Implicits: Intro and Tour

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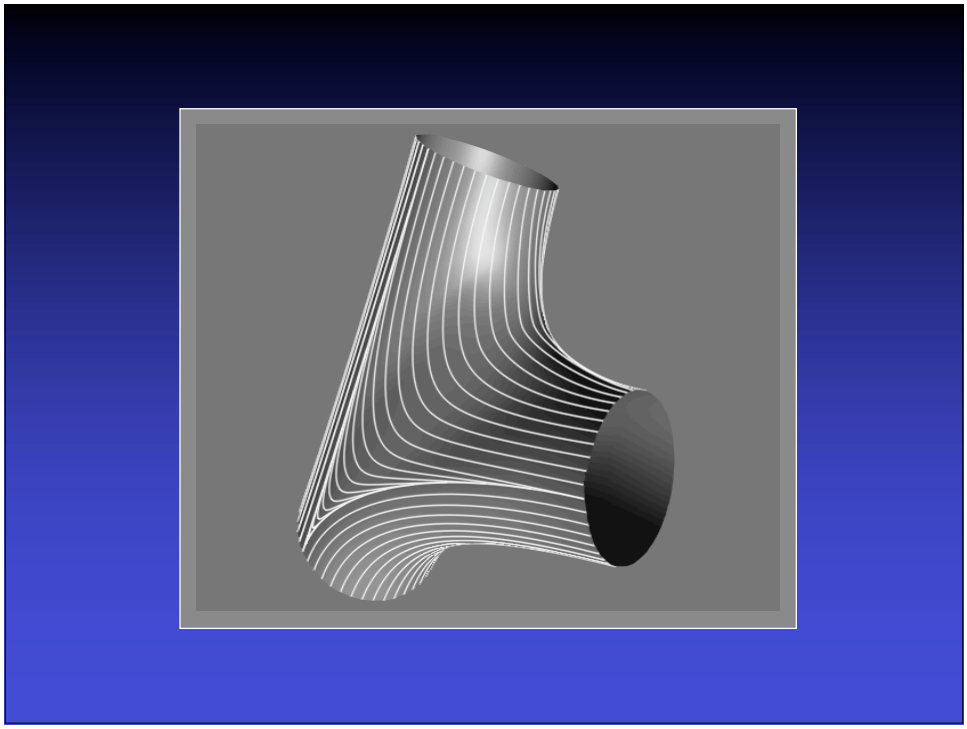
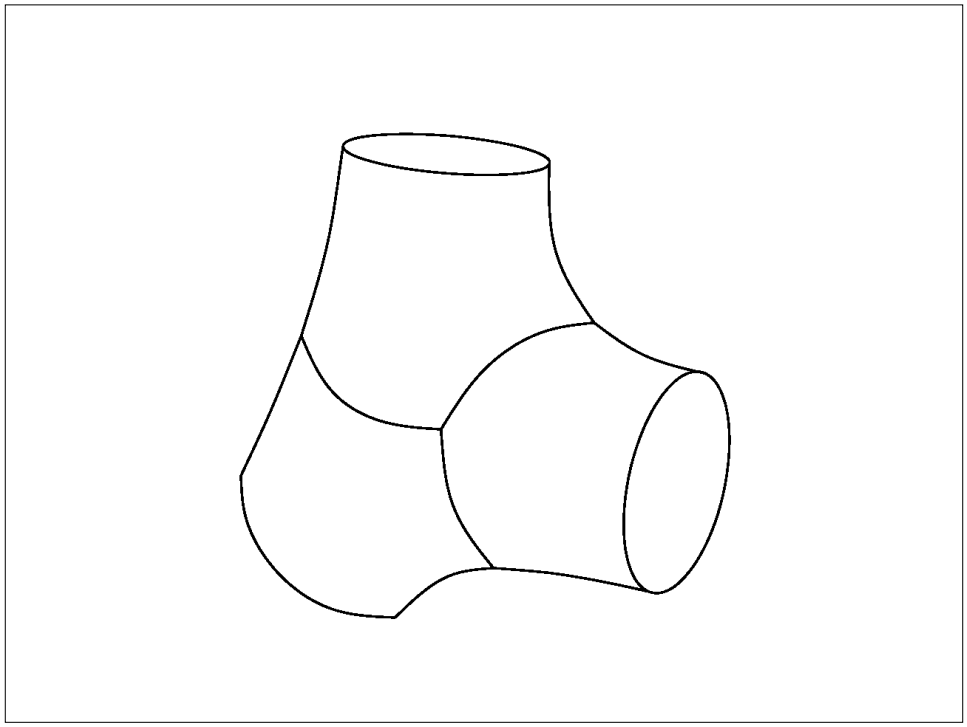
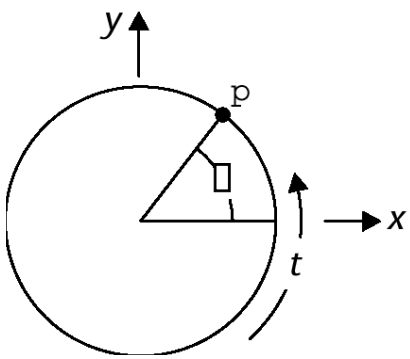






Equiangular Parametric

(transcendental trigonometric)

p = (cos(□), sin(□))

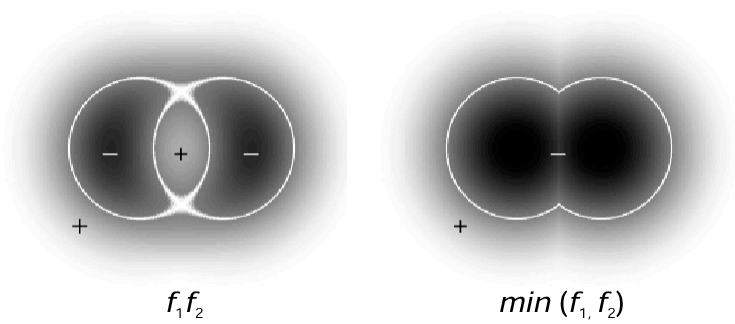
Non-Equiangular Parametric

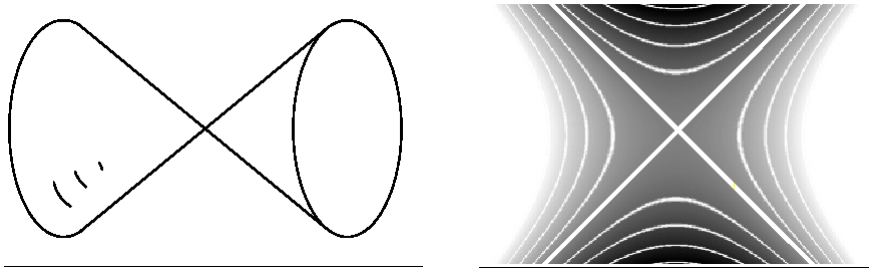
(rational trigonometric)

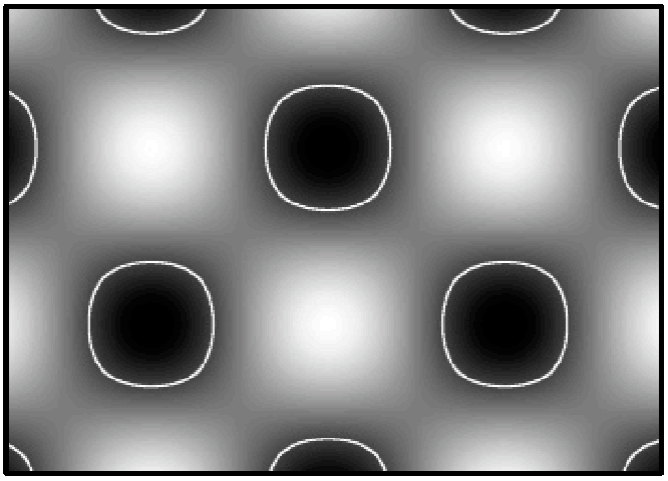
p = (±(1-t^2) / (1+t^2), 2t / (1+t^2))

