# Suggestive Hatching

Mayank Singh

Scott Schaefer

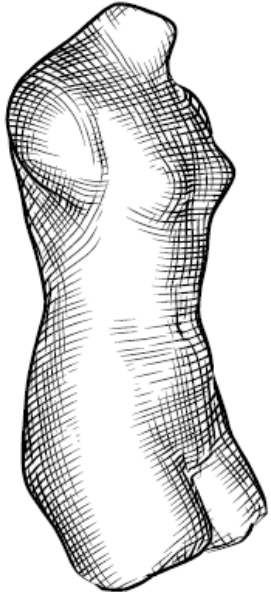TAMU Computer Science

# Traditional Hatching
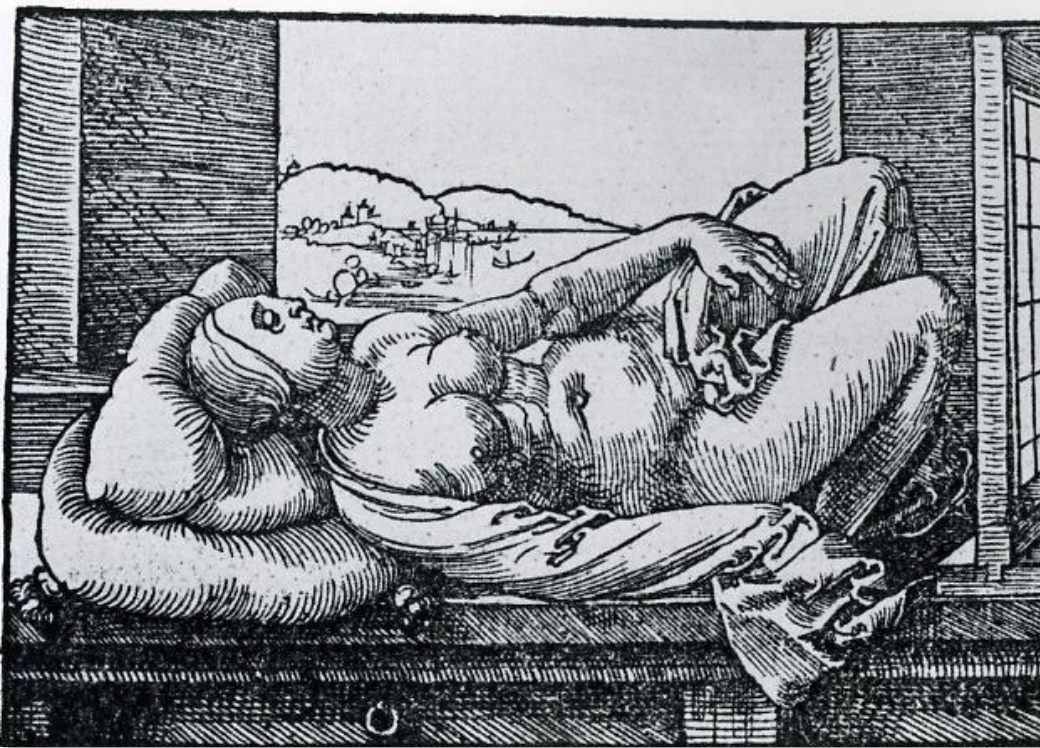


Albrecht Dürer



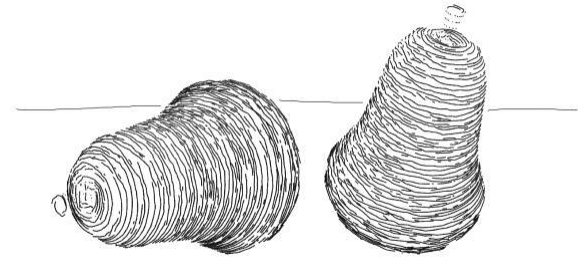Leonardo da Vinci

# Computational Hatching



Wikenbach  and Salesin [1994]
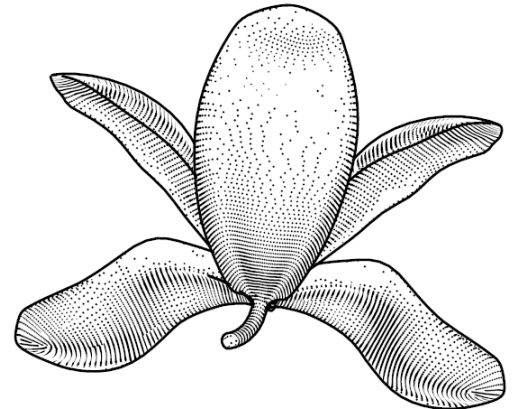
Hertzmann and Zorin [2000]
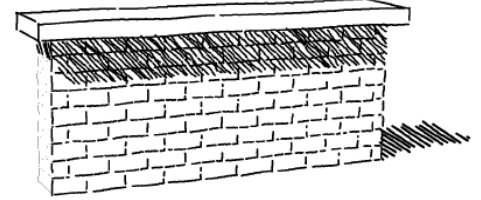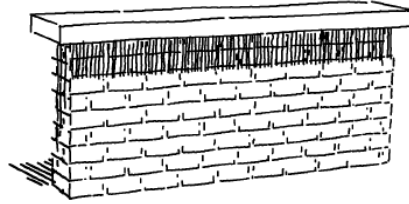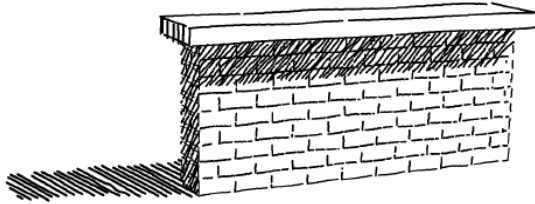
Wikenbach  and  Salesin [1996]

Girshick et al. [2000]

Elber et al. [1998]

Praun et al. [2001]

Zander et al. [2004]

# Sparse Line Drawing
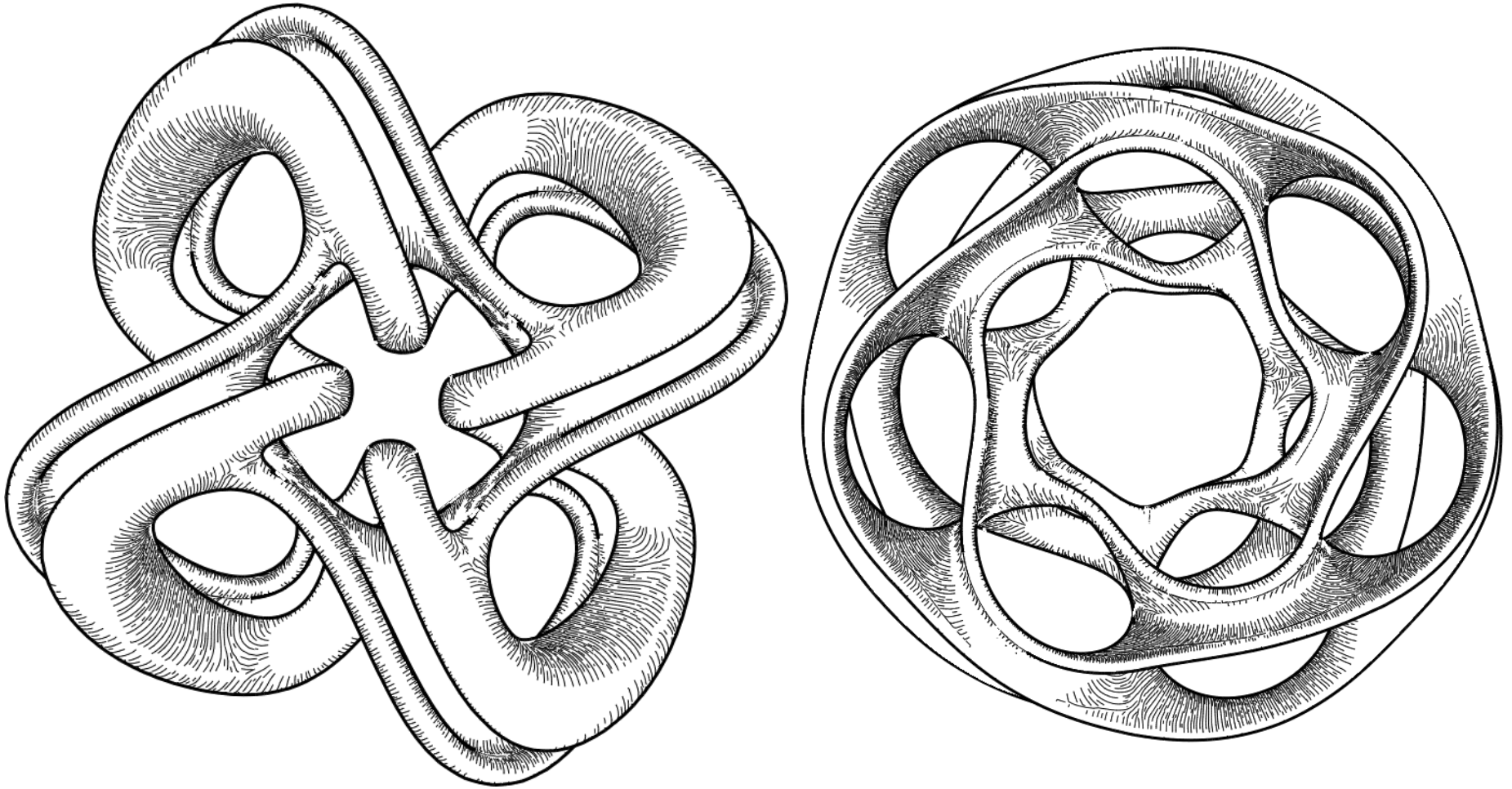


Suggestive Contours

Apparent Ridges

DeCarlo et al. [2003]

Judd et al. [2007]
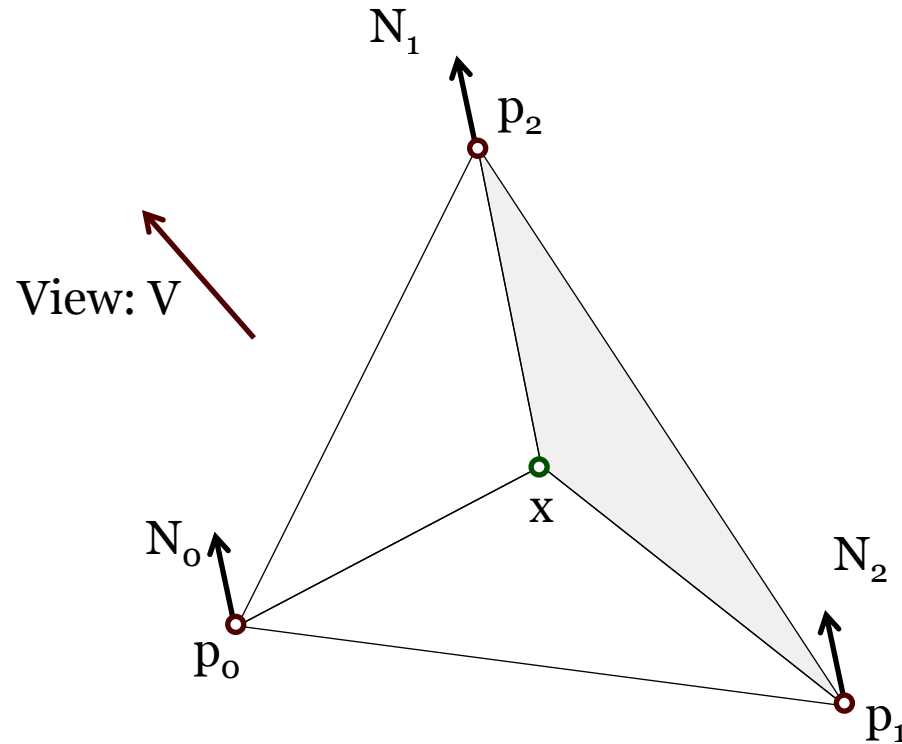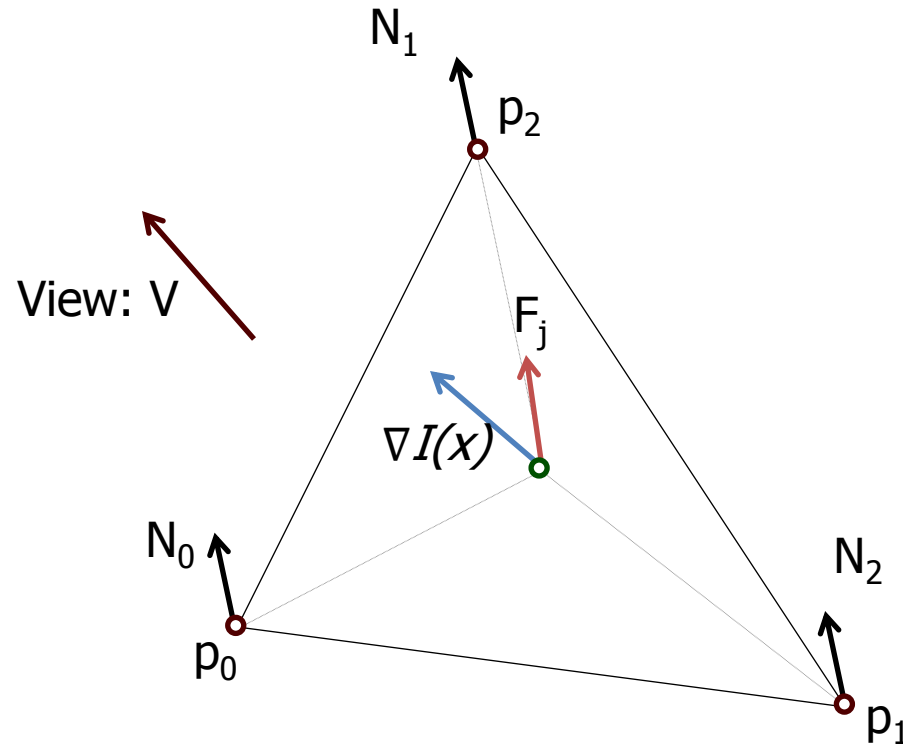
# Contour & Hatching



Suggestive Hatching

# Shading Vector Field



$$I(x) = \sum_{k=0}^{2} (V \cdot N_{j,k}) \frac{A(x, p_{j,k+1}, p_{j,k+2})}{A(p_{j,0}, p_{j,1}, p_{j,2})}$$
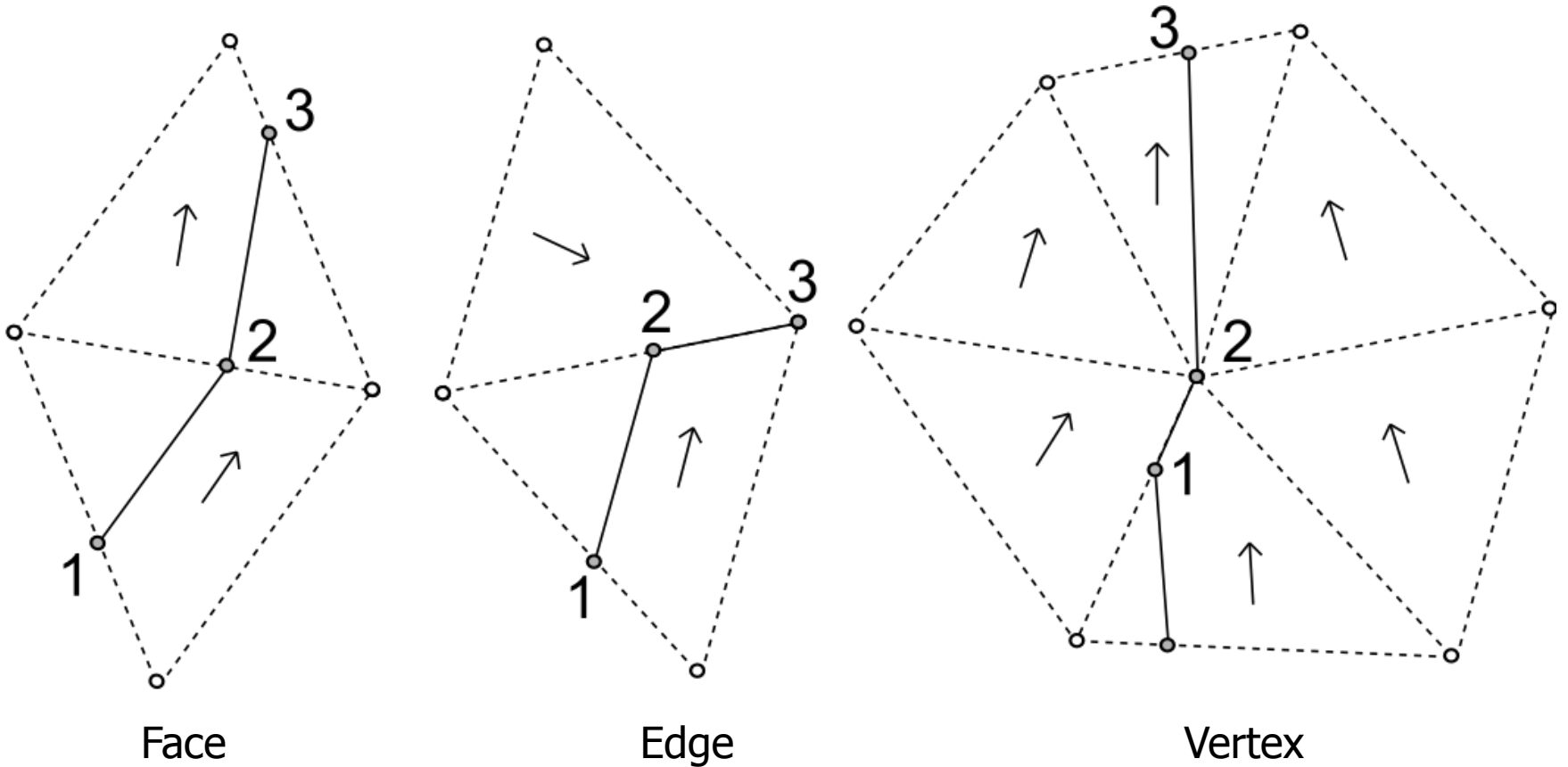
# Shading Vector Field



$$\nabla I(x) = \sum_{k=0}^{2} \frac{(V \cdot N_{j,k})}{A(p_{j,0}, p_{j,1}, p_{j,2})} (p_{j,k+2} - p_{j,k+1}) \times F_j$$
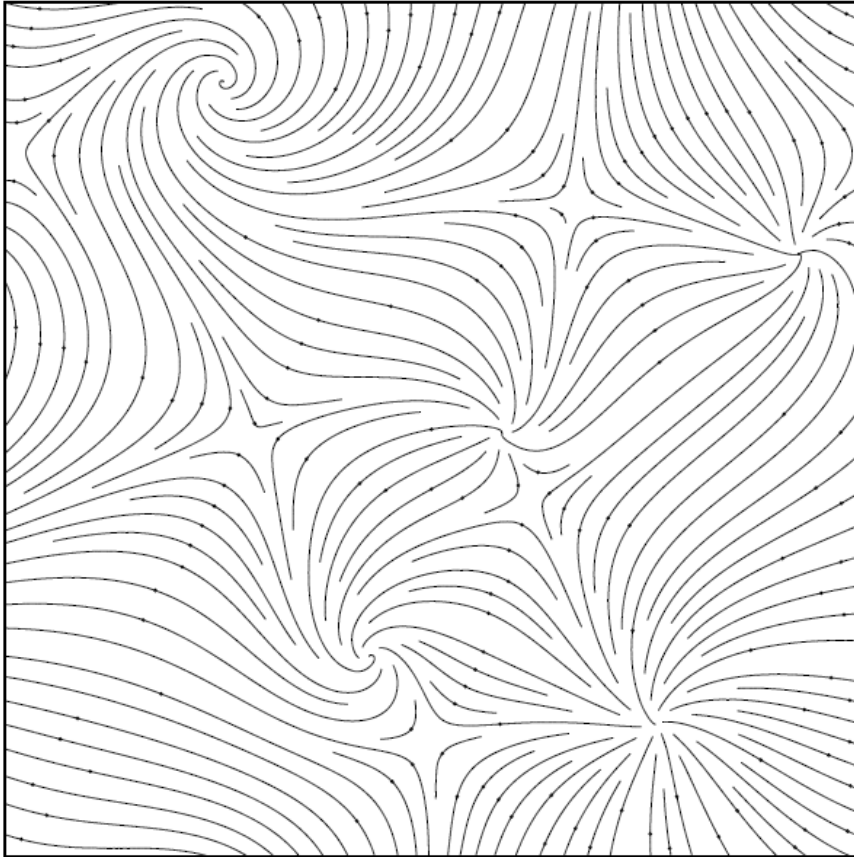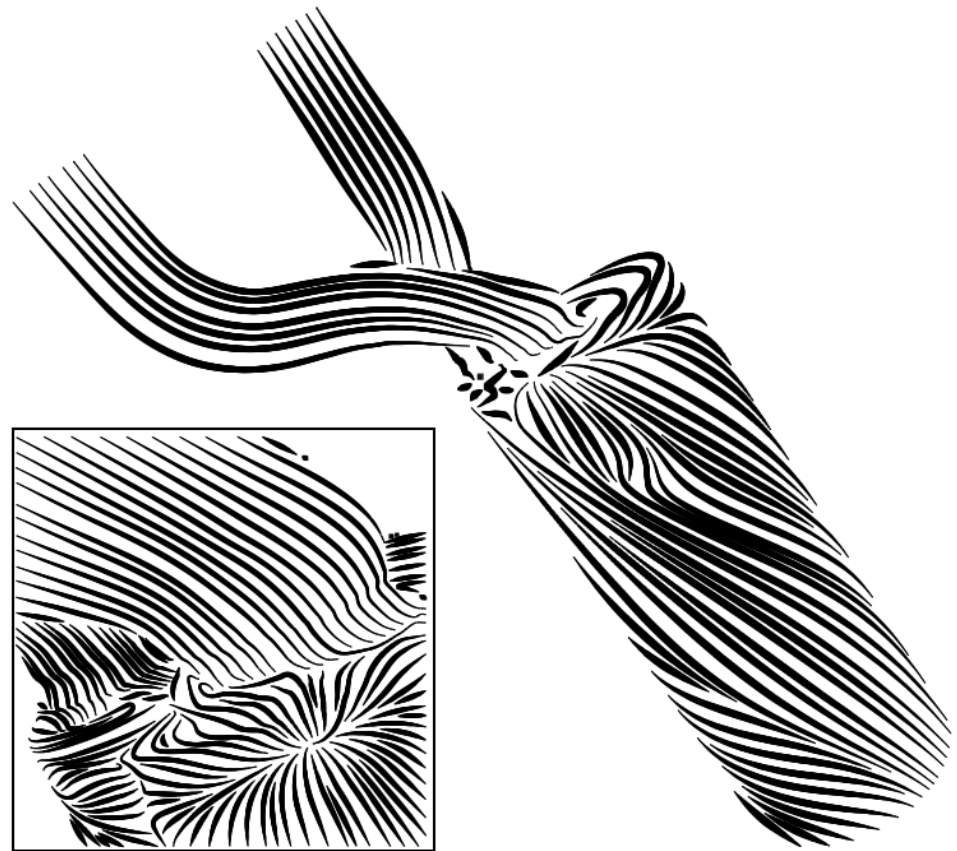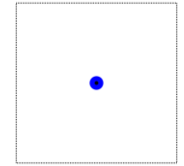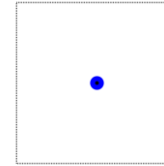
# Shading Strokes



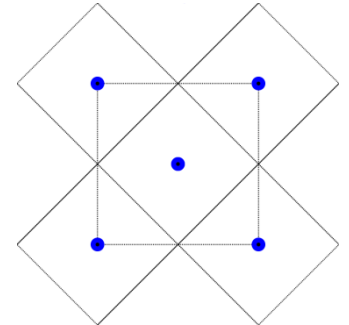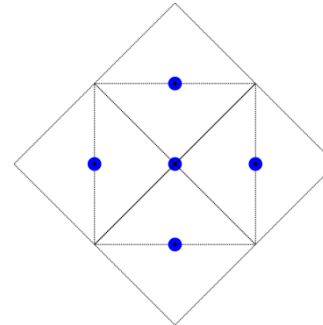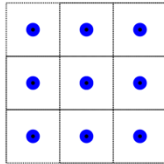Face            Edge            Vertex
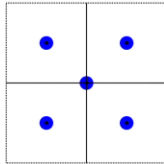
Dong et al. [2005]

# Streamlines



Mebarki et al.[2005]

Spencer et al. [2009]

# Seeding and Spacing of Lines
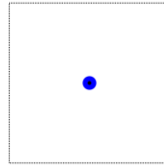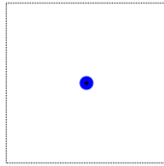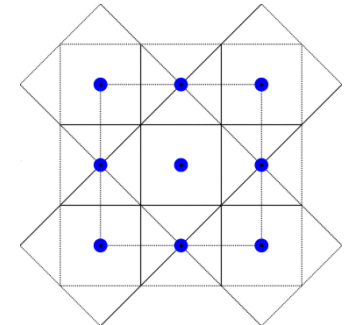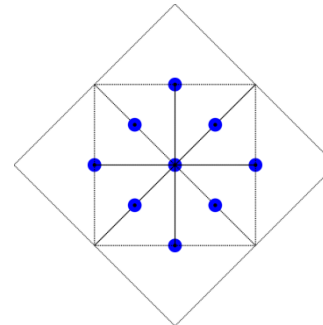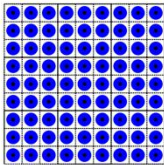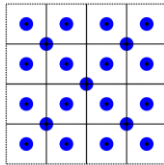


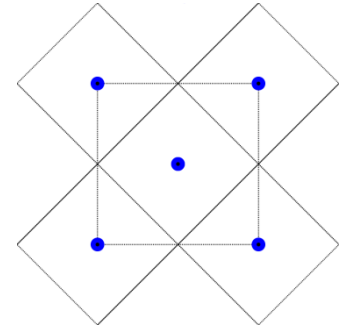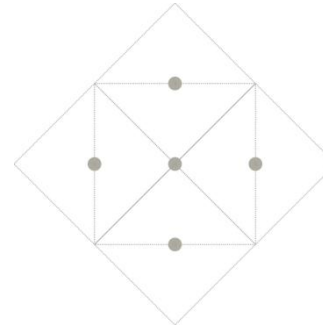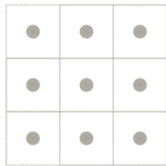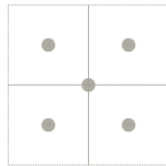| Levels | Binary | Ternary | Sqrt(2) | **Midpoint** |

# Seeding and Spacing of Lines
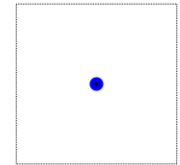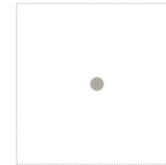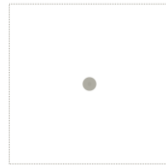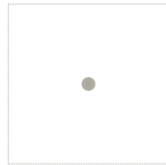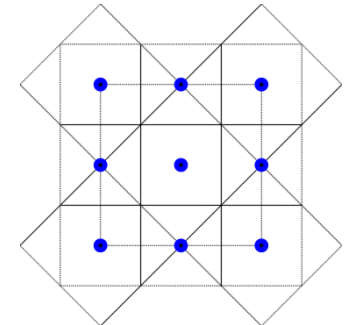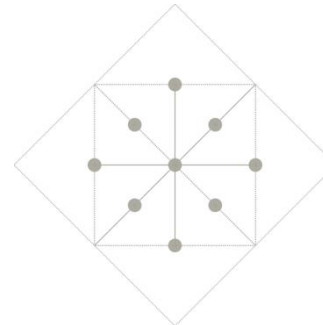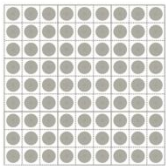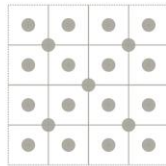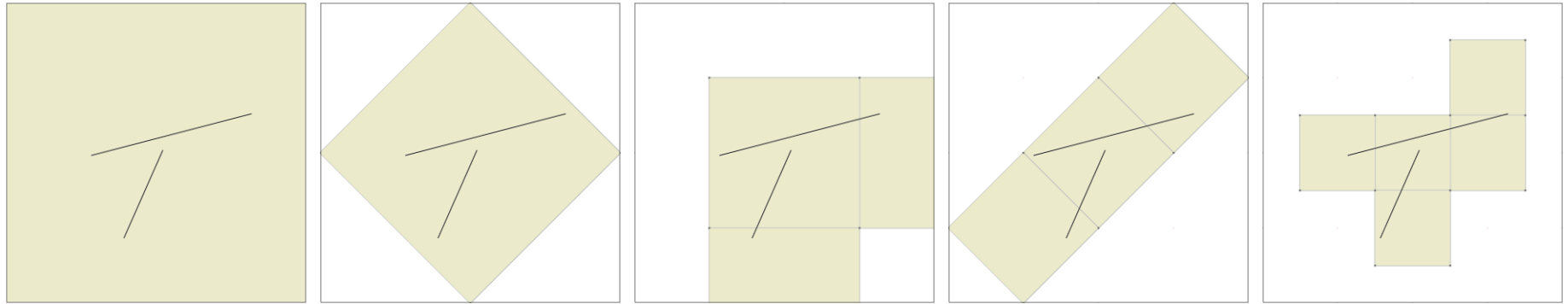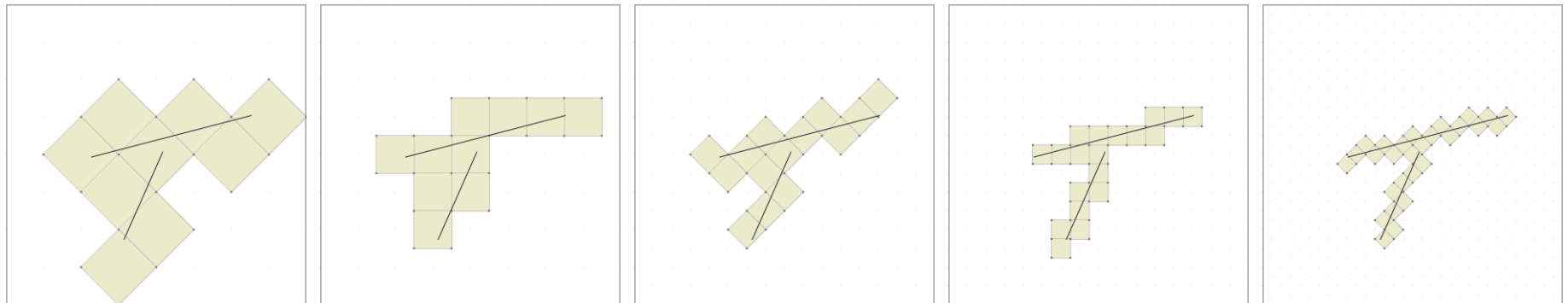