projection(cut)
render(convexity)
children([idx])

List Comprehensions

Generate [for (i = *range|list*) i]
Conditions [for (i = …) if (condition(i)) i]
Assignments [for (i = …) let (assignments) a]

Special variables

$fa minimum angle
$fs minimum size
$fn number of fragments
$t animation step
$vpr viewport rotation angles in degrees
$vpt viewport translation
$vpd viewport camera distance
$children number of module children

Links: Official website | Code | Issues | Manual | MCAD library | Forum | Other links

Edit me on GitHub!
By Peter Uithoven @ Fablab Amersfoort (CC-BY)

展示

zip

dice

chair

谢　谢