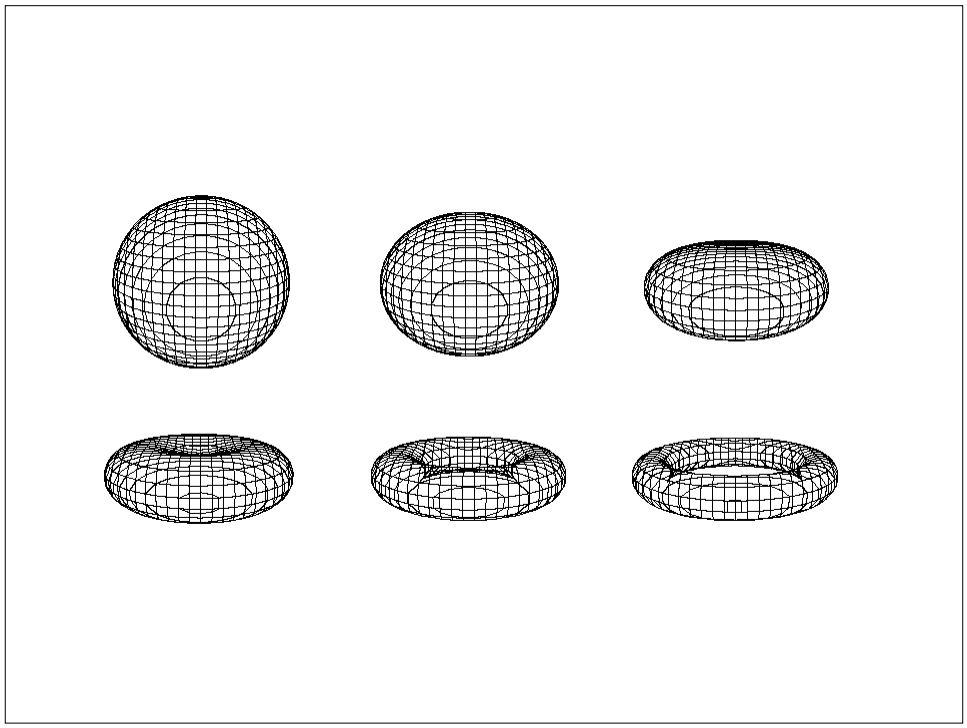
Implicit

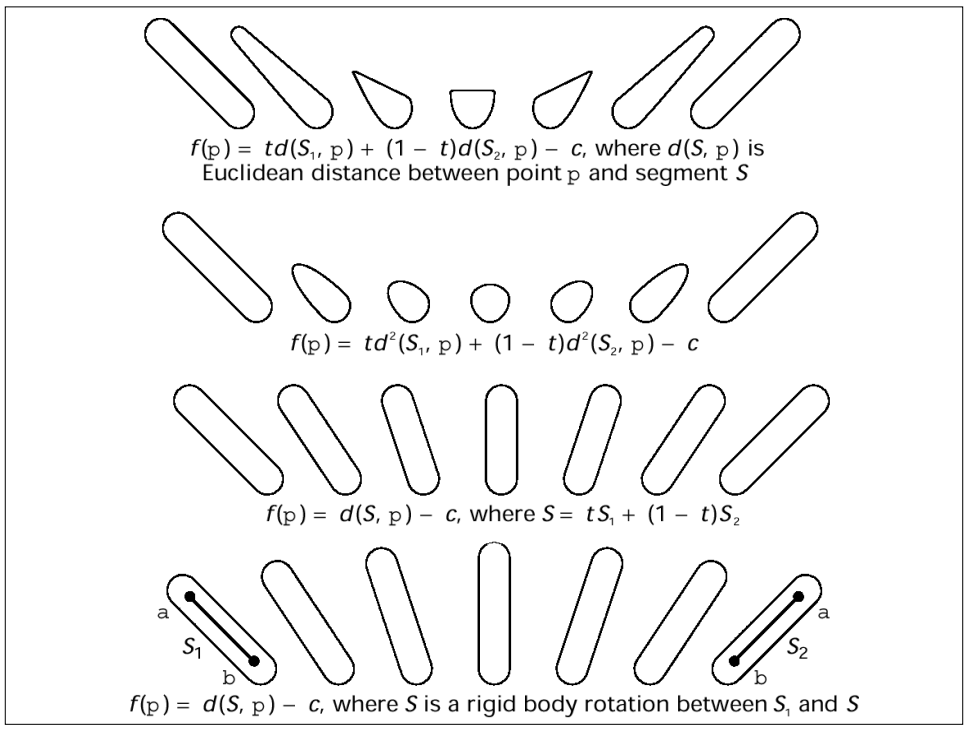
$p_x^2+p_y^2-1 = 0$

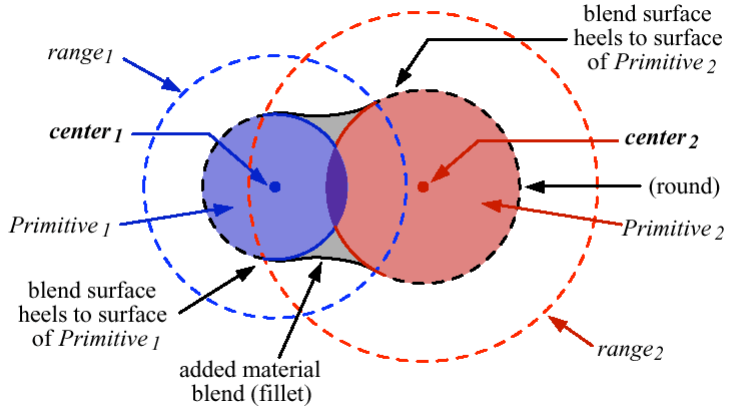


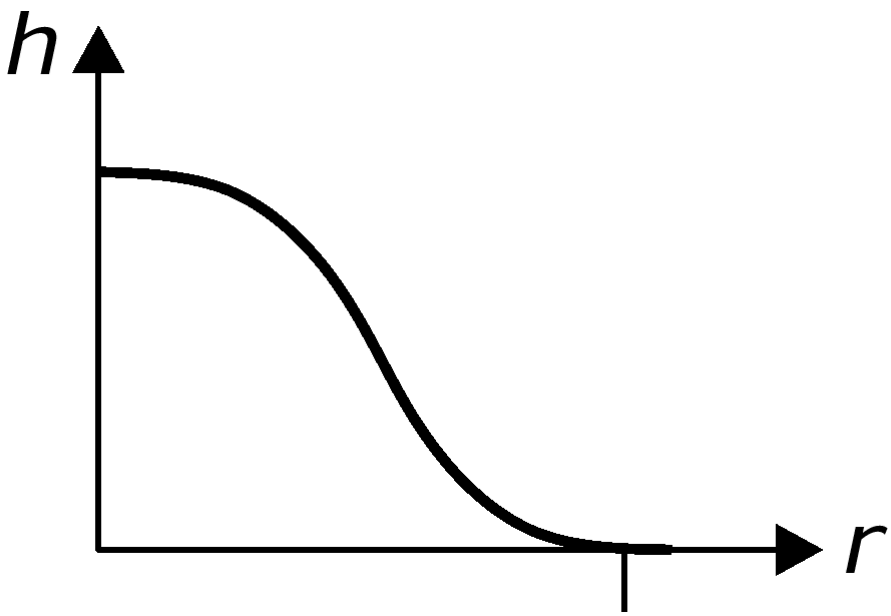


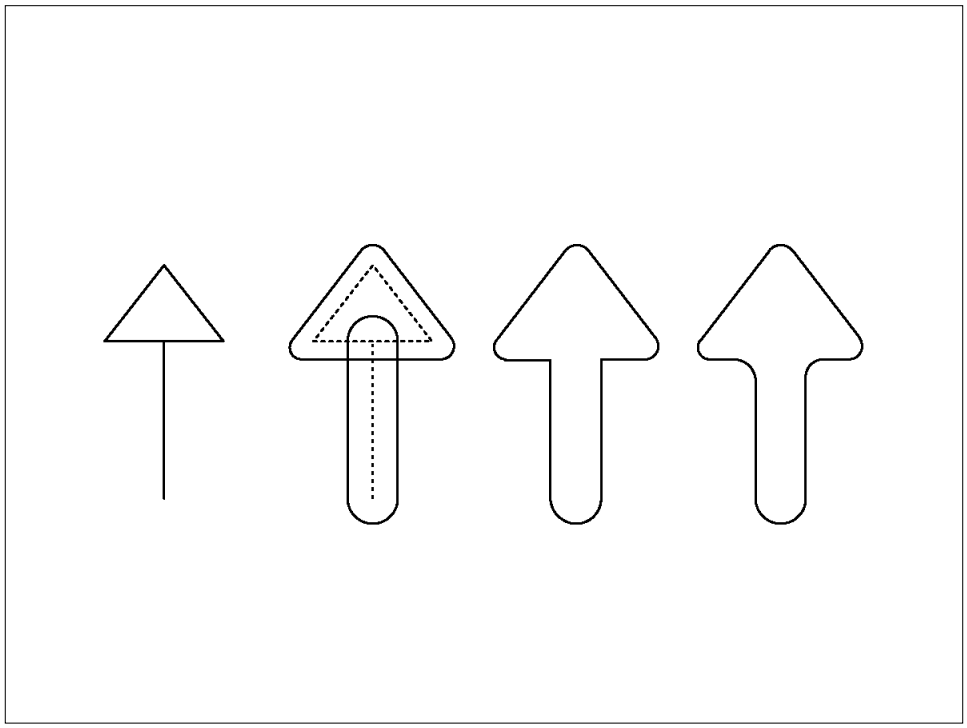


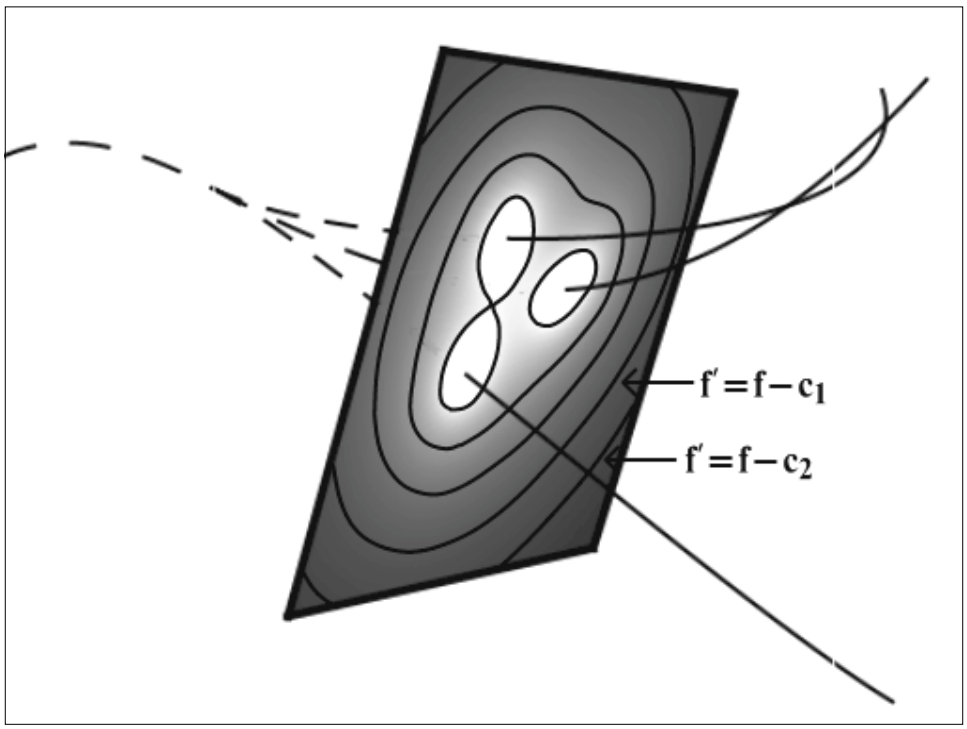


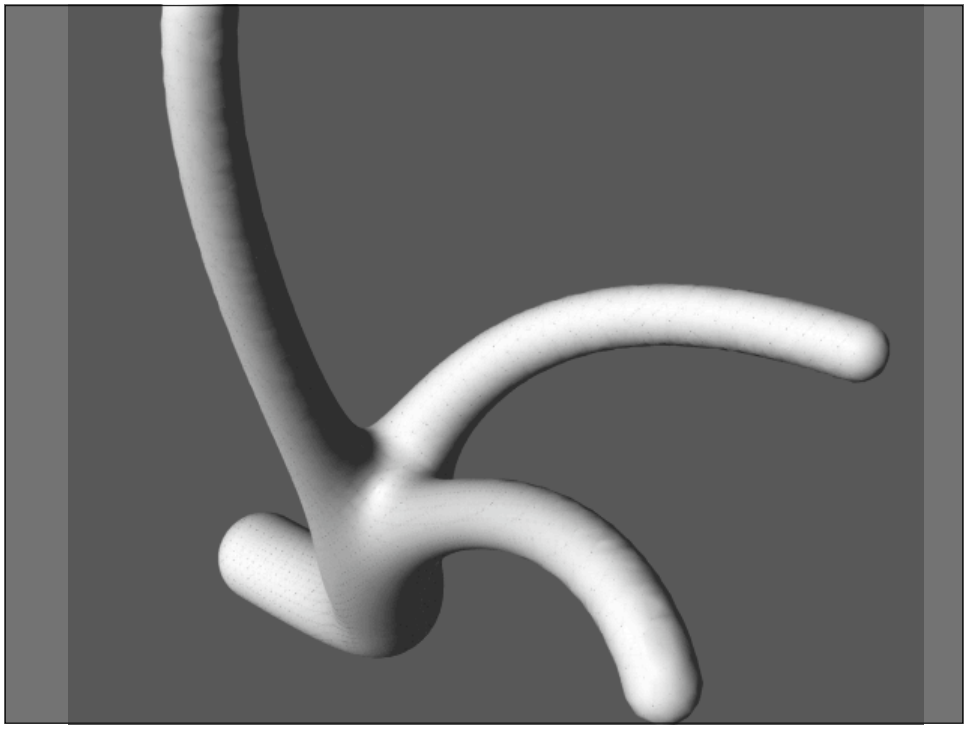

$f(\mathrm{p}) = td(S_1, \mathrm{p}) + (1 - t)d(S_2, \mathrm{p}) - c$, where $d(S, \mathrm{p})$ is Euclidean distance between point p and segment S
$f(\mathrm{p}) = td^2(S_1, \mathrm{p}) + (1 - t)d^2(S_2, \mathrm{p}) - c$
$f(\mathrm{p}) = d(S, \mathrm{p}) - c$, where $S = tS_1 + (1 - t)S_2$
a
S_1
b
a
S_2
b
$f(\mathrm{p}) = d(S, \mathrm{p}) - c$, where S is a rigid body rotation between S_1 and S

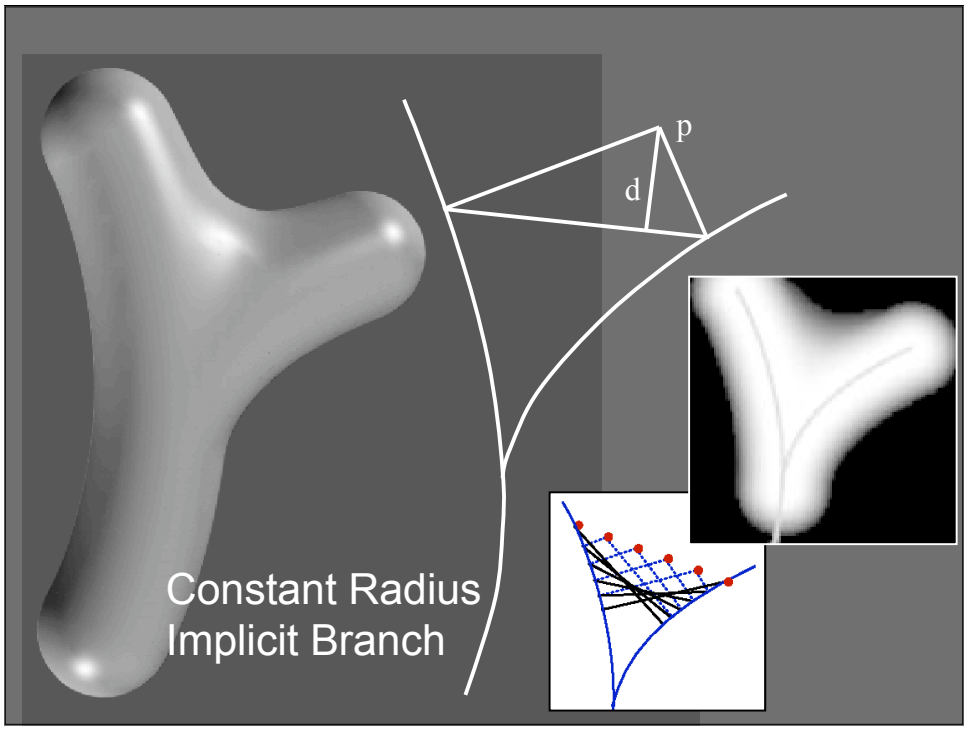

range 1
center 1
Primitive 1
blend surface heels to surface of Primitive 1
added material blend (fillet)
blend surface heels to surface of Primitive 2
center 2
(round)
Primitive 2
range 2

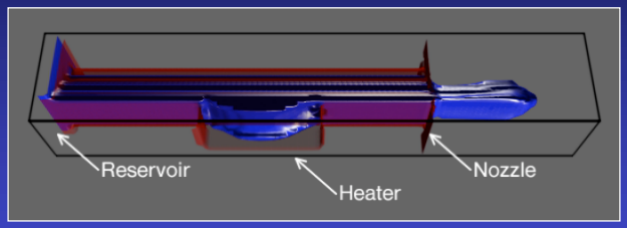

h
r

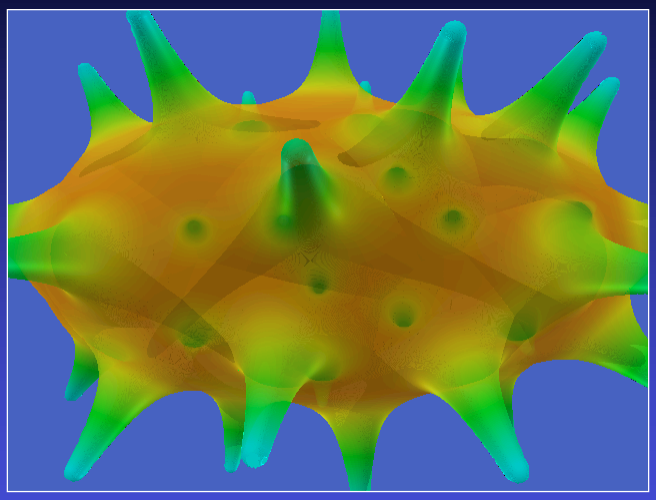


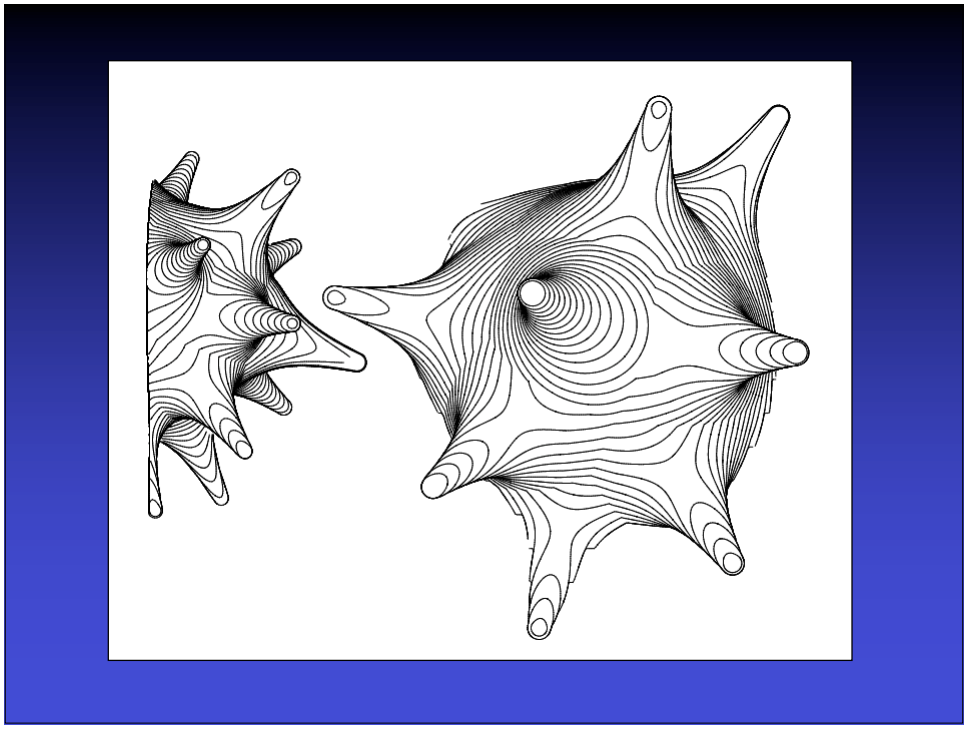

$f' = f - c_1$
$f' = f - c_2$

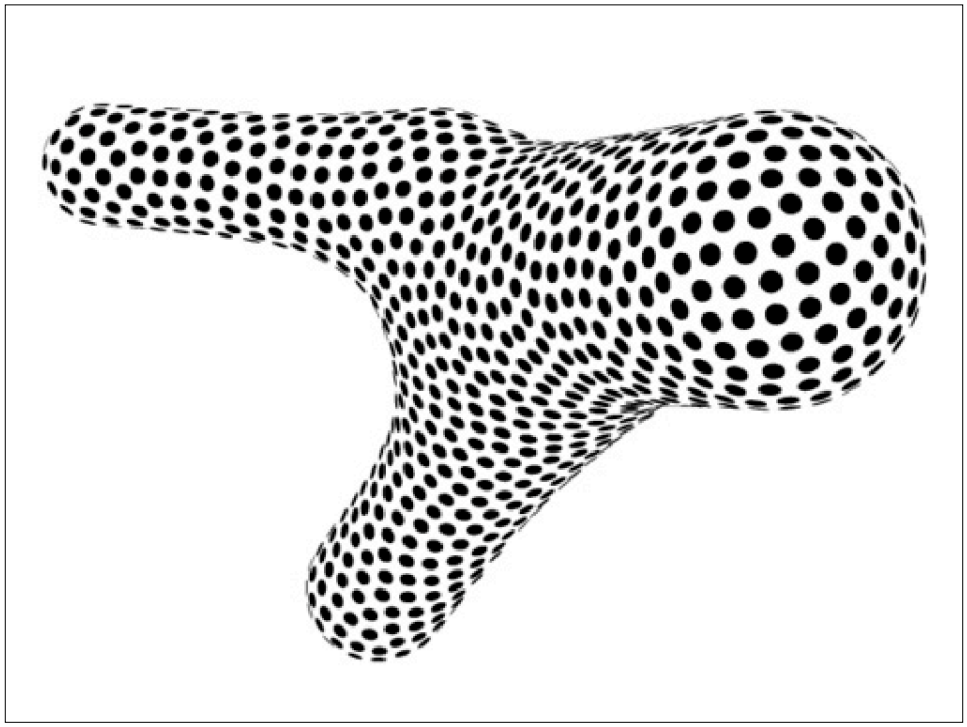


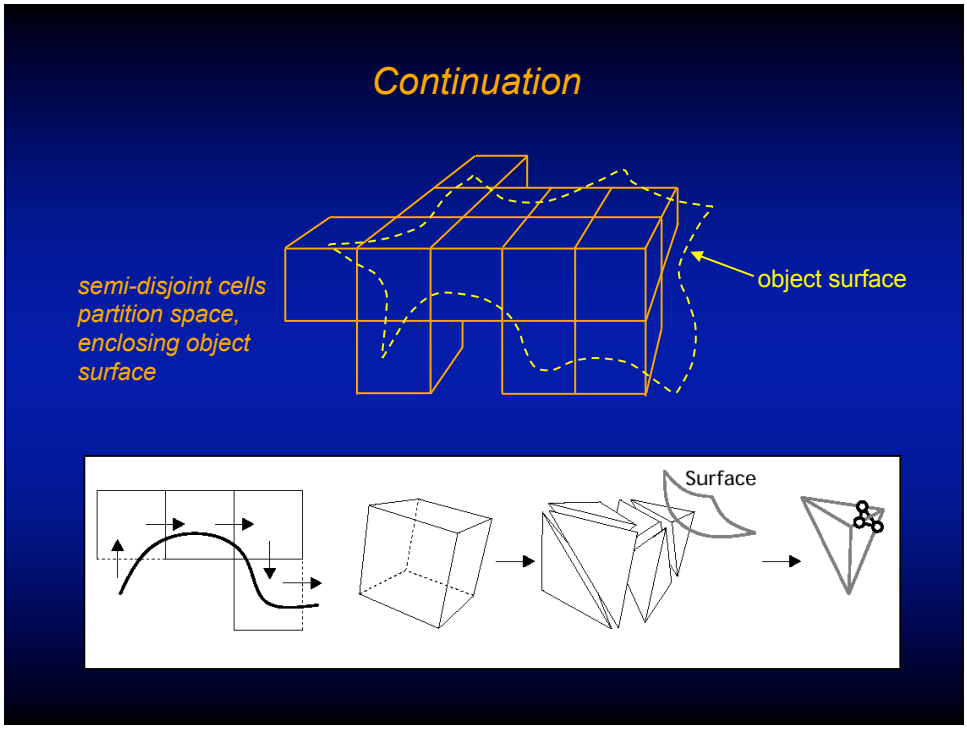

p
d
Constant Radius
Implicit Branch

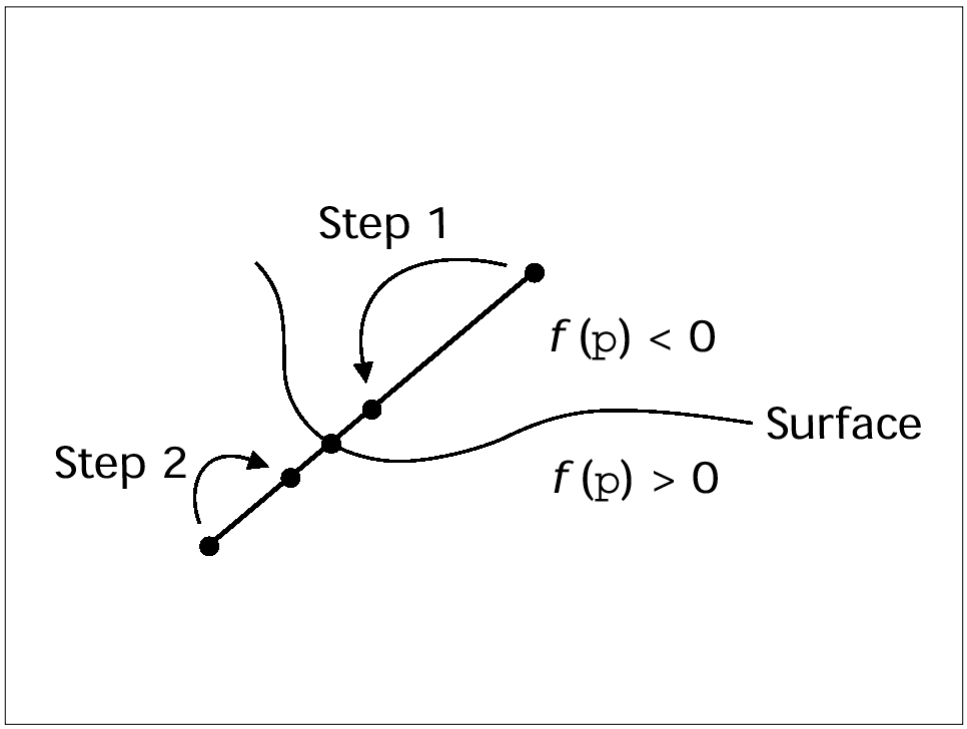

Reservoir
Heater
Nozzle

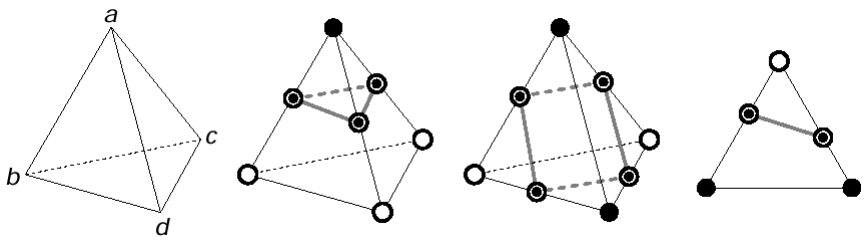


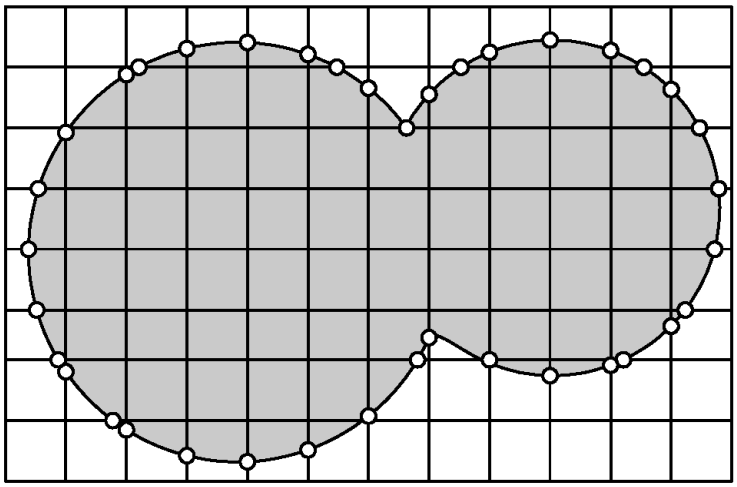


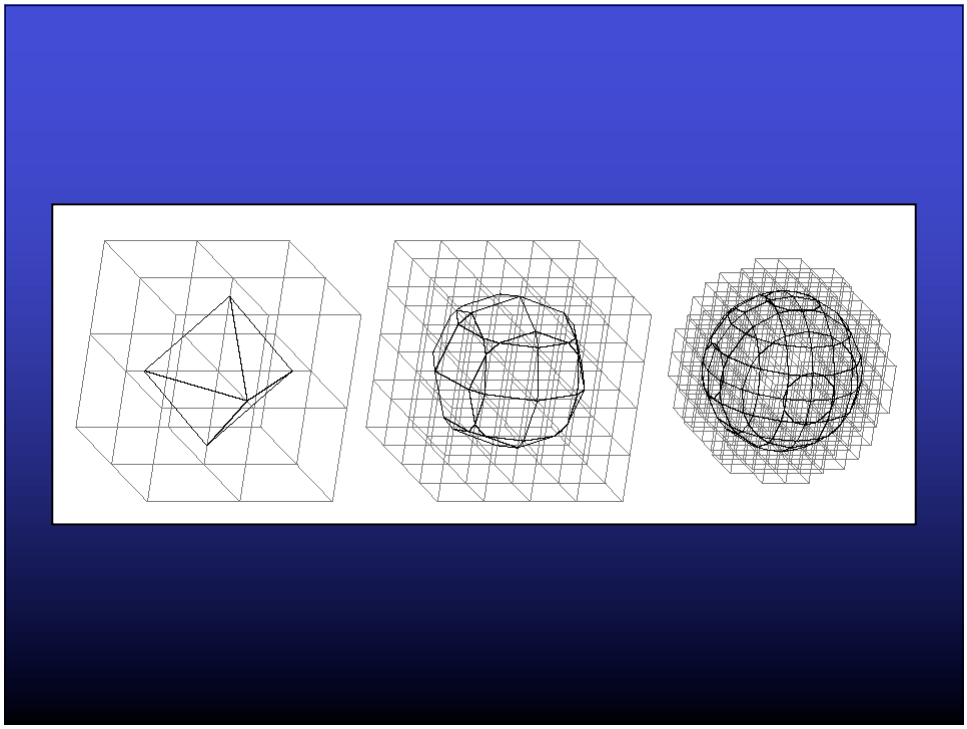


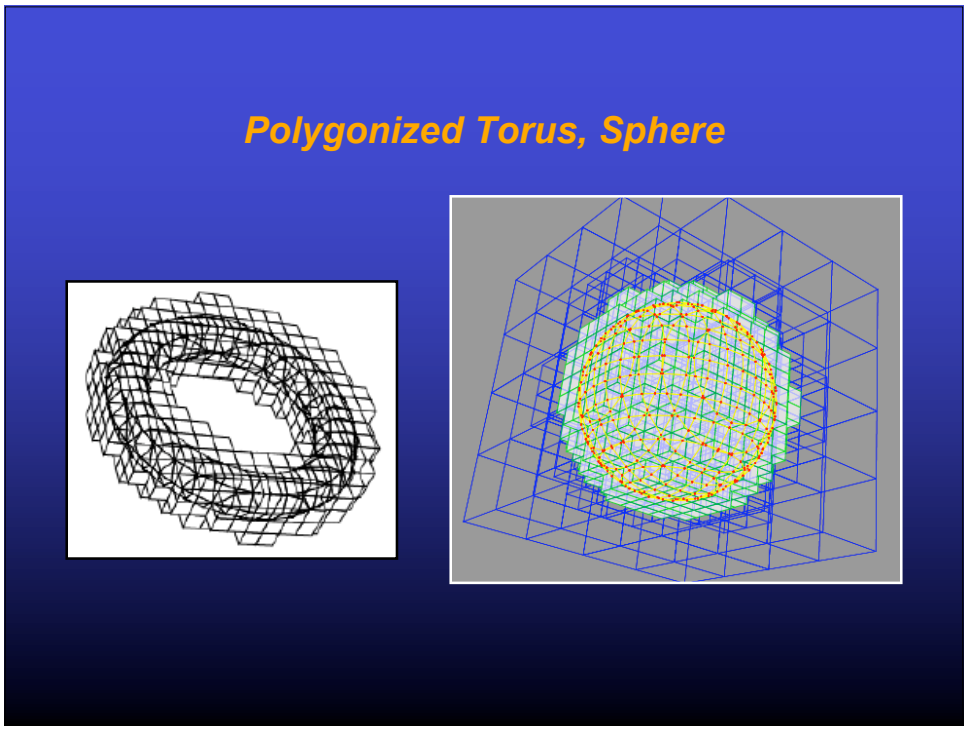

Continuation
semi-disjoint cells partition space, enclosing object surface
object surface
Surface

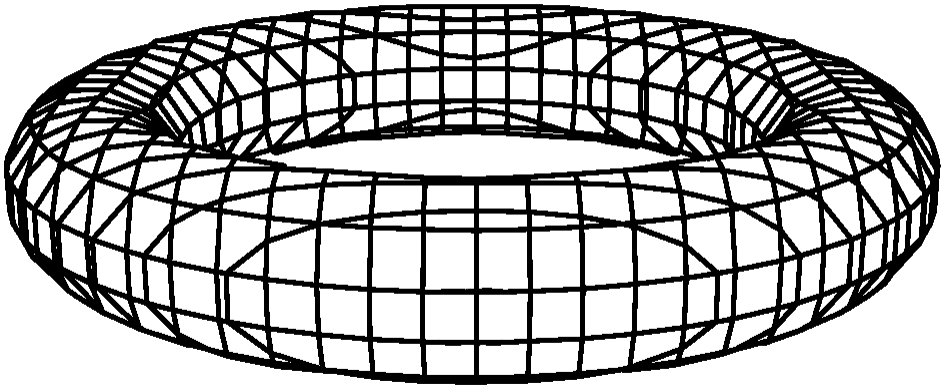

Step 1
f (p) < 0
Surface
Step 2
f (p) > 0

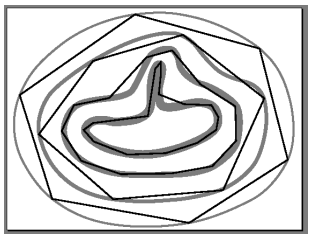

a
b
c
d

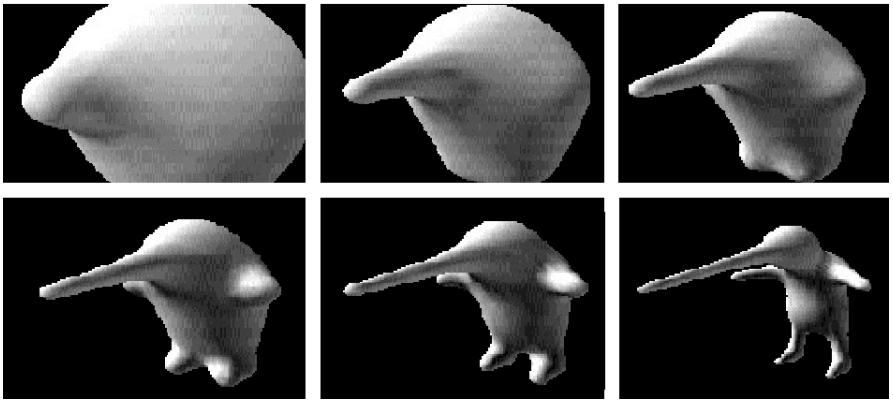


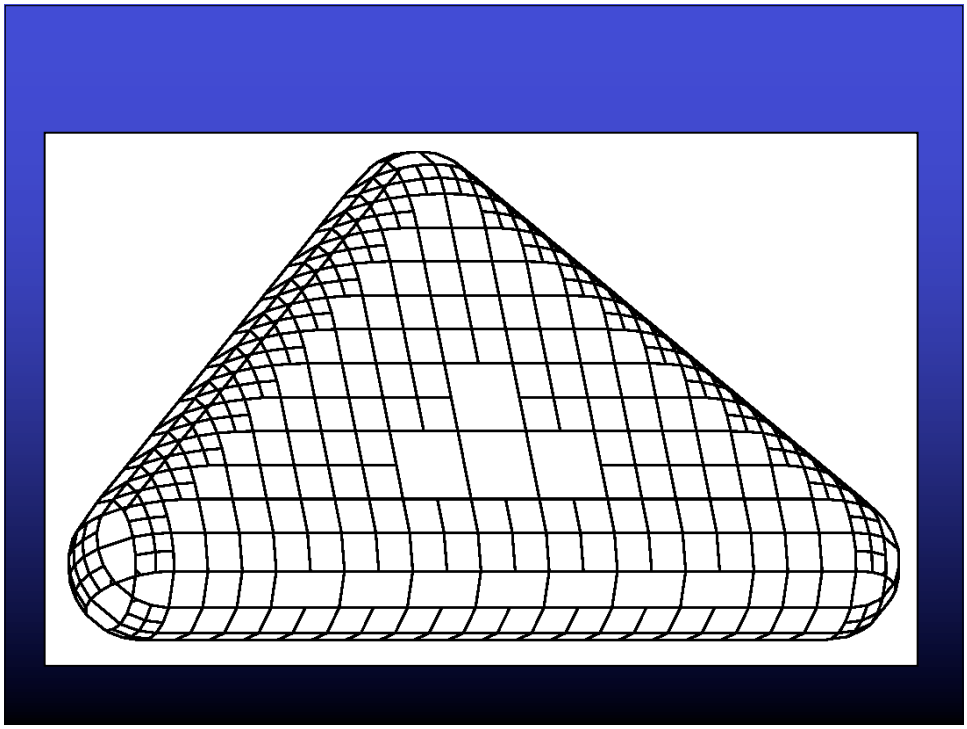


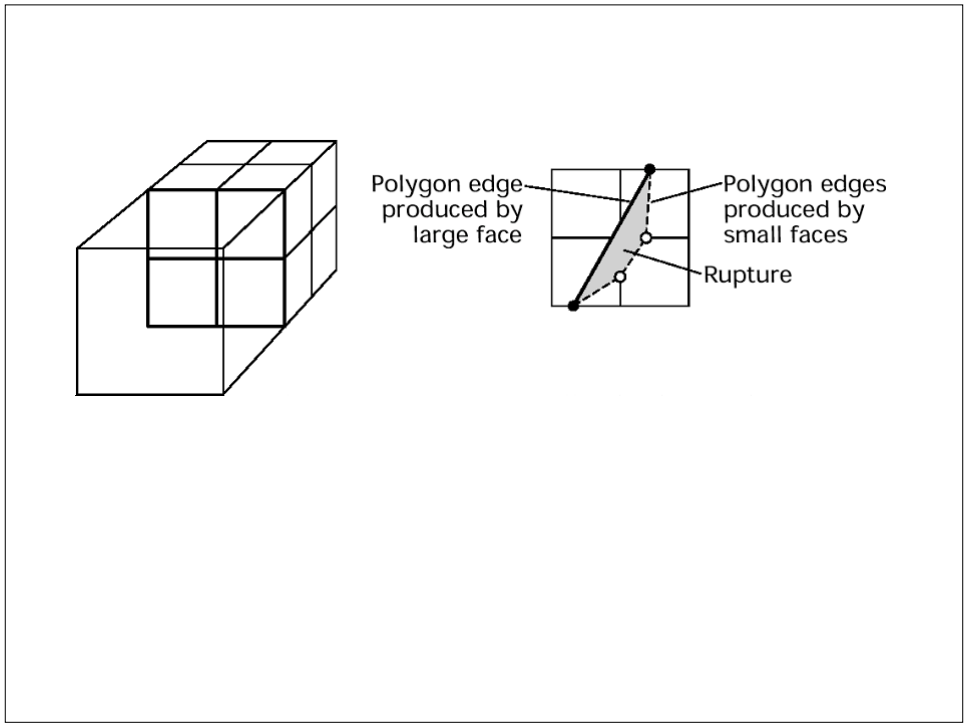

Polygonized Torus, Sphere

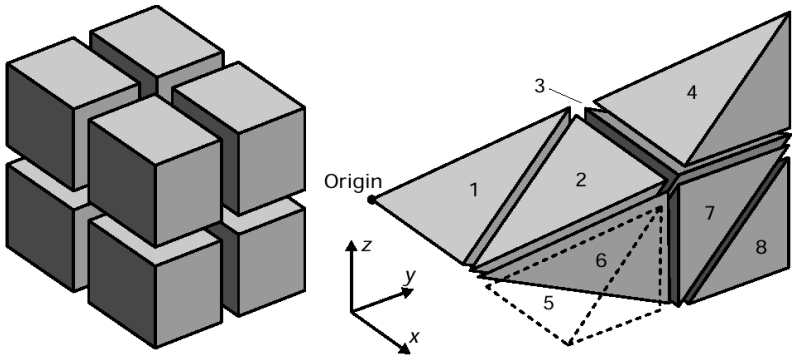


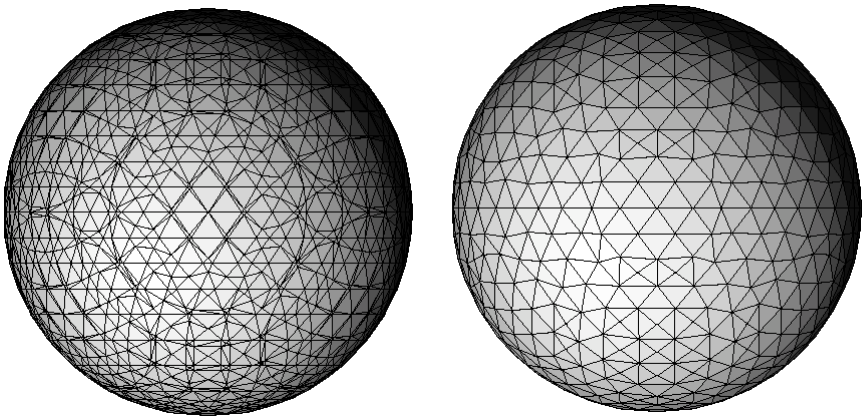


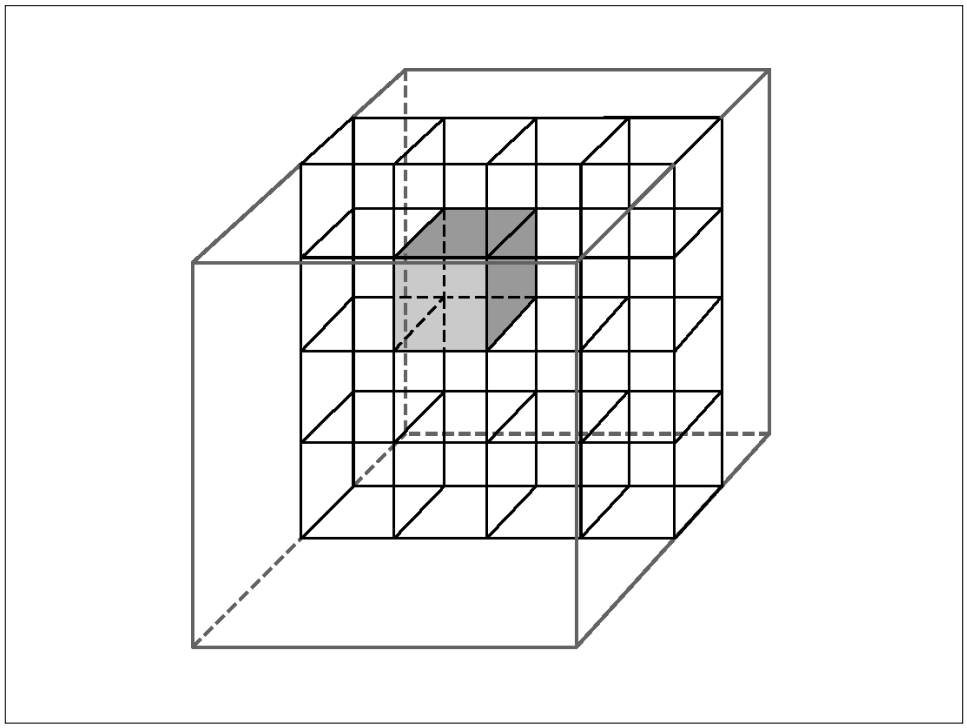


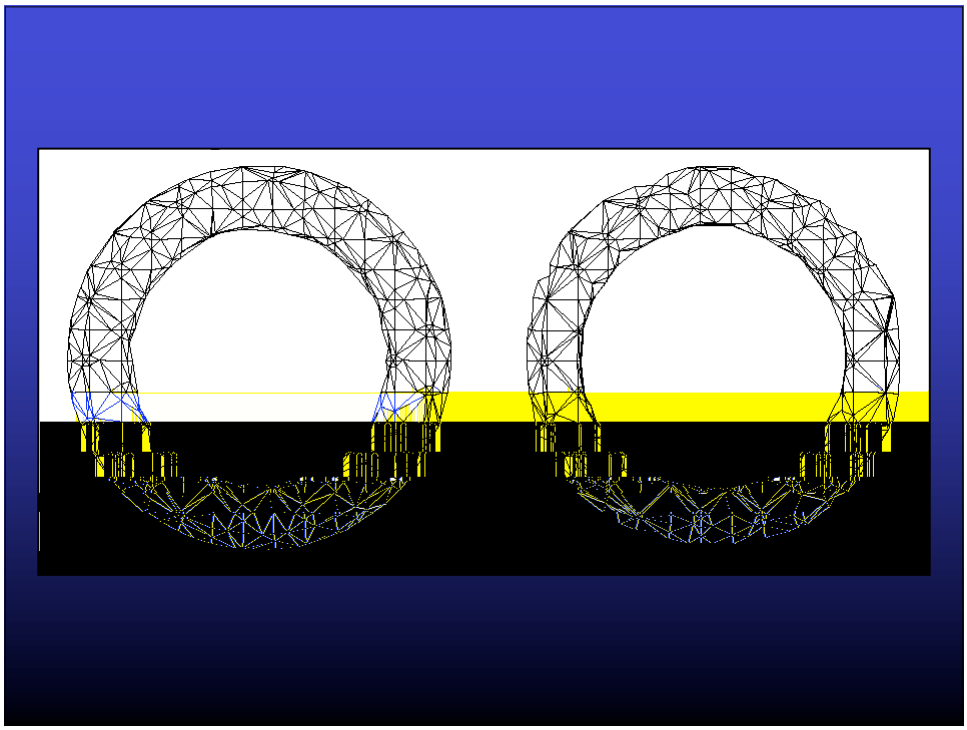


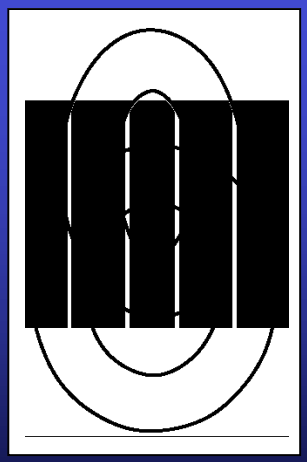

Polygon edge produced by large face
Polygon edges produced by small faces
Rupture

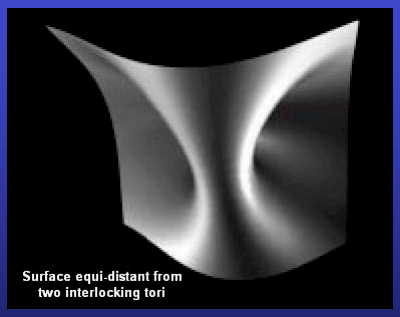

Origin
1
2
3
4
5
6
7
8
z
y
x

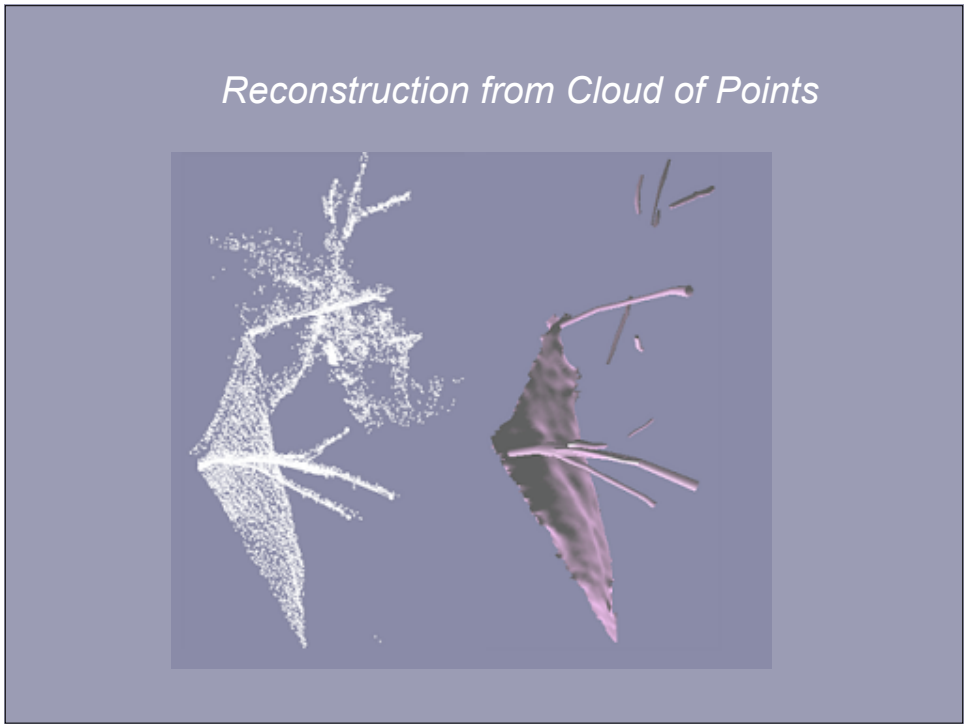


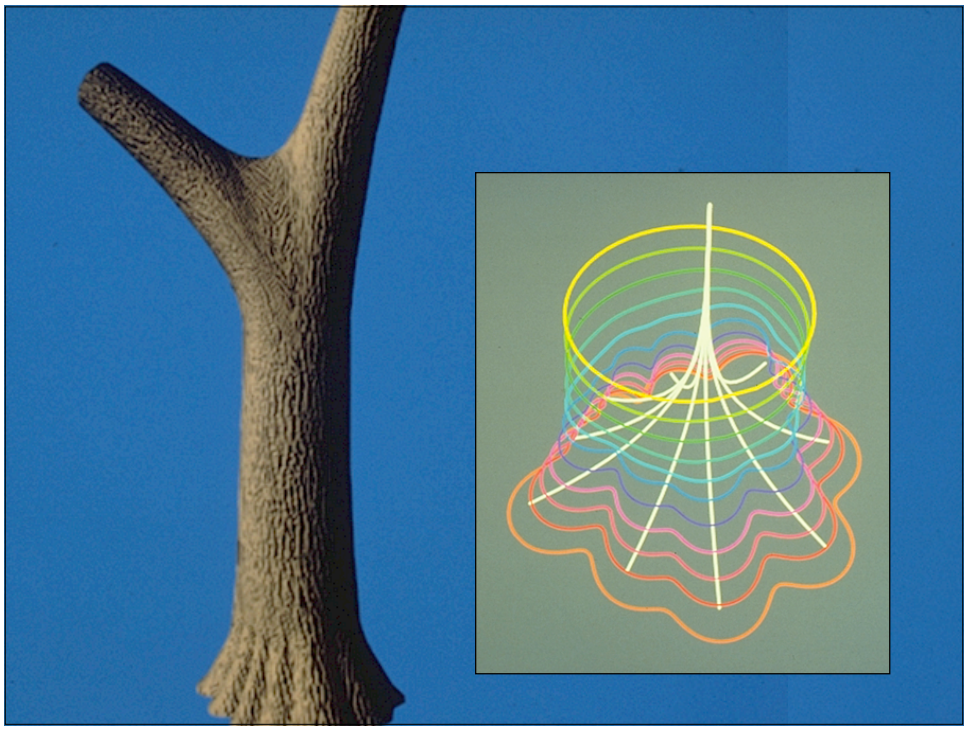




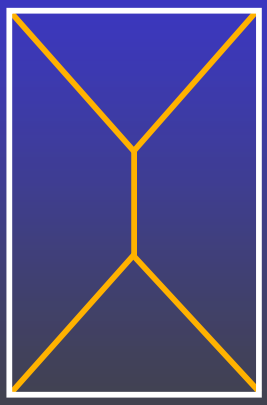


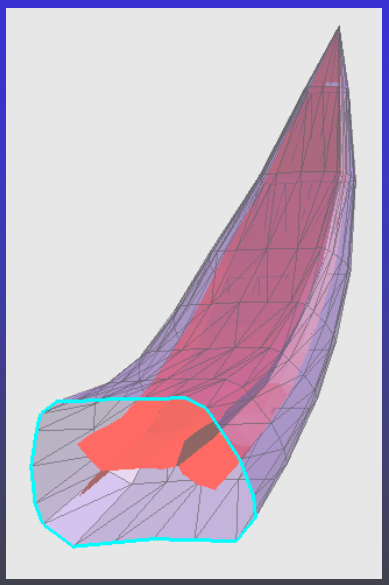

Surface equi-distant from
two interlocking tori


Reconstruction from Cloud of Points



2D and 3D Skeletons

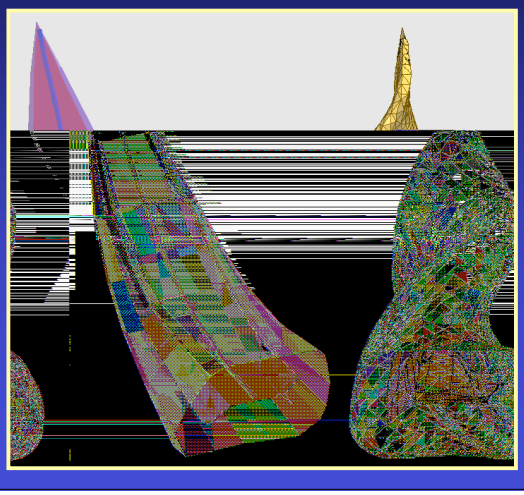


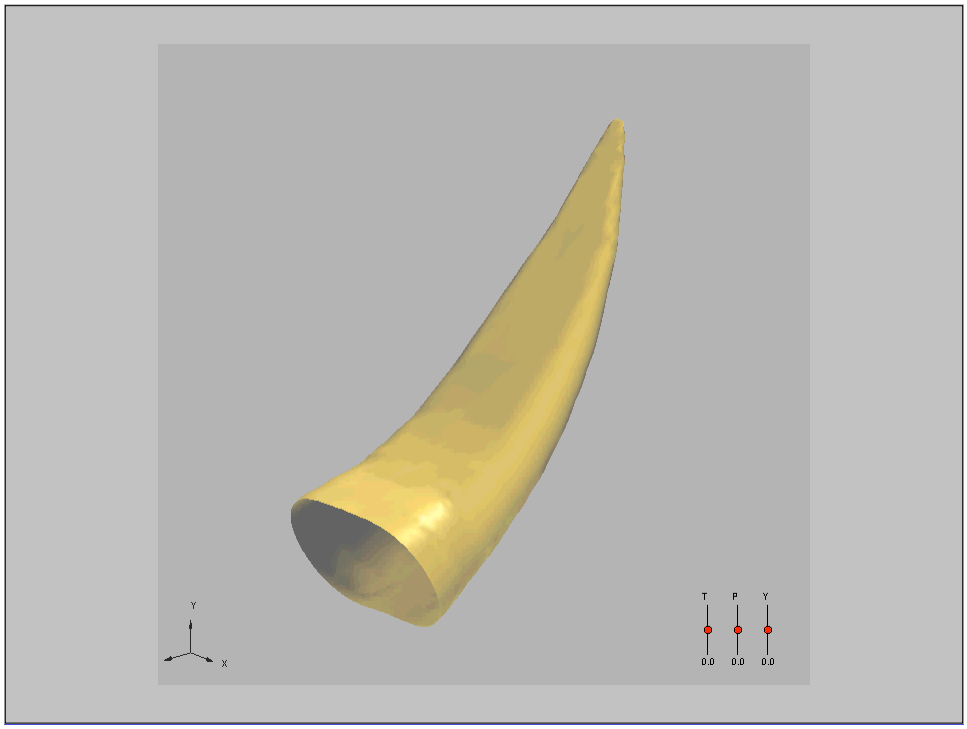


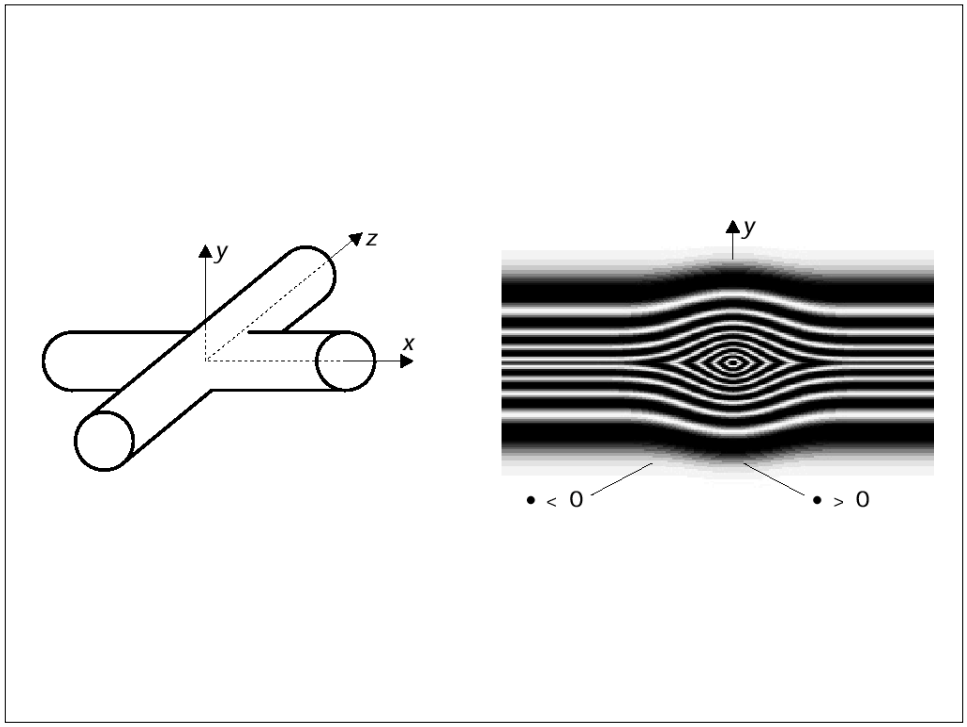
The Medial Axis/Surface

Obvious choice for internal control?
Original reconstructable

distance surface (exact reconstruction)
convolution surface (differentiable)



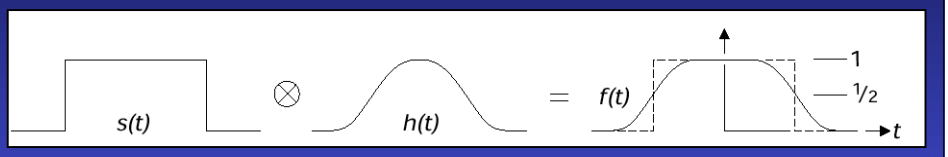

Y
X
T
P
Y
0.0
0.0
0.0

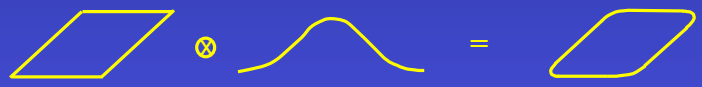

y
z
x
y
< 0
> 0

Convolution

rounds corners, fillets crevices

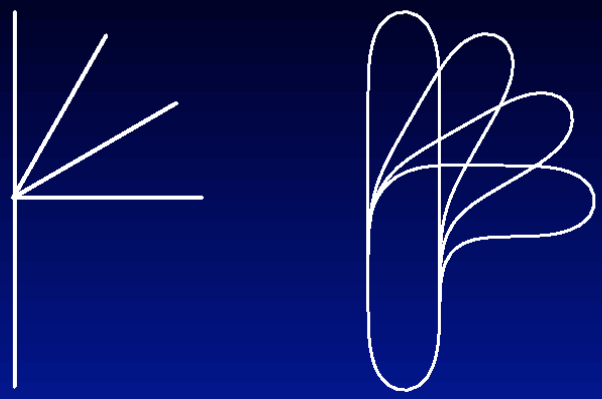
produces a smooth, differentiable field

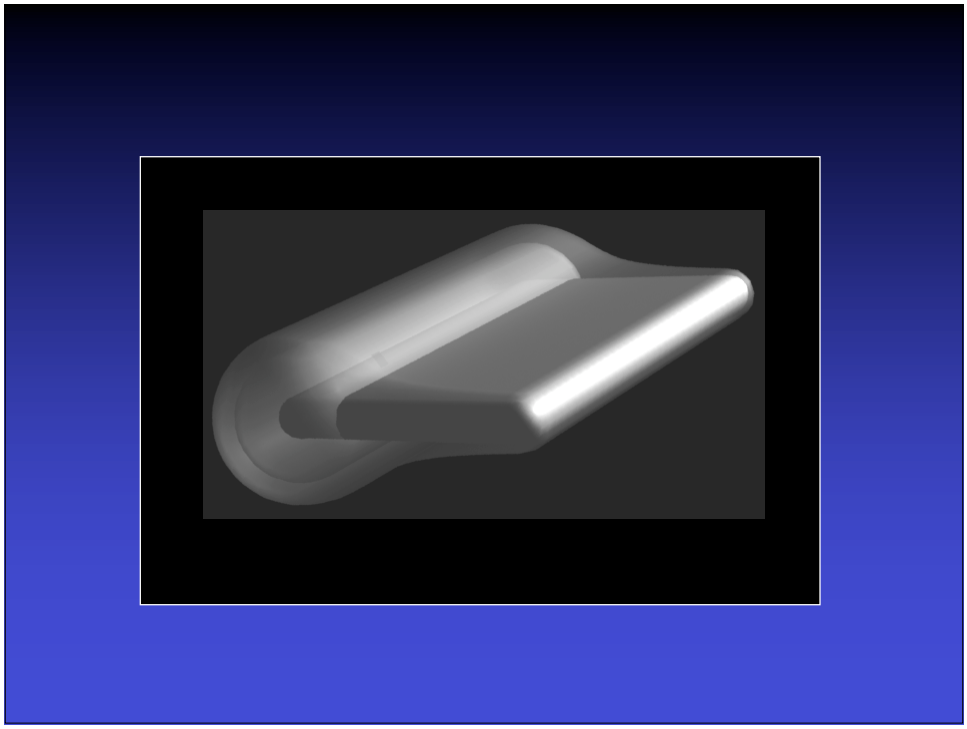


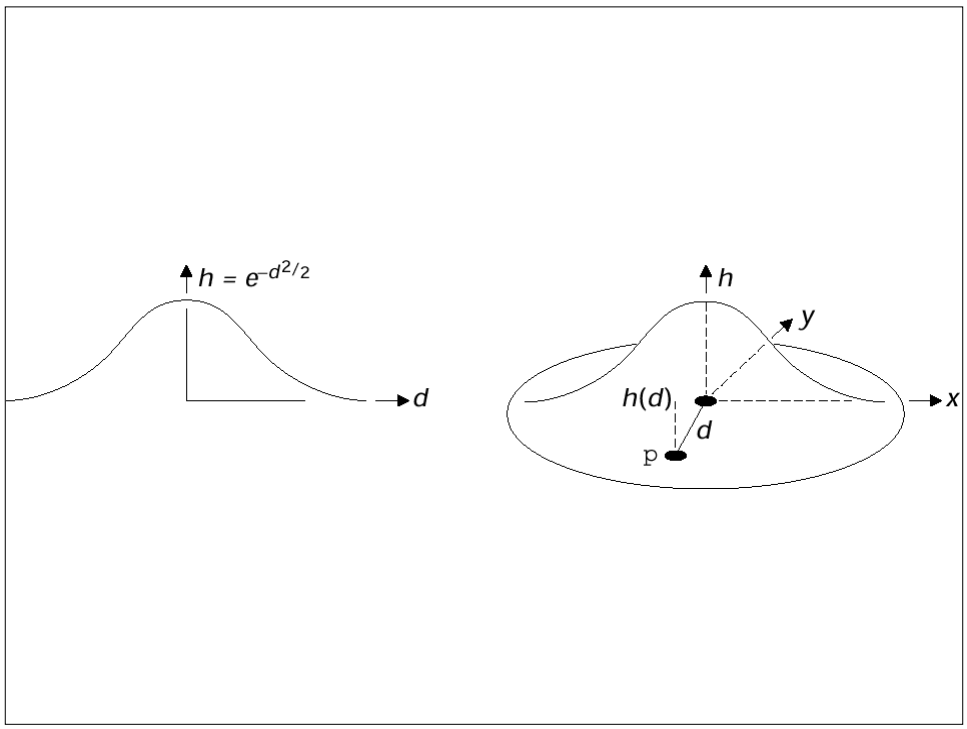


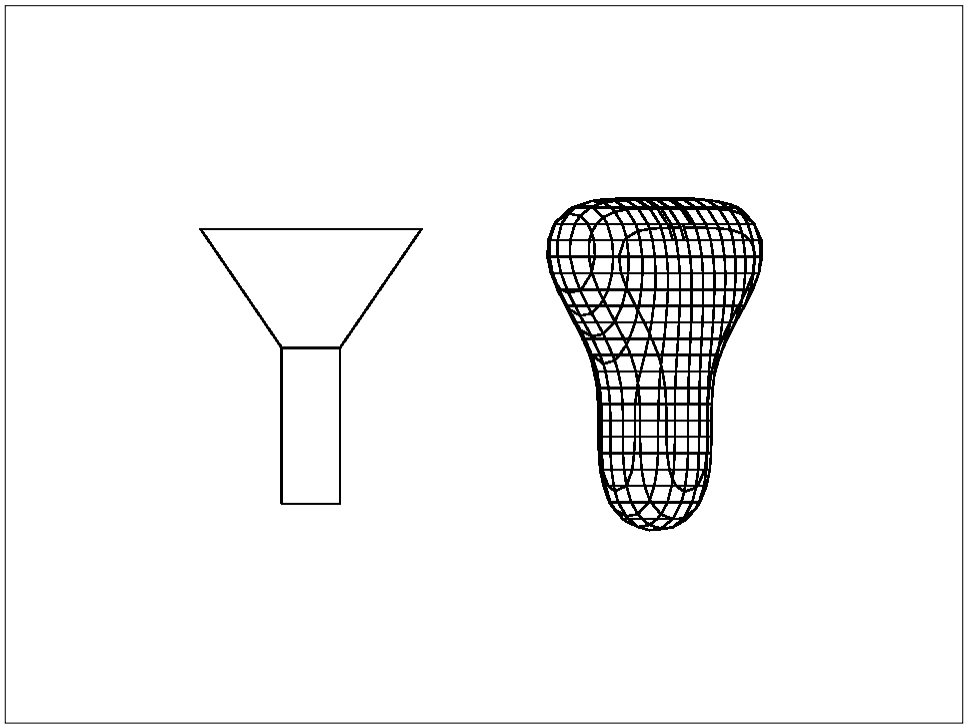
object | filter kernel | smoothed object

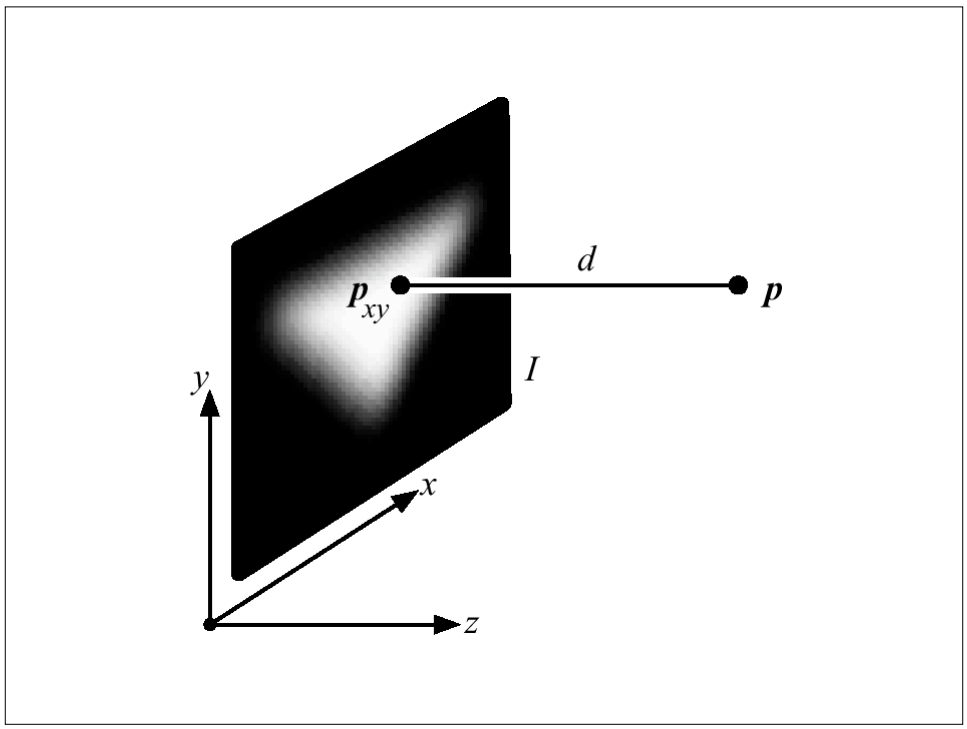
Two Segments and their Convolution

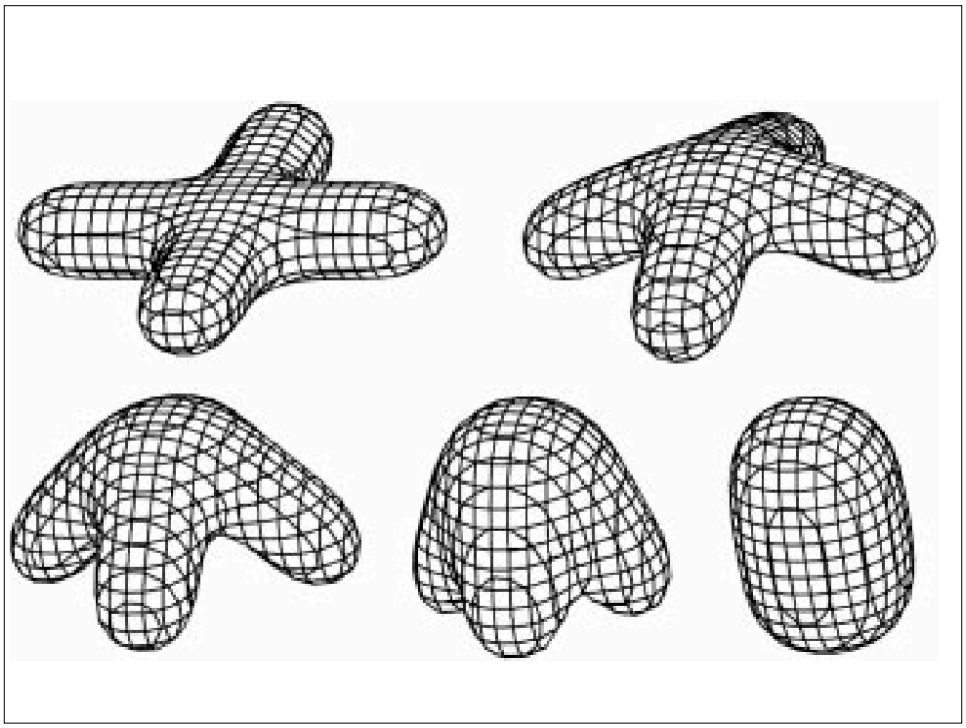


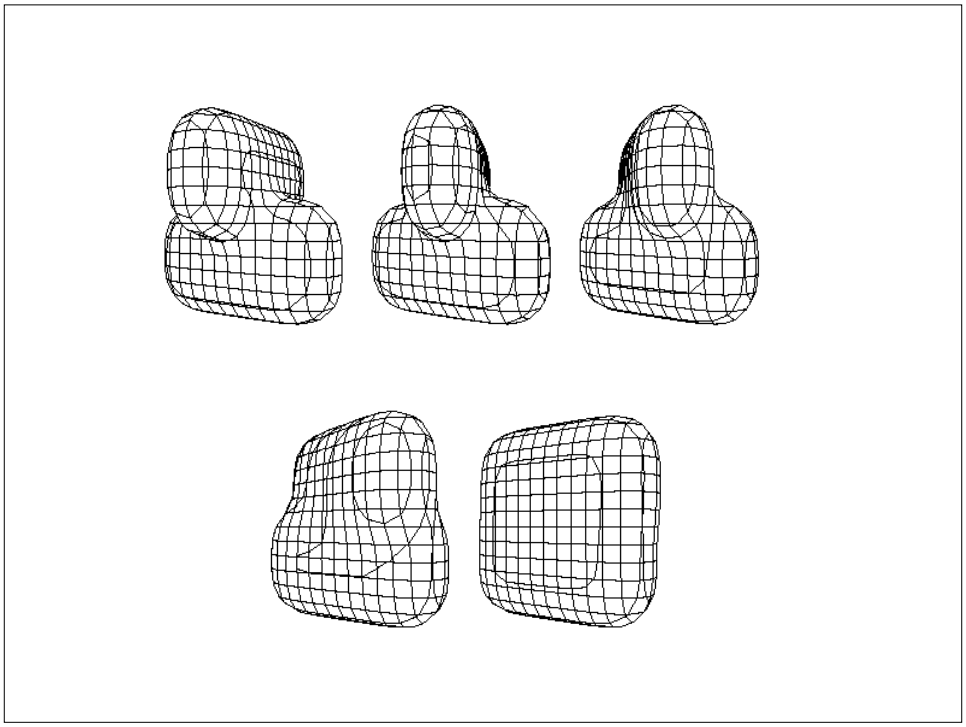


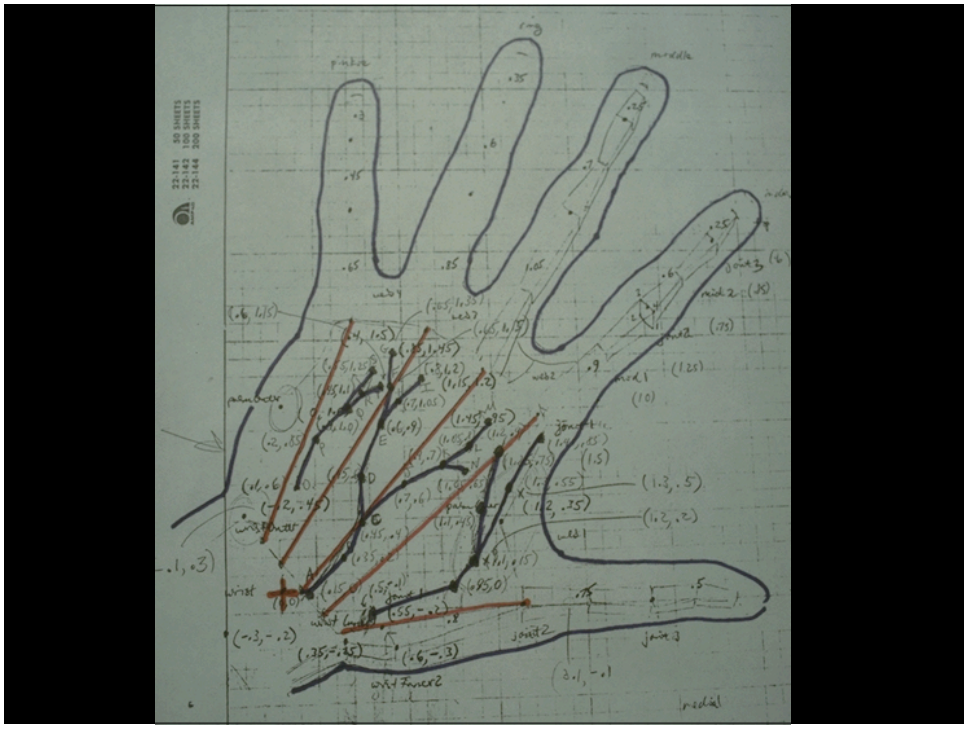

$h = e^{-d^2/2}$
d
h
y
h(d)
d
p
x

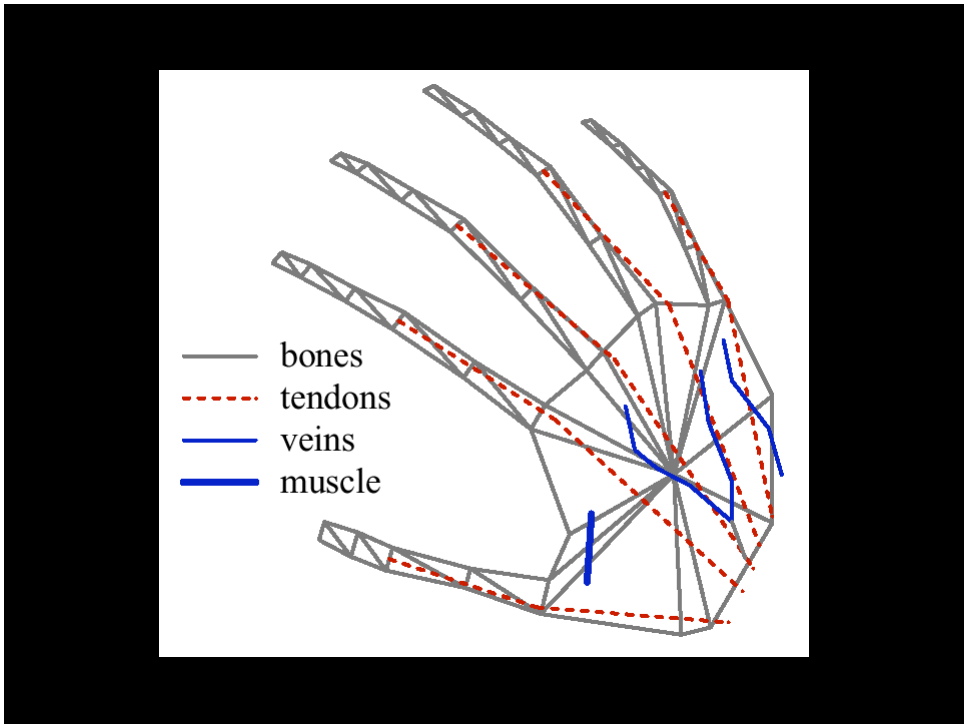


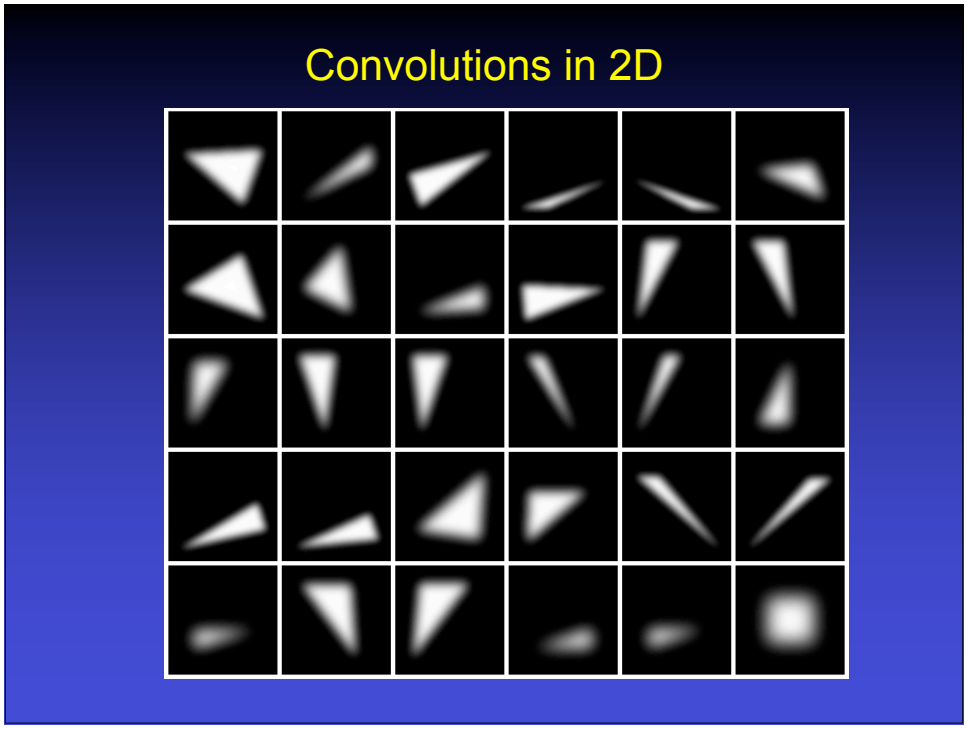

d
p_{xy}
p
I
y
x
z

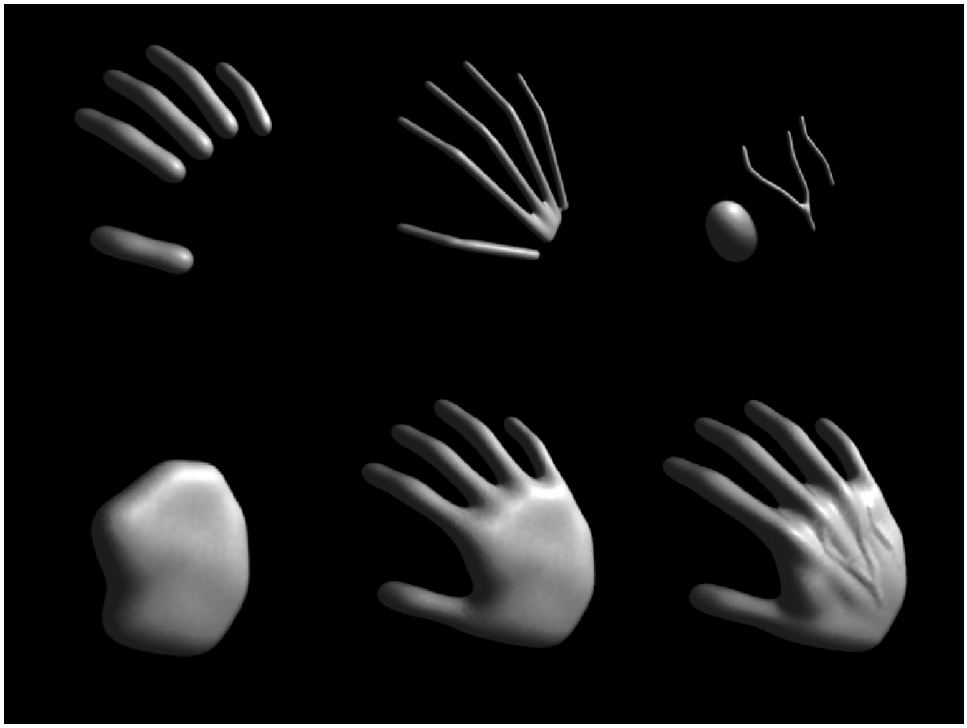


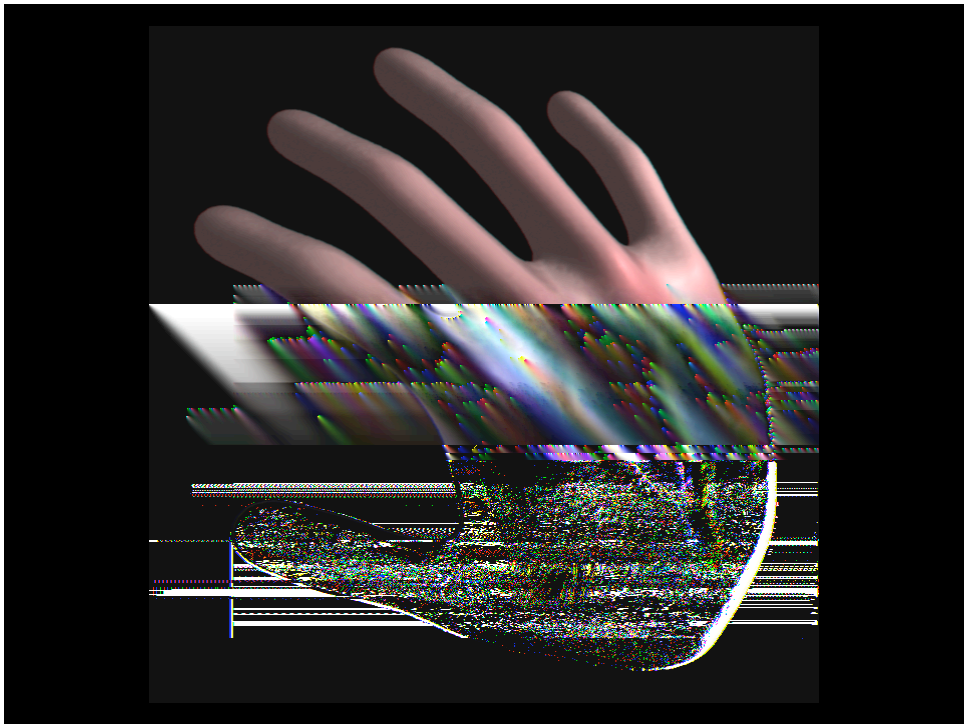




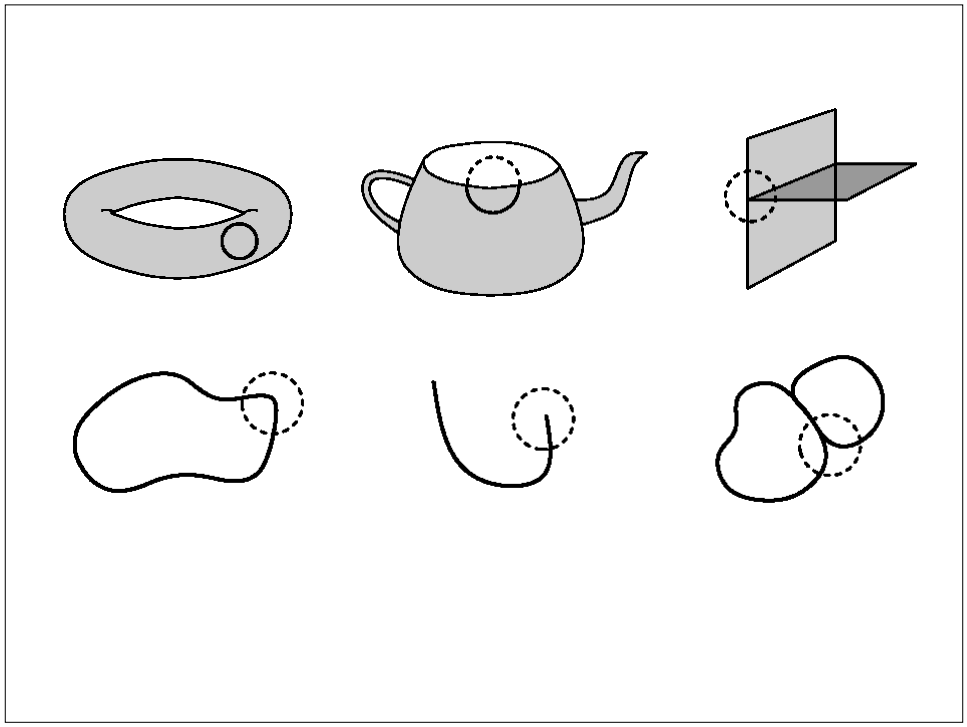

bones
tendons
veins
muscle

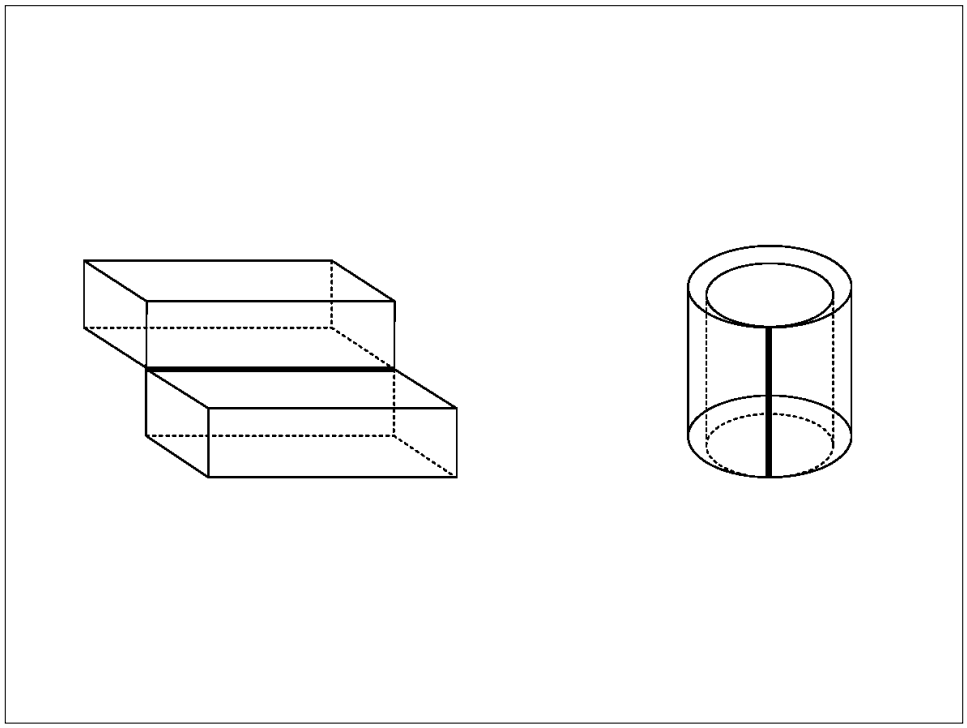

Convolutions in 2D

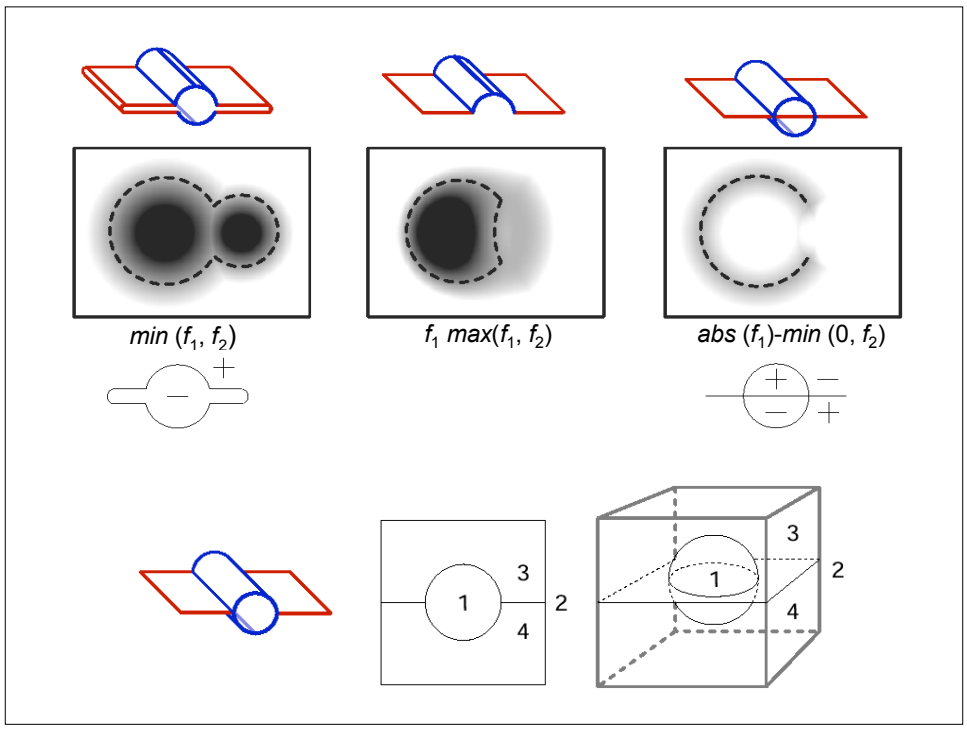


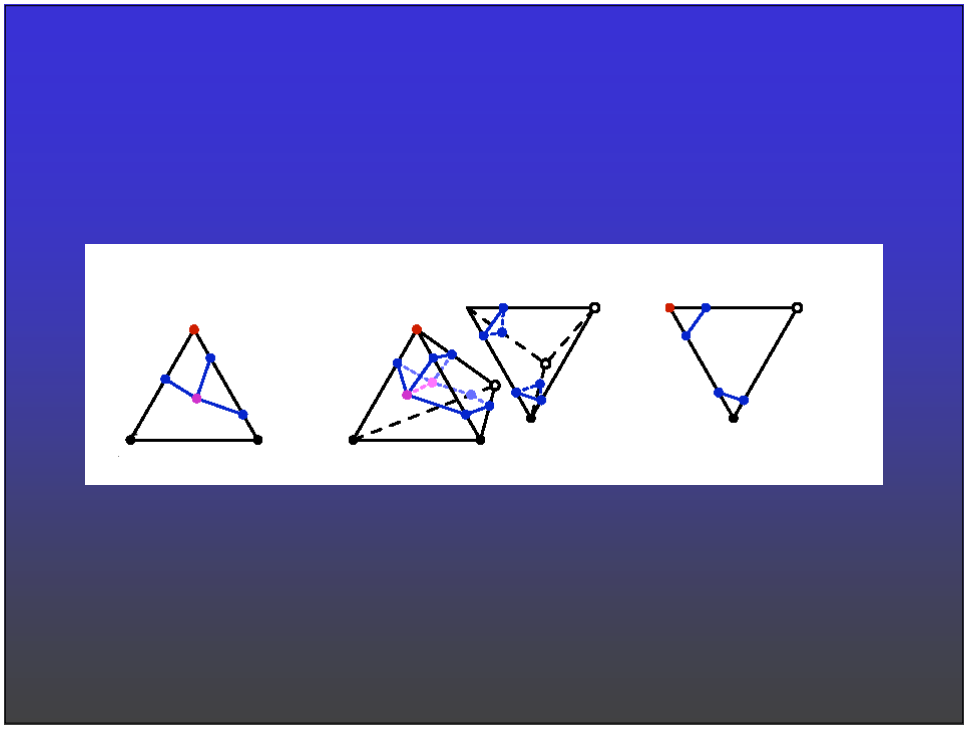


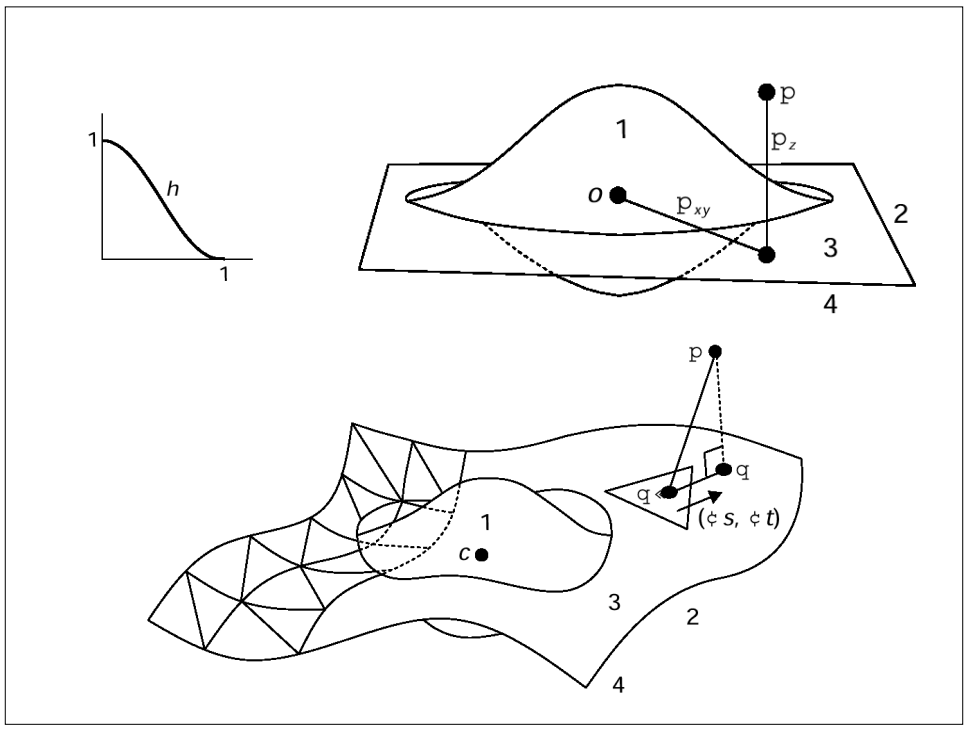
‘blobby’

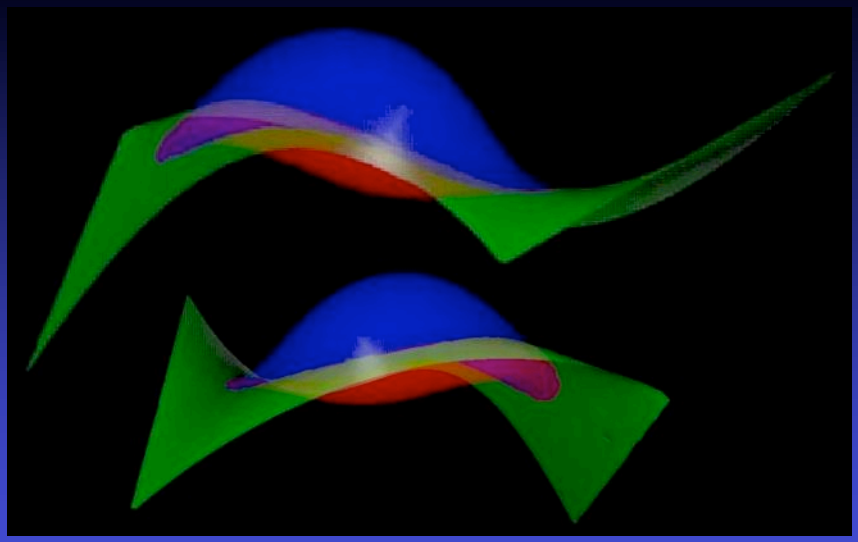





min (f_1, f_2)
f_1 max(f_1, f_2)
abs (f_1)-min (0, f_2)
+
−
1
2
3
4



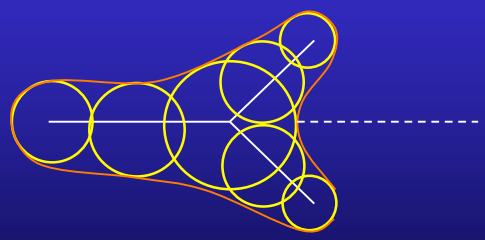

1
h
1
p
1
p_z
o
p_{xy}
2
3
4
p
q
q
(¢ s, ¢ t)
1
c
3
2
4



Non-Manifold Implicit Blend

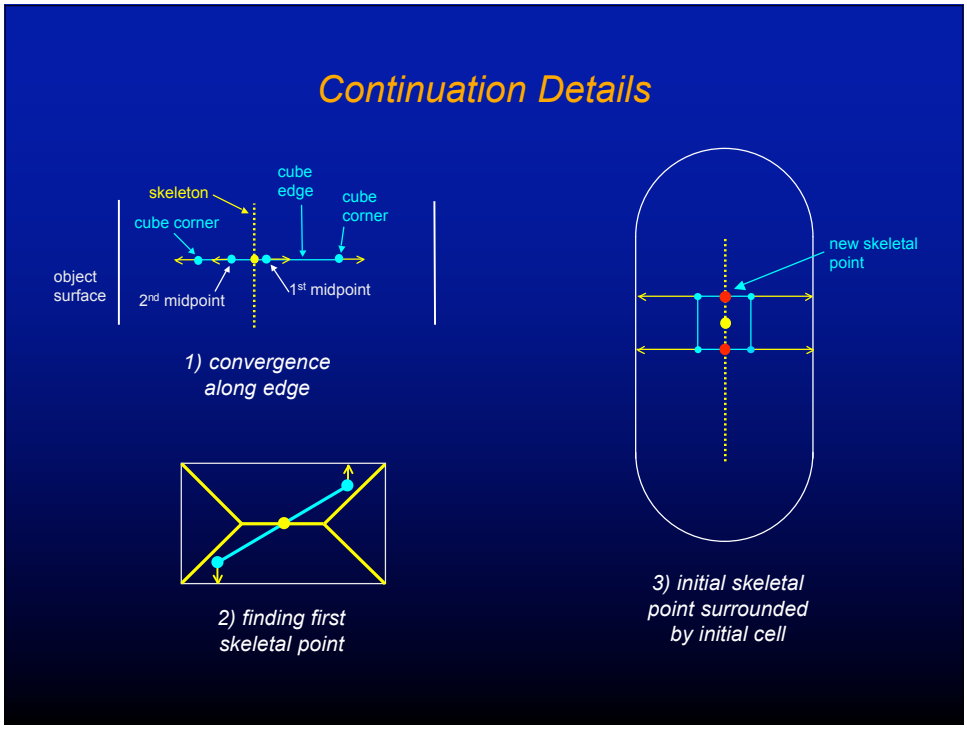
The Geometric Skeleton

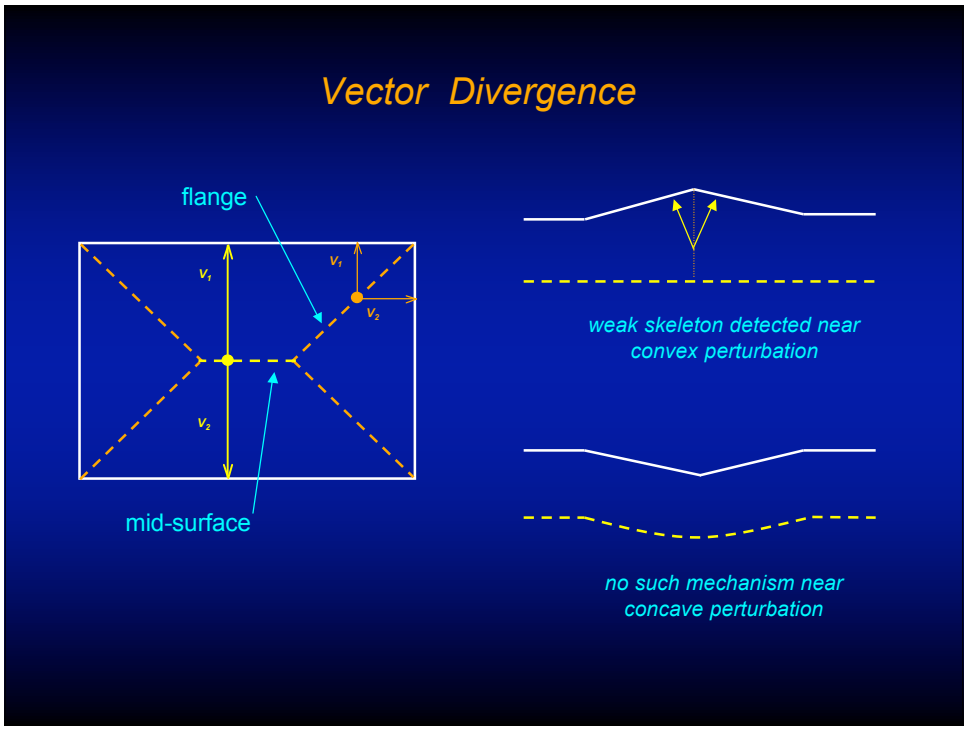
the locus of centers of maximally sized inscribable spheres (circles)



Skeletonization: Object → Locus

Reconstruction: Locus → Object


Continuation Details
skeleton
cube edge
cube corner
cube corner
object surface
2nd midpoint
1st midpoint
1) convergence along edge
2) finding first skeletal point
new skeletal point
3) initial skeletal point surrounded by initial cell


Vector Divergence
flange
mid-surface
weak skeleton detected near convex perturbation
no such mechanism near concave perturbation

Motivation

Difficulty with control point networks

⇨ Volumetric model
smooth surface

⇨ Object Manipulation
geometrically derivable
internal stick-figure control

"Users hate reconstruction"

non-interactive
prone to artifacts
variable vertex count

Deformation (vertex blending)

inherent artifacts
sensitive blend weights

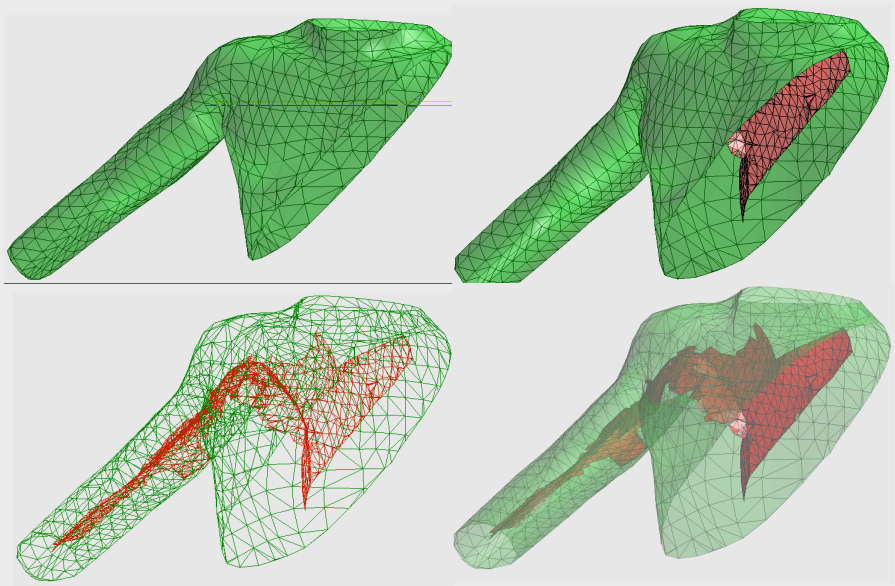
Medial-Based Vertex Deformation

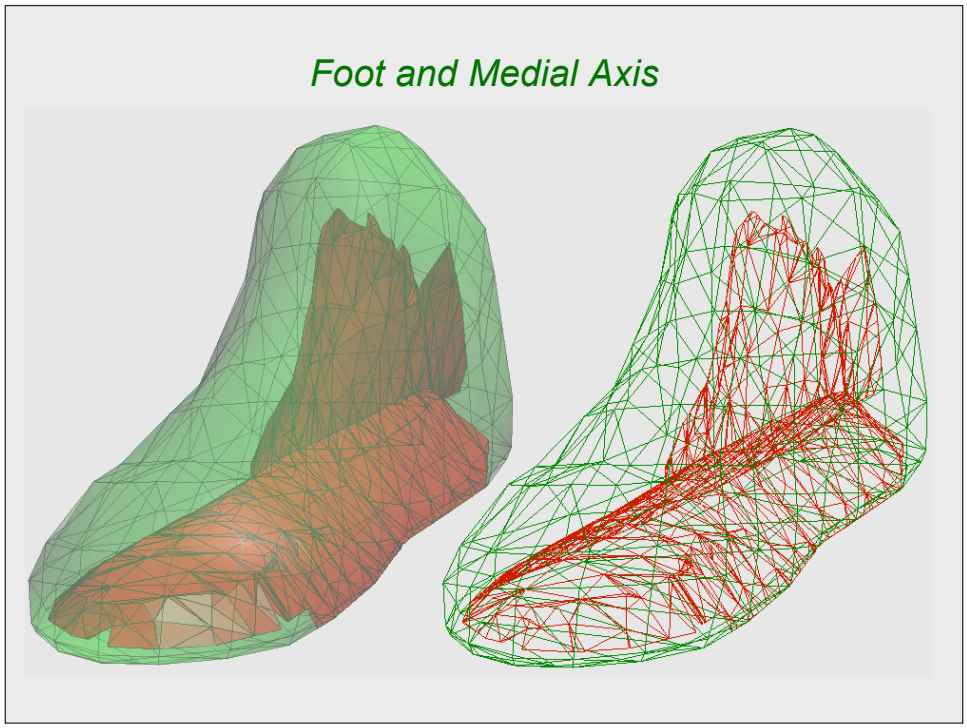
Jules Bloomenthal
Unchained Geometry
jules@unchainedgeometry.com

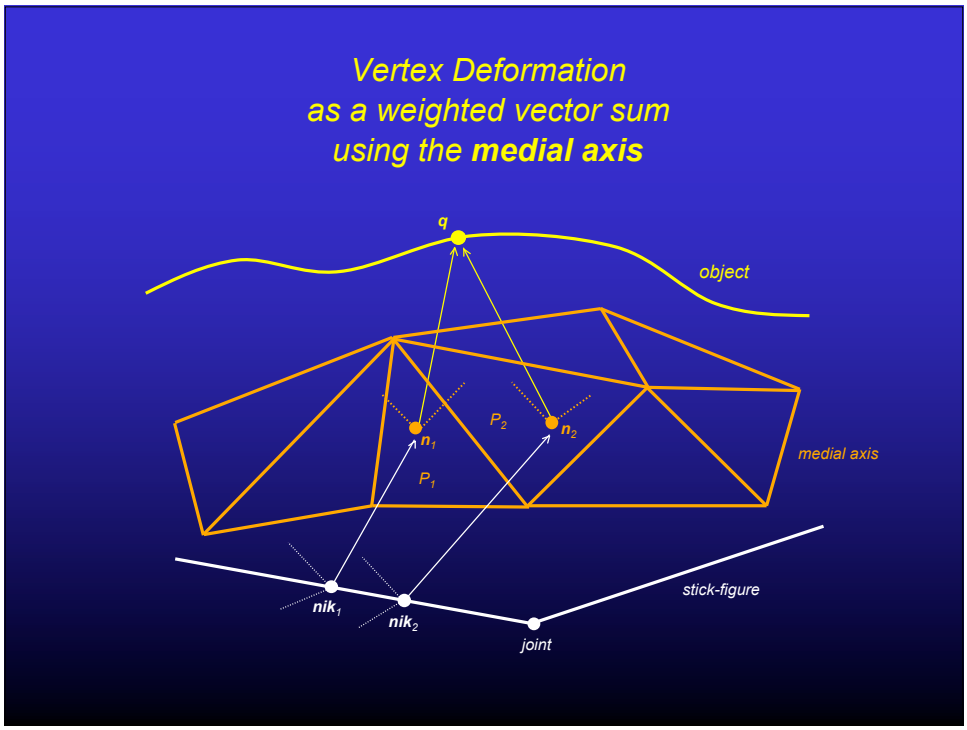
Motivation
The Medial
Reconstruction / Deformation
Post-Blend
Implementation
Future Work
Conclusion

Torso and Medial Axis

(various displays)

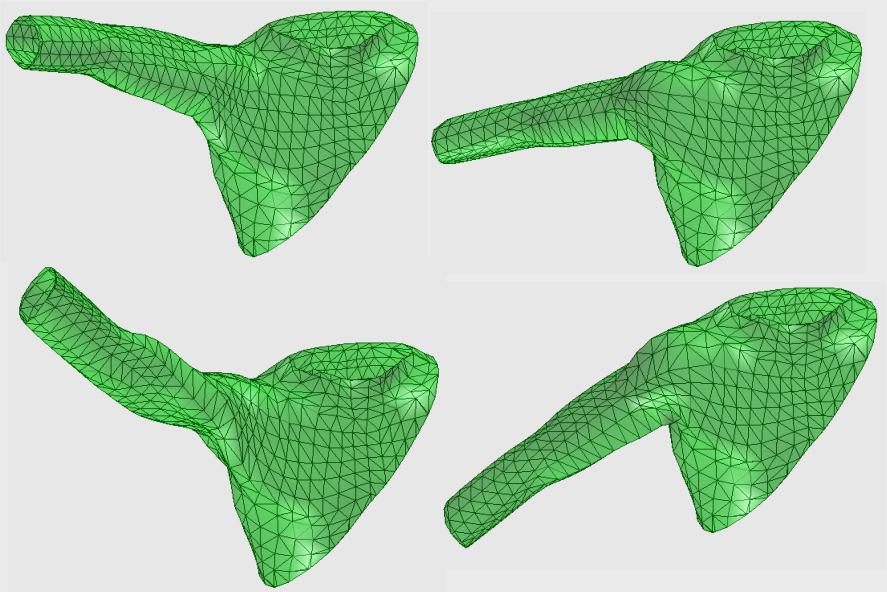



Foot and Medial Axis


Vertex Deformation
as a weighted vector sum
using the **medial axis**
q
object
P_2
n_2
n_1
P_1
medial axis
stick-figure
nik_1
nik_2
joint

Demo

Object Articulation achieved by
Vertex Deformation



Questions?