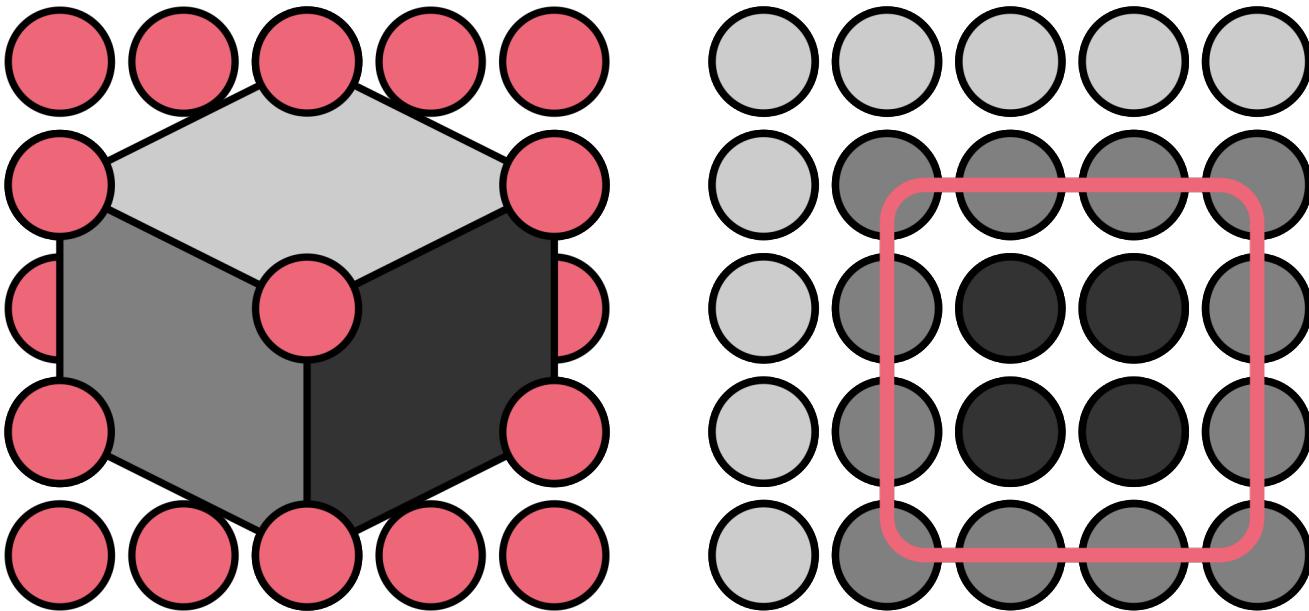
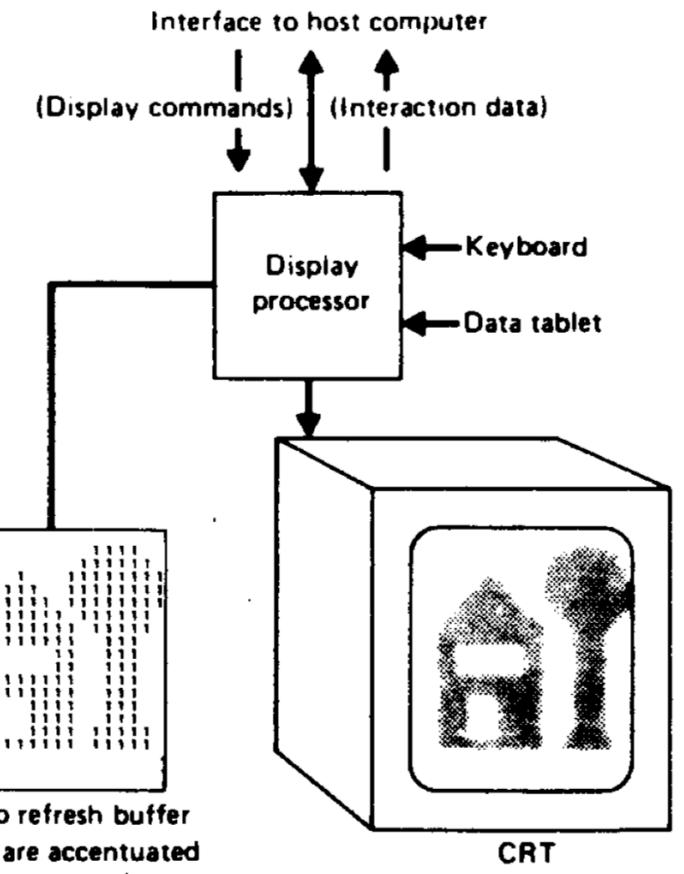
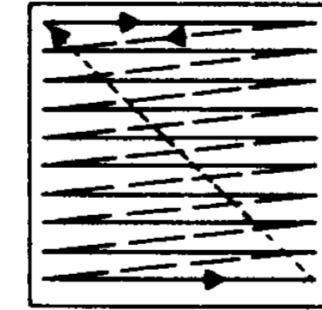
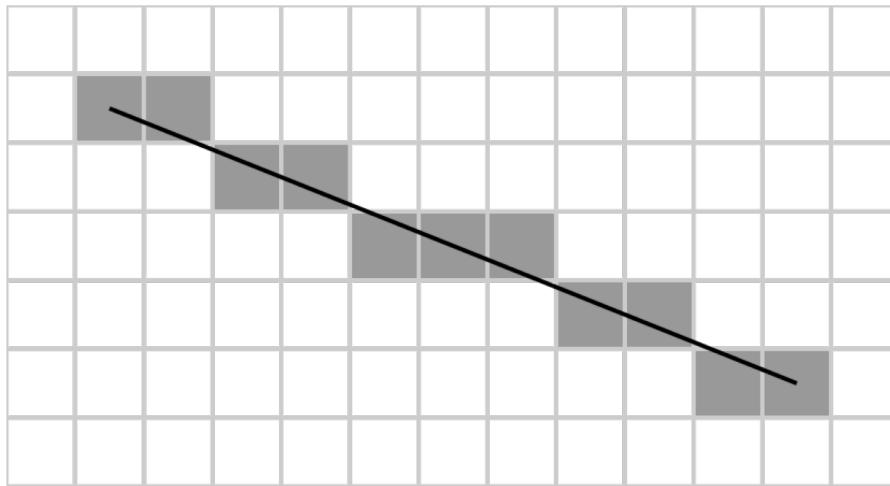
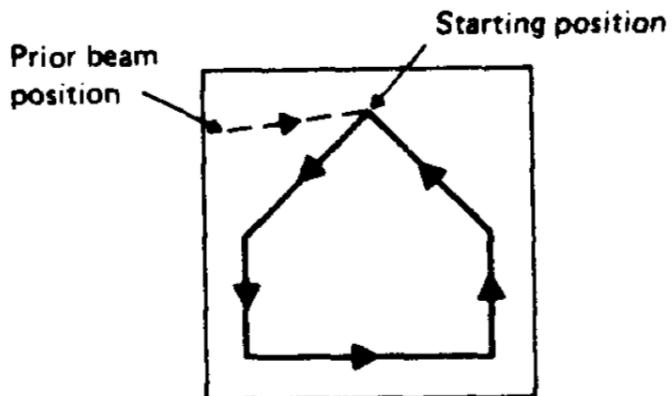


On Full and
Empty Space



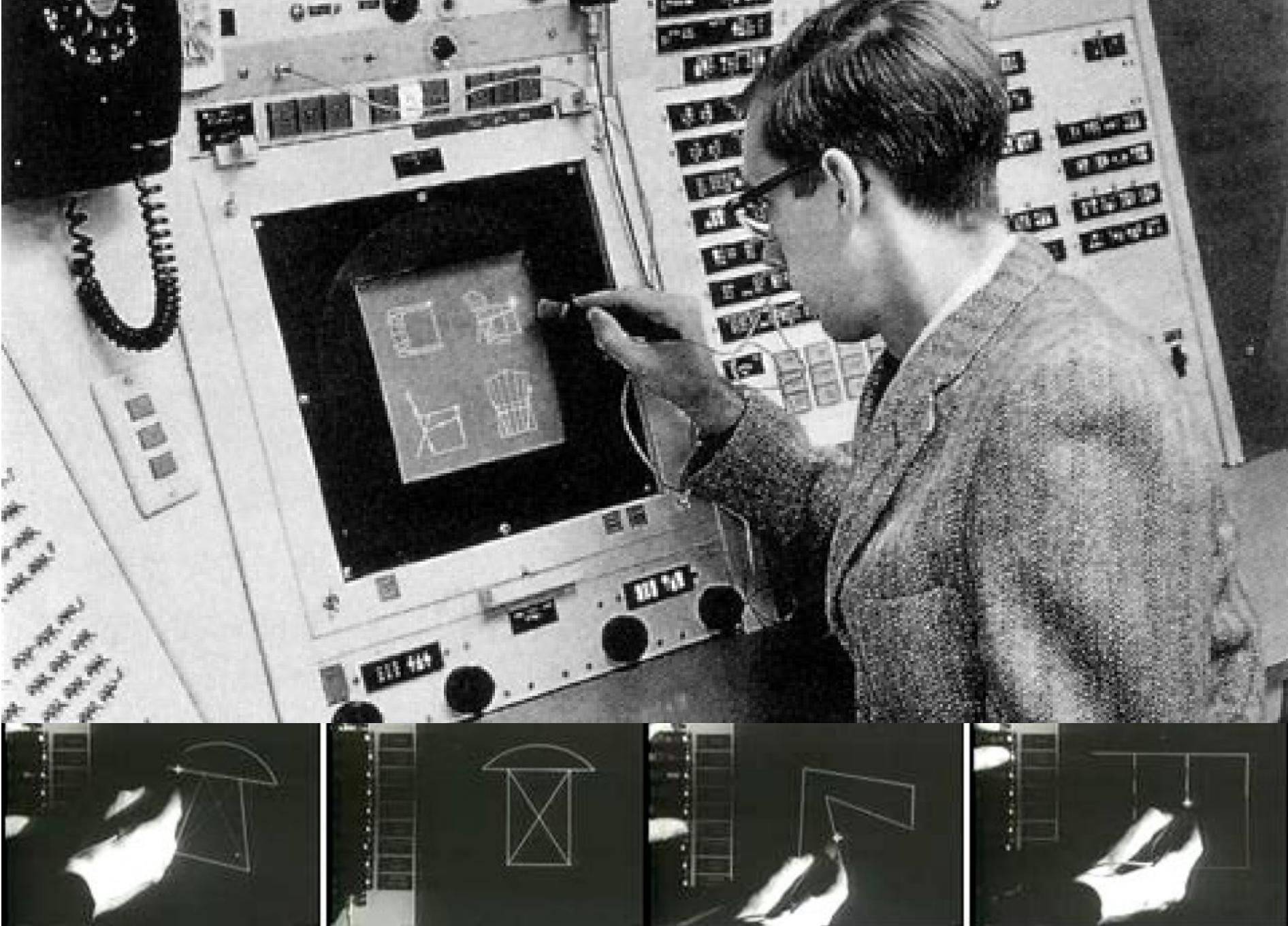
Display Technology

Andries van Dam, 1983
An Overview of Interactive Computer Graphics



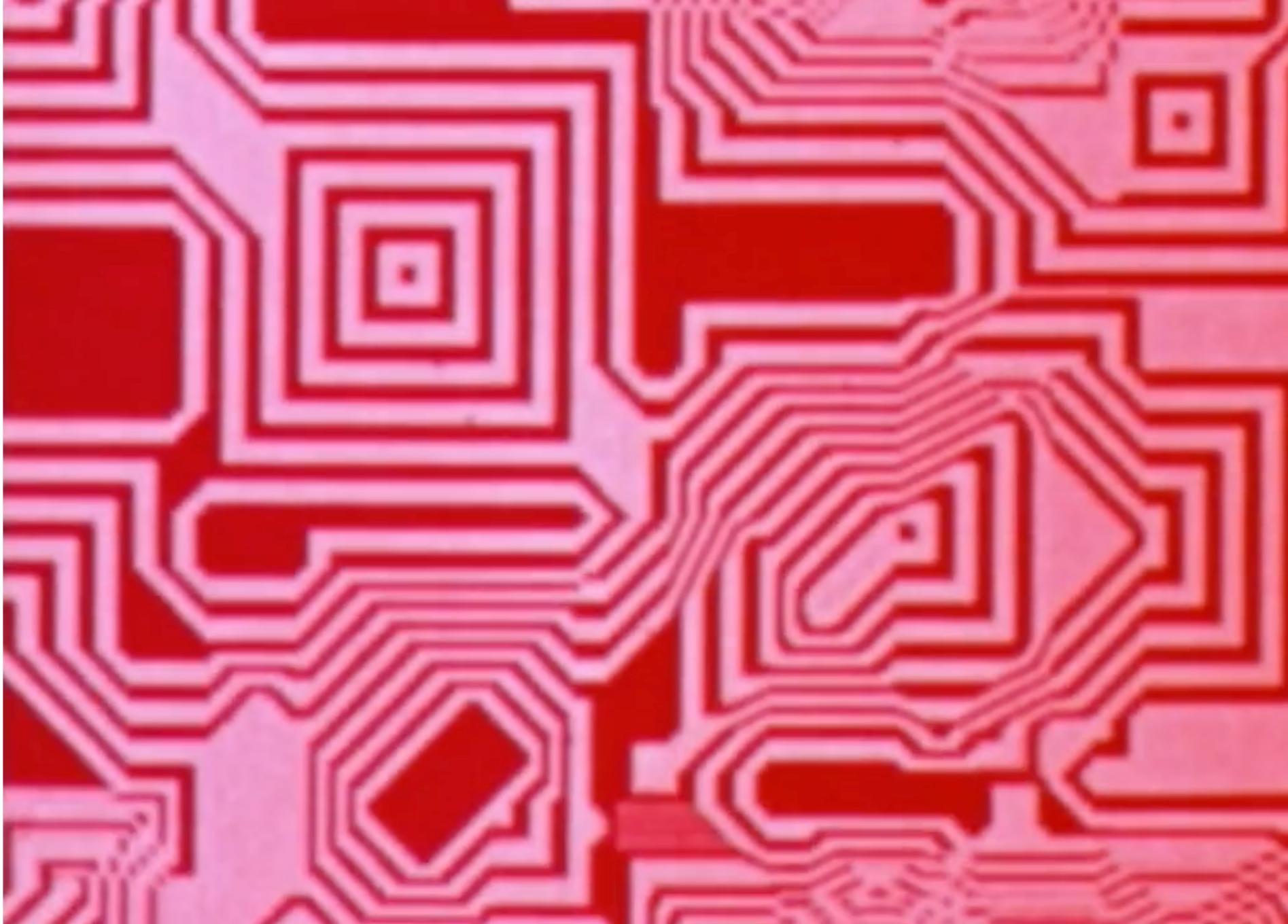
Cathode Ray Tubes

Ivan Sutherland, 1963
Sketchpad



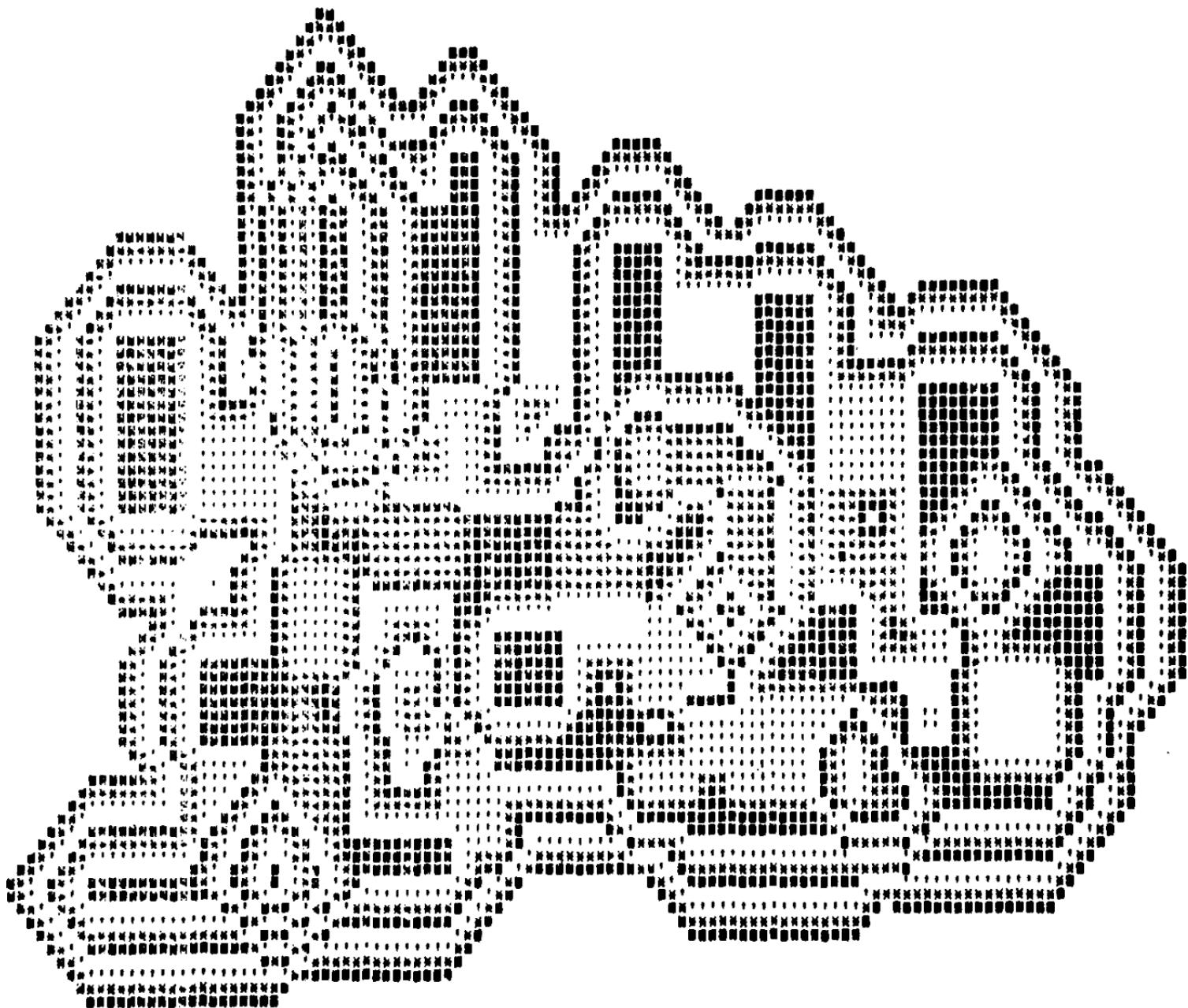
Pixillation

Pixillation
Lillian F. Schwartz, 1970

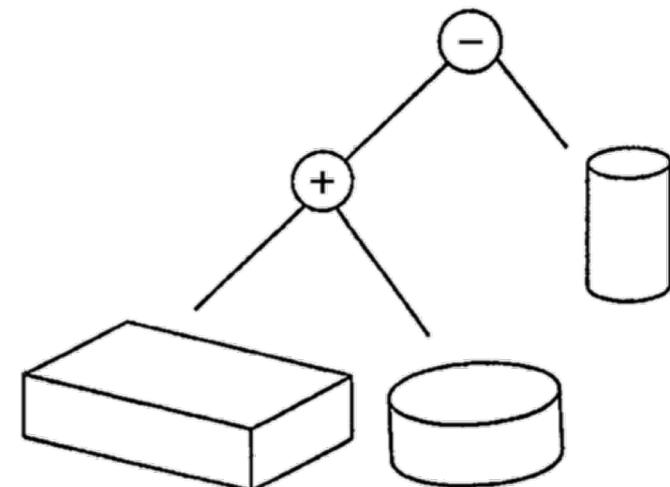
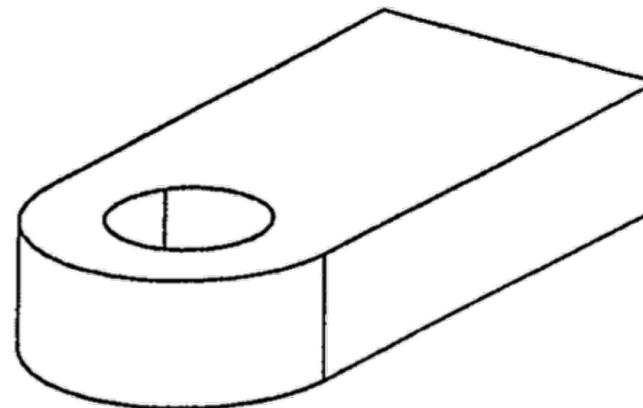
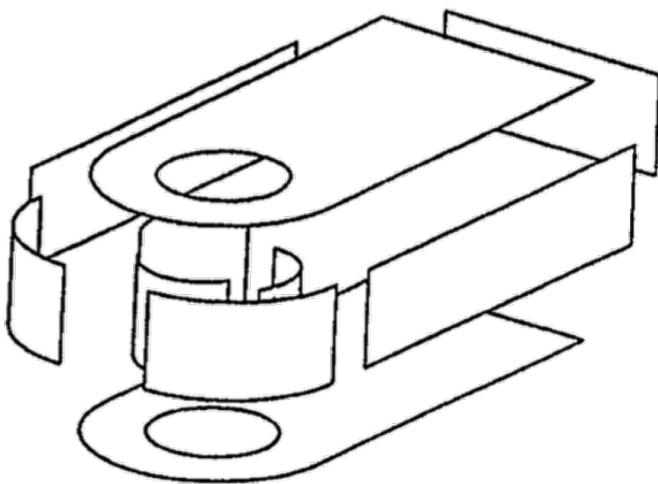


Mini-Explor

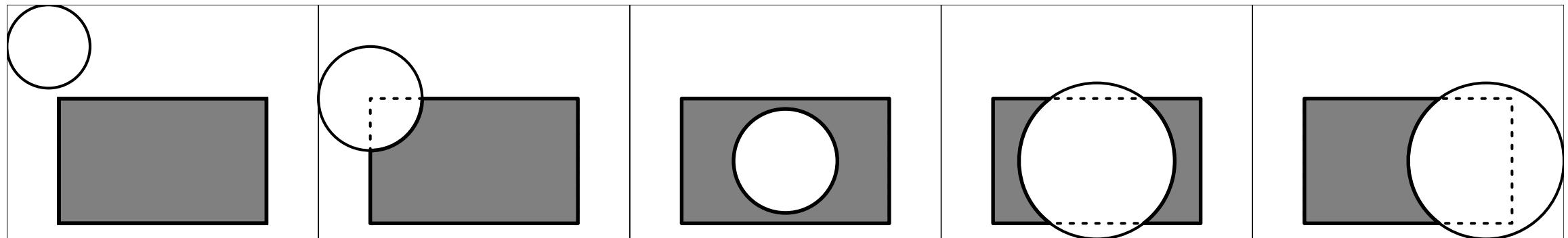
Knowlton, Ken. 1975. "MINI-EXPLOR - A FORTRAN-Coded Version of the EXPLOR Language for Mini (and Larger) Computers." ACM SIGGRAPH Computer Graphics 9 (3): 31–42.



Surface versus Solid Modelling



Boolean Operations



Signed Distance Functions

$$f(x,y) = ((cx-x)^2 + (cy-y)^2) - r$$

3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.0	4.9	5.8
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.6	4.5	5.5
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-1.8	-1.2	0.4	0.5	1.4	2.3	3.3	4.2	5.2
1.1	0.1	-0.8	-1.8	-2.6	-3.0	-2.6	-1.8	0.8	0.1	1.1	2.1	3.1	4.1	5.1
1.0	0.0	-1.0	-2.0	-3.0	-4.0	-3.0	-2.0	-1.0	0.0	1.0	2.0	3.0	4.0	5.0
1.1	0.1	0.8	-1.8	-2.6	-3.0	-2.6	-1.8	-0.8	0.1	1.0	1.0	1.0	1.0	2.0
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-1.8	-1.2	0.4	0.5	1.4	2.0	2.0	2.0	2.0
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.0	3.6	4.5
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.1	4.9	5.8
3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
3.8	3.2	2.7	2.3	2.1	2.0	2.1	2.3	2.7	3.2	3.8	4.5	5.2	6.0	6.8
4.6	4.1	3.6	3.3	3.1	3.0	3.1	3.3	3.6	4.1	4.6	5.2	5.9	6.6	7.4
5.4	4.9	4.5	4.2	4.1	4.1	4.2	4.5	4.9	5.4	6.0	6.6	7.3	8.0	
6.3	5.8	5.5	5.2	5.1	5.0	5.1	5.2	5.5	5.8	6.3	6.8	7.4	8.0	8.7

$$u(x,y) = \min(f(x,y), g(x,y))$$

3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.0	4.0	4.0
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.0	3.0	3.0
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-1.8	-1.2	0.4	0.5	1.4	2.0	2.0	2.0	2.0
1.1	0.1	-0.8	-1.8	-2.6	-3.0	-2.6	-1.8	-0.8	0.1	1.0	1.0	1.0	1.0	2.0
1.0	0.0	-1.0	-2.0	-3.0	-4.0	-3.0	-2.0	-1.0	0.0	0.0	0.0	0.0	0.0	2.0
1.1	0.1	0.8	-1.8	-2.6	-3.0	-2.6	-1.8	-1.0	-1.0	-1.0	0.0	1.0	1.0	2.0
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-2.0	-2.0	-2.0	-1.0	0.0	1.0	2.0	2.0	2.0
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.0	3.6	4.5
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.1	4.9	5.8
3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
3.8	3.2	2.7	2.3	2.1	2.0	2.1	2.3	2.7	3.2	3.8	4.5	5.2	6.0	6.8
4.6	4.1	3.6	3.3	3.1	3.0	3.1	3.3	3.6	4.1	4.6	5.2	5.9	6.6	7.4
5.4	4.9	4.5	4.2	4.1	4.1	4.2	4.5	4.9	5.4	6.0	6.6	7.3	8.0	
6.3	5.8	5.5	5.2	5.1	5.0	5.1	5.2	5.5	5.8	6.3	6.8	7.4	8.0	8.7

$$s1(x,y) = \max(f(x,y), -g(x,y))$$

3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.1	4.9	5.8
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.6	4.5	5.5
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-1.8	-1.2	0.4	0.5	1.4	2.3	3.3	4.2	5.2
1.1	0.1	-0.8	-1.8	-2.6	-3.0	-2.6	-1.8	-0.8	0.1	1.1	2.1	3.1	4.1	5.1
1.0	0.0	-1.0	-2.0	-3.0	-4.0	-3.0	-2.0	-1.0	0.0	0.0	0.0	0.0	0.0	2.0
1.1	0.1	-0.8	-1.8	-2.6	-3.0	-2.6	-1.8	-1.0	-1.0	-1.0	0.0	1.0	1.0	2.0
1.4	0.5	-0.4	-1.2	-1.8	-2.0	-2.0	-2.0	-2.0	-1.0	0.0	1.0	2.0	2.0	2.0
1.8	1.0	0.2	-0.4	-0.8	-1.0	-0.8	-0.4	0.2	1.0	1.8	2.7	3.6	4.5	5.5
2.4	1.7	1.0	0.5	0.1	0.0	0.1	0.5	1.0	1.7	2.4	3.2	4.1	4.9	5.8
3.1	2.4	1.8	1.4	1.1	1.0	1.1	1.4	1.8	2.4	3.1	3.8	4.6	5.4	6.3
3.8	3.2	2.7	2.3	2.1	2.0	2.1	2.3	2.7	3.2	3.8	4.5	5.2	6.0	6.8
4.6	4.1	3.6	3.3	3.1	3.0	3.1	3.3	3.6	4.1	4.6	5.2	5.9	6.6	7.4
5.4	4.9	4.5	4.2	4.1	4.1	4.2	4.5	4.9	5.4	6.0	6.6	7.3	8.0	
6.3	5.8	5.5	5.2	5.1	5.0	5.1	5.2	5.5	5.8	6.3	6.8	7.4	8.0	8.7

$$s(x,y) = \text{abs}(u(x,y)) - d/2$$

2.1	1.4	0.8	0.4	0.1	0.0	0.1	0.4	0.8	1.4	2.1	2.8	3.6	4.0	4.0
1.4	0.7	0.0	-0.5	-0.9	-1.0	-0.9	-0.5	0.0	0.7	1.4	2.2	3.0	3.0	3.0
0.8	0.0	-0.8	-0.6	-0.2	0.0	-0.2	-0.6	-0.8	0.0	1.7	2.0	2.0	2.0	2.0
0.4	-0.5	-0.6	0.2	0.8	1.0	0.8	0.2	-0.6	-0.5	0.4	1.0	1.0	1.0	1.0
0.1	-0.9	-0.2	0.8	1.6	2.0	1.6	0.8	-0.2	-0.9	0.0	0.0	0.0	0.0	1.0
0.0	-1.0	0.0	1.0	2.0	3.0	2.0	1.0	0.0	-1.0	-1.0	-1.0	-1.0	0.0	1.0
0.1	-0.9	-0.2	0.8	1.6	2.0	1.6	0.8	0.0	0.0	0.0	0.0	0.0	-1.0	0.0
0.4	-0.5	-0.6	0.2	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.8	0.0	-0.8	-0.6	-0.2	0.0	1.0	2.0	2.0	1.0	0.0	-1.0	0.0	0.0	1.0
1.4	0.7	0.0	-0.5	-1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2.1	1.4	0.8	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
2.8	20	1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
3.0	20	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3.0	20	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

$$g(x,y) = \max(\text{abs}(cx-x)-a/2, \text{abs}(cy-y)-b/2)$$

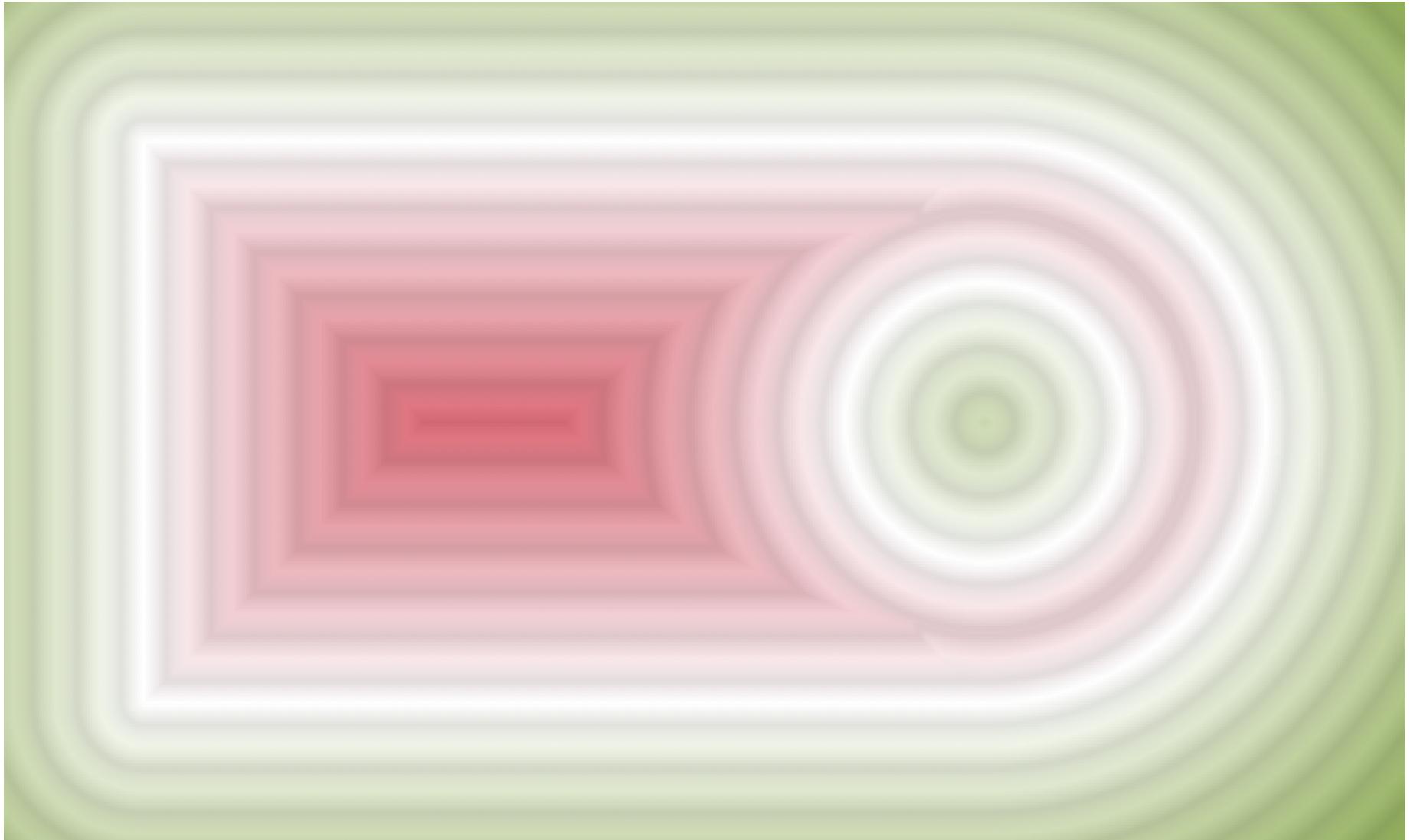
$$i(x,y) = \max(f(x,y), g(x,y))$$

$$s2(x,y) = \max(-f(x,y), g(x,y))$$

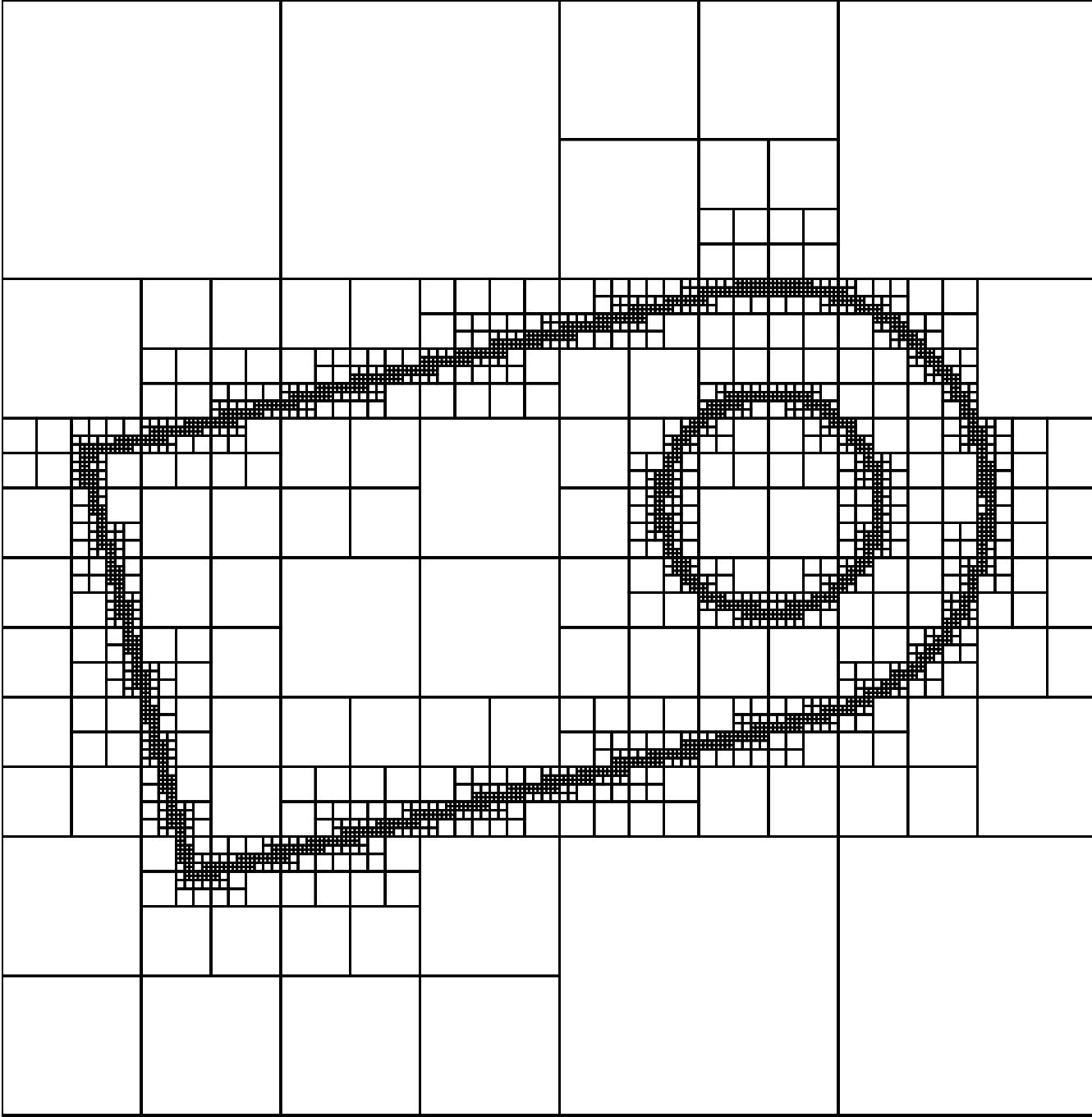
$$b(x,y) = u(x,y) - e^{2*0.25/r}$$

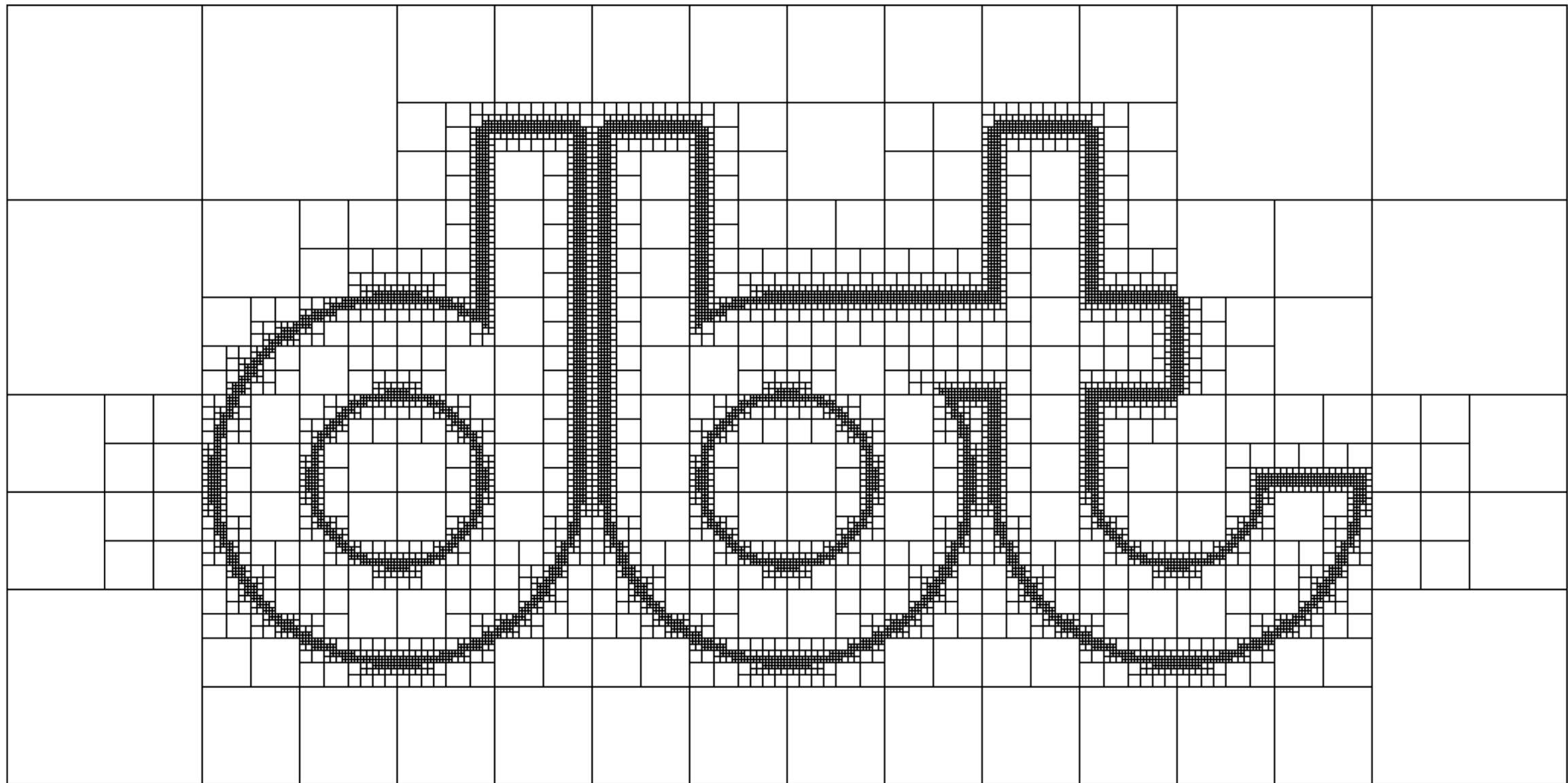
$$e = \max(r - \text{abs}(f(x,y) - g(x,y)), 0)$$

Signed Distance Function

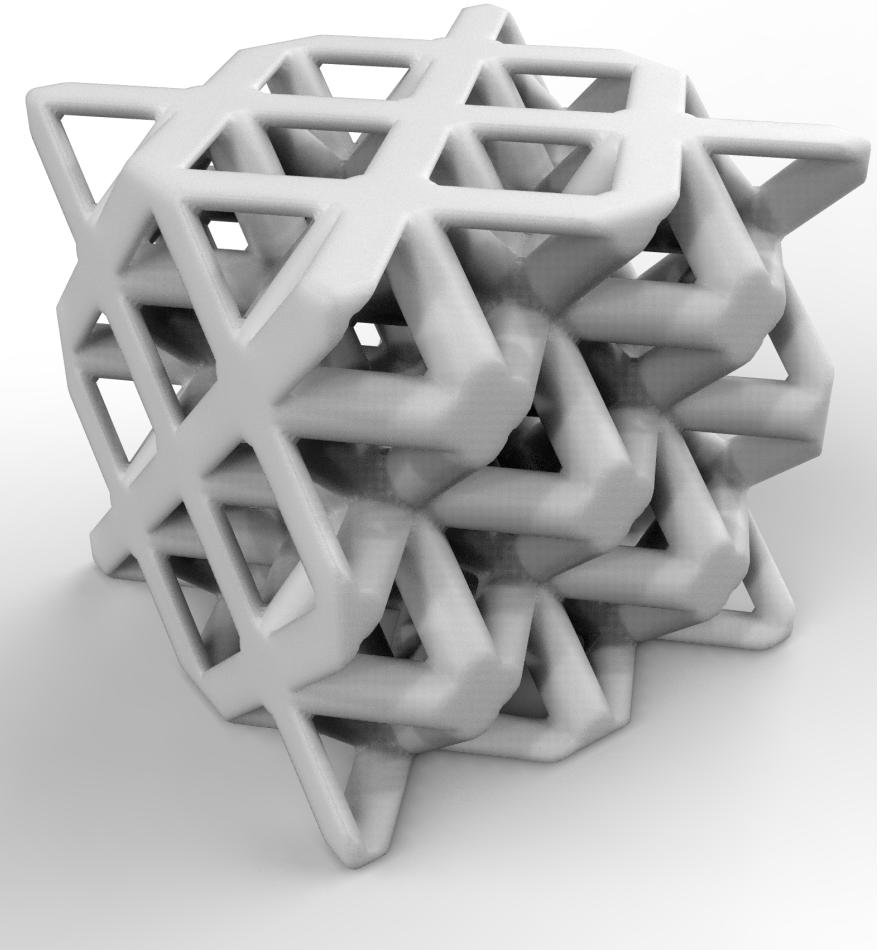
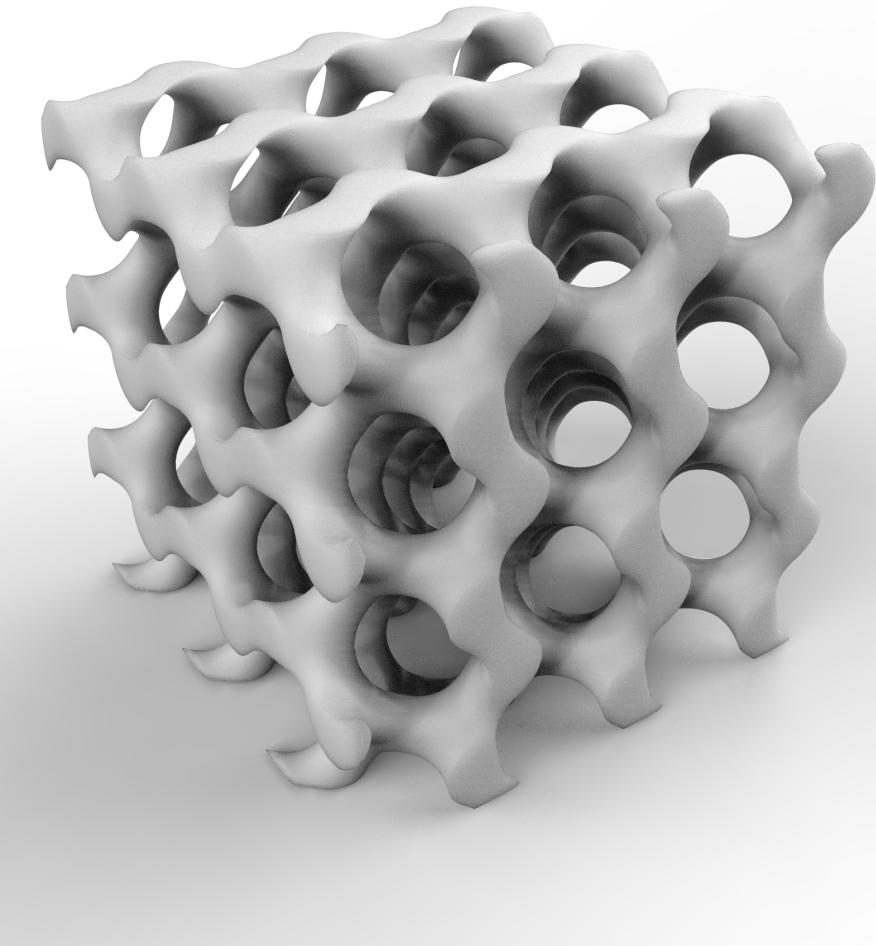


Quadtree

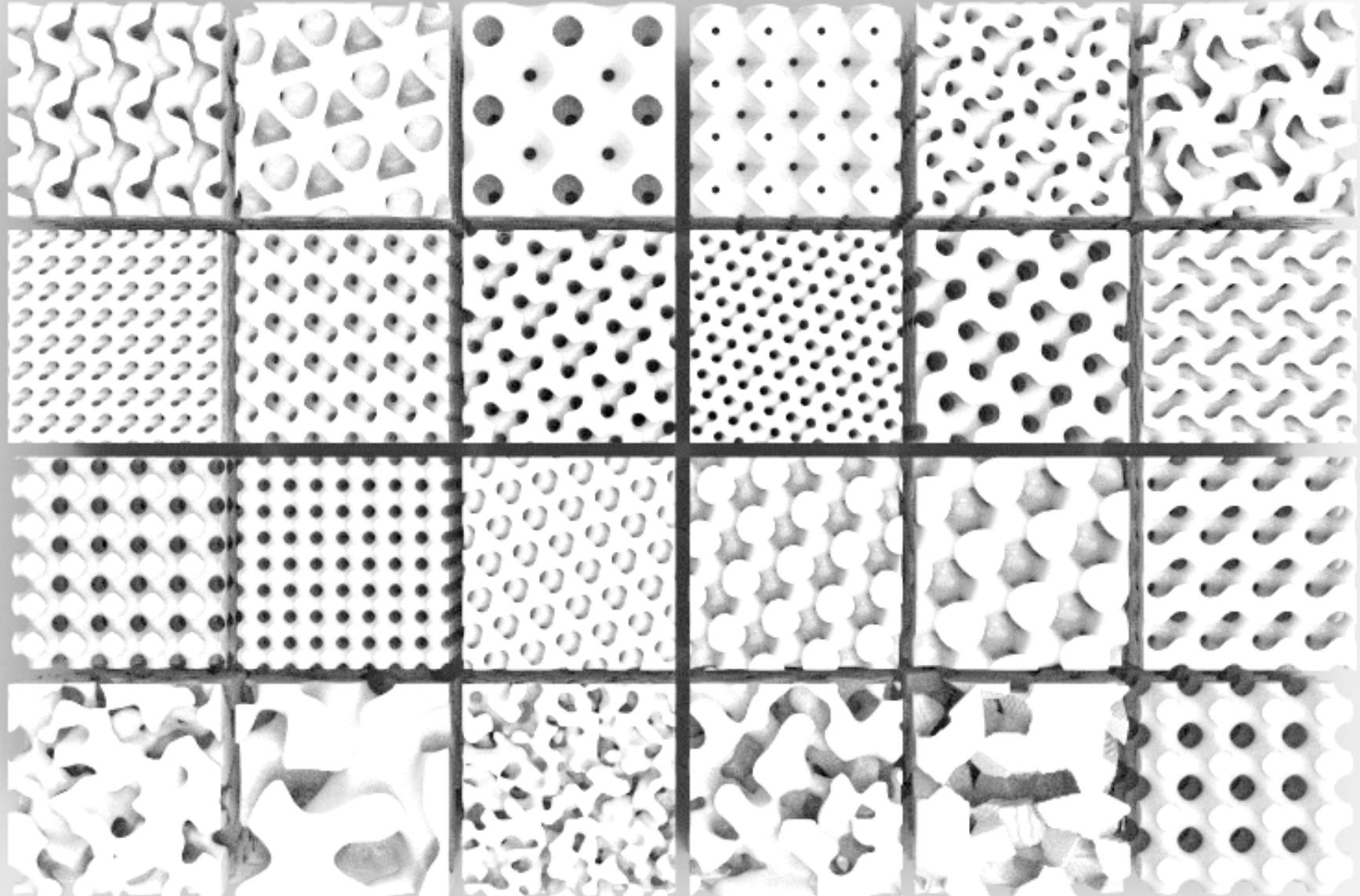




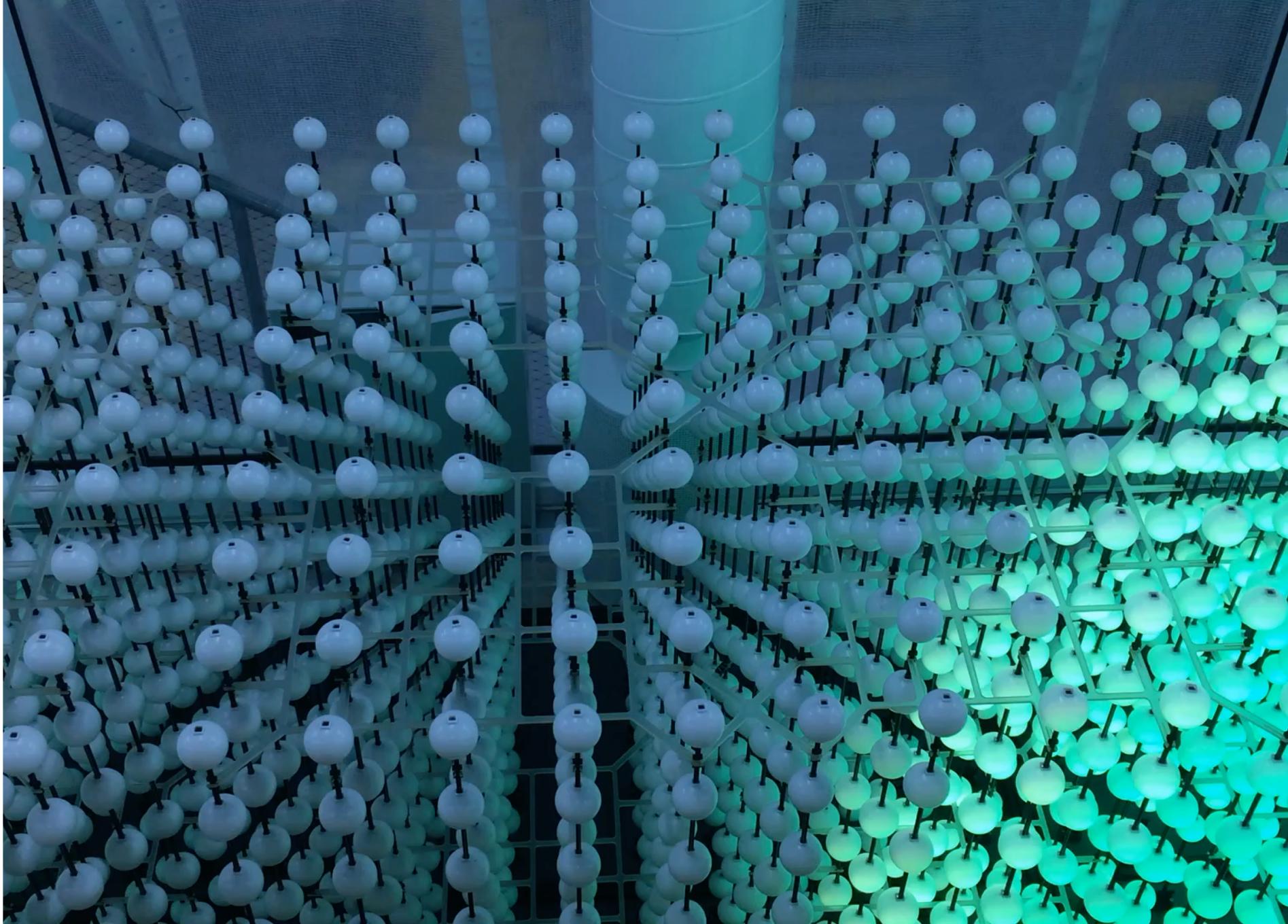
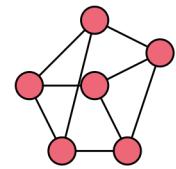
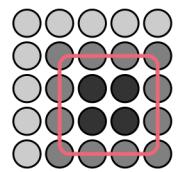
Microstructures



More TPMS and Noise

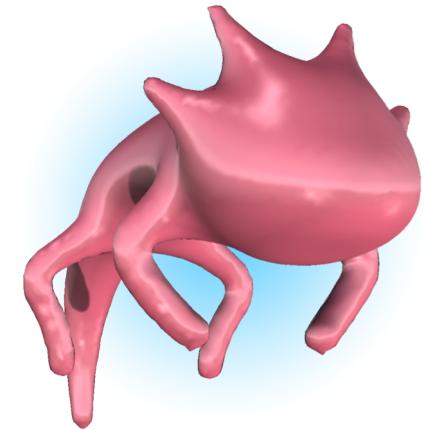


Volumetric Modelling

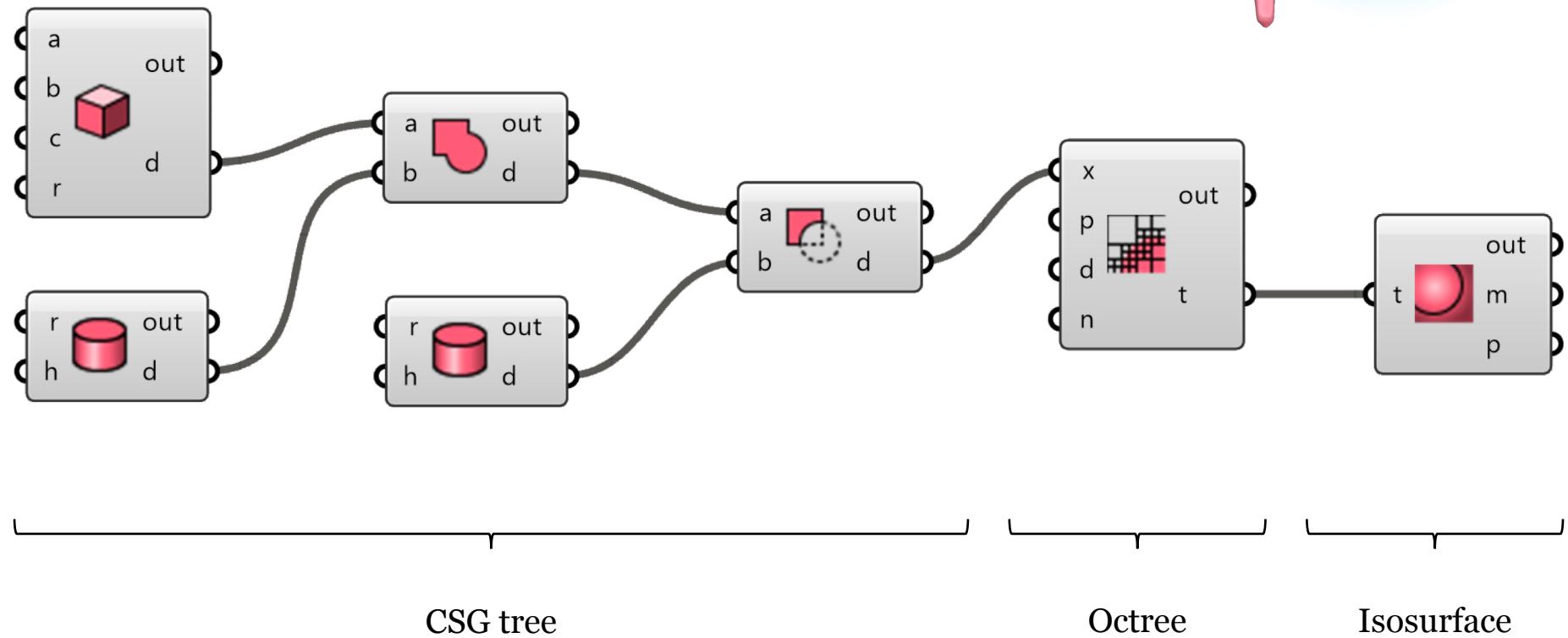


Six Branched Node

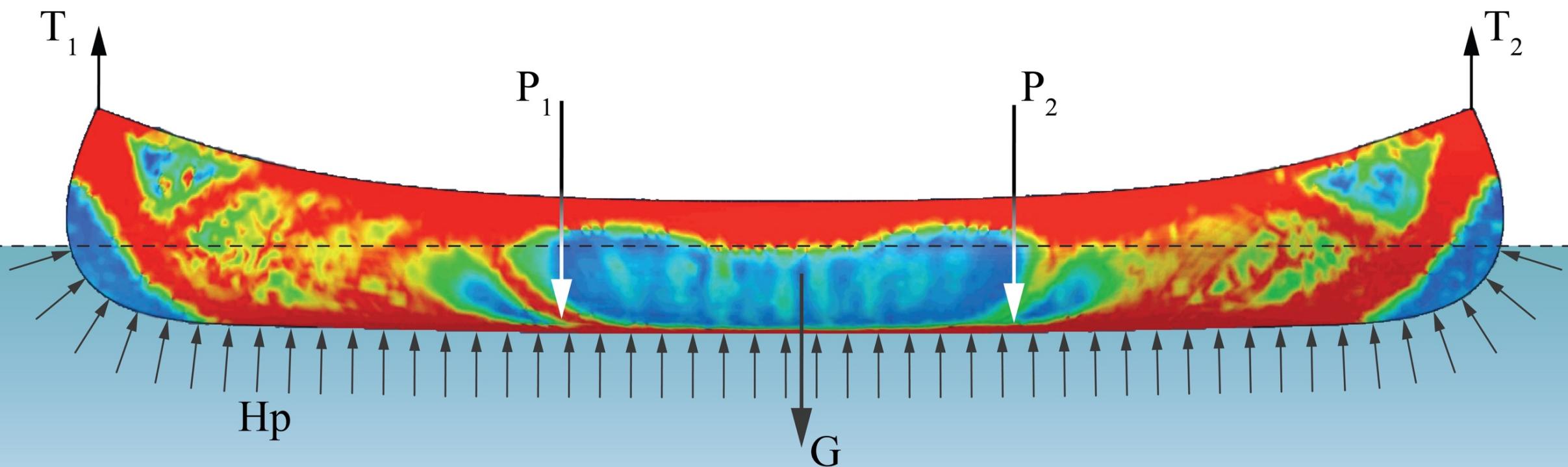




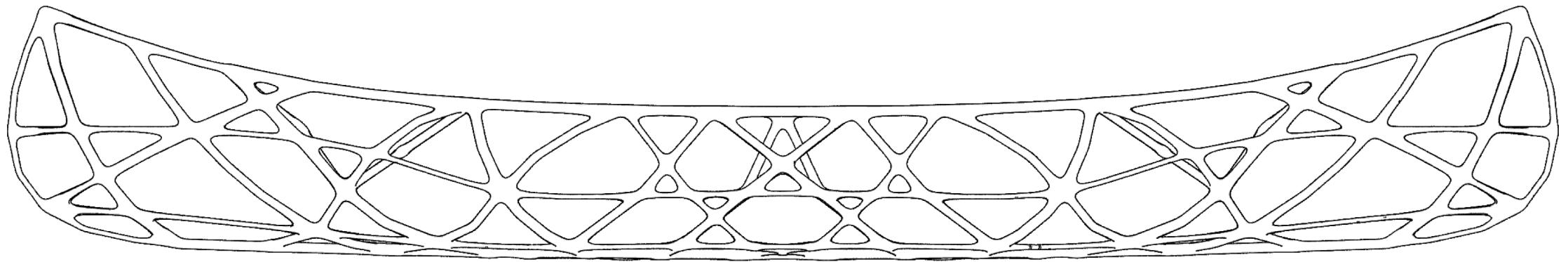
Axolotl

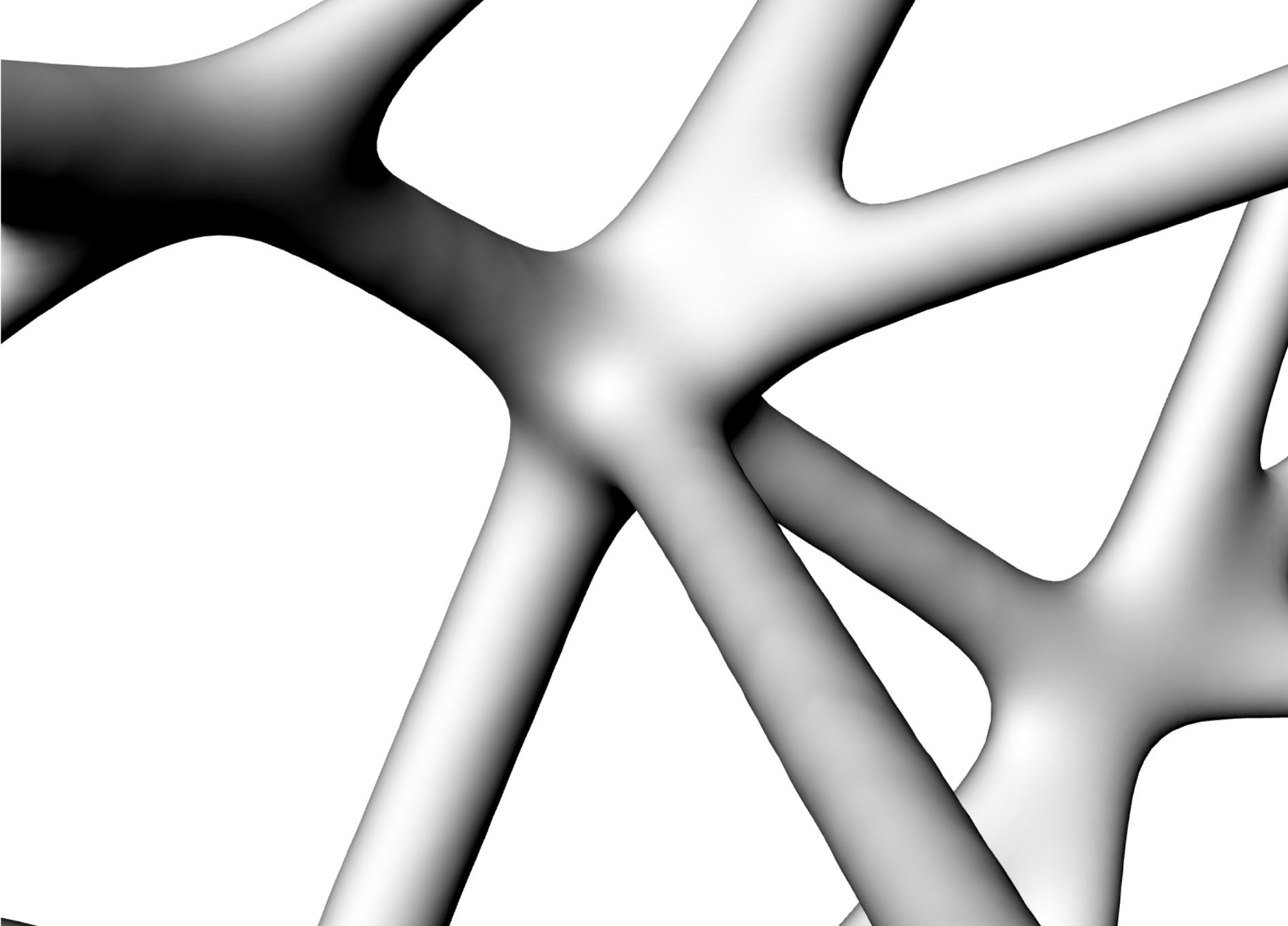


Concrete Canoe



Concrete Canoe

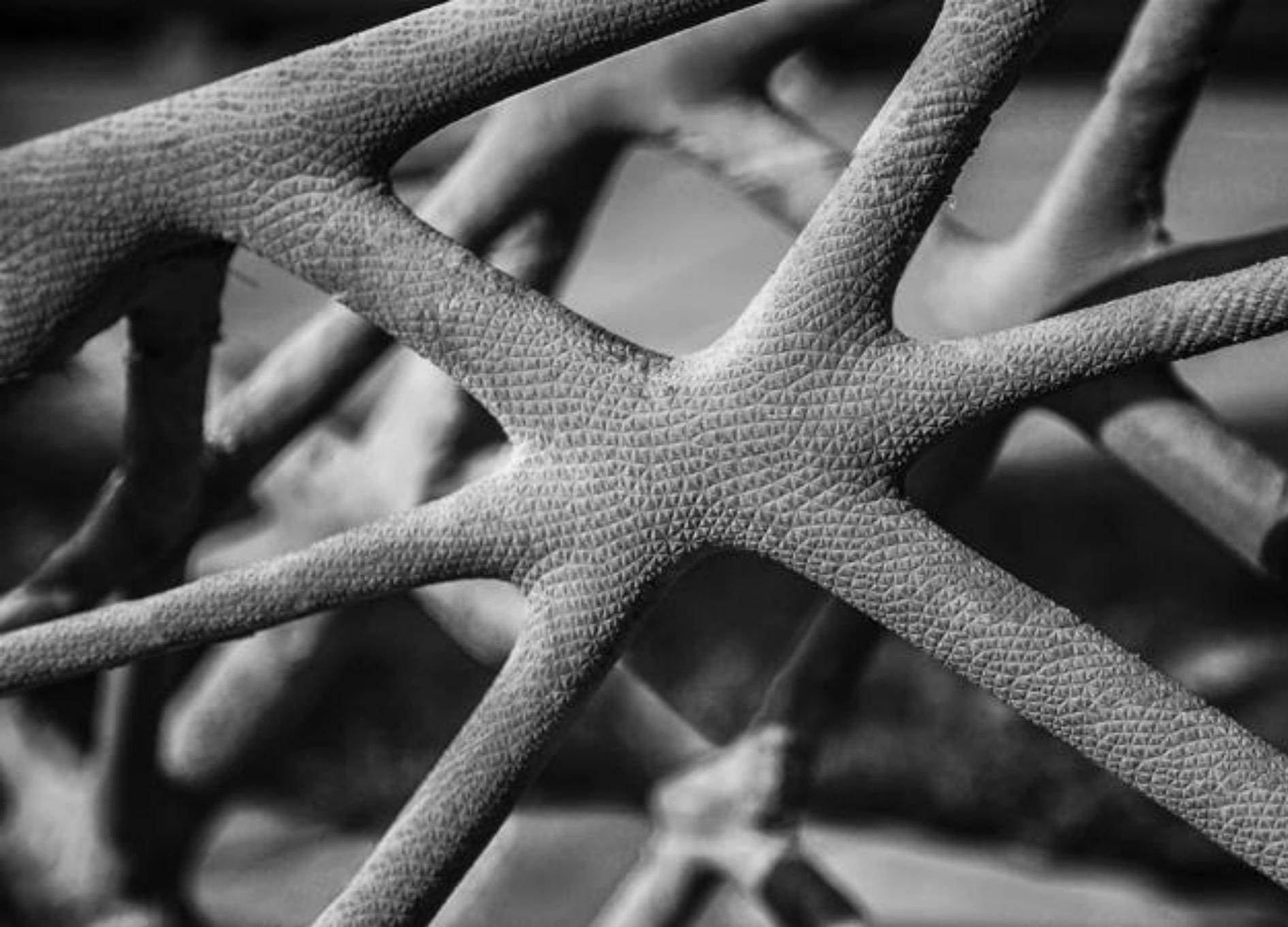


A large, abstract, grayscale image occupies the right two-thirds of the slide. It features several organic, flowing shapes in a high-contrast black-and-white style. These shapes resemble stylized leaves or perhaps a network of veins, with smooth curves and some internal shading.

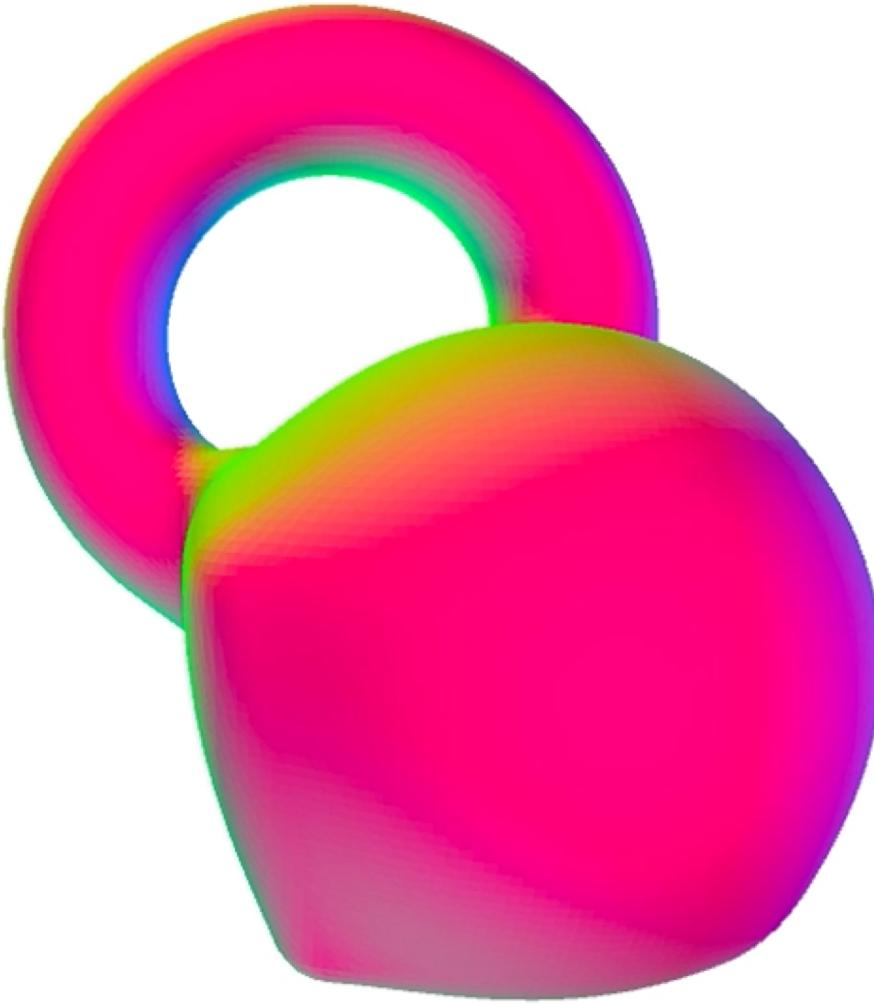
Concrete Canoe

Concrete Canoe

Photo: Andrei Jipa



Conclusion



Thank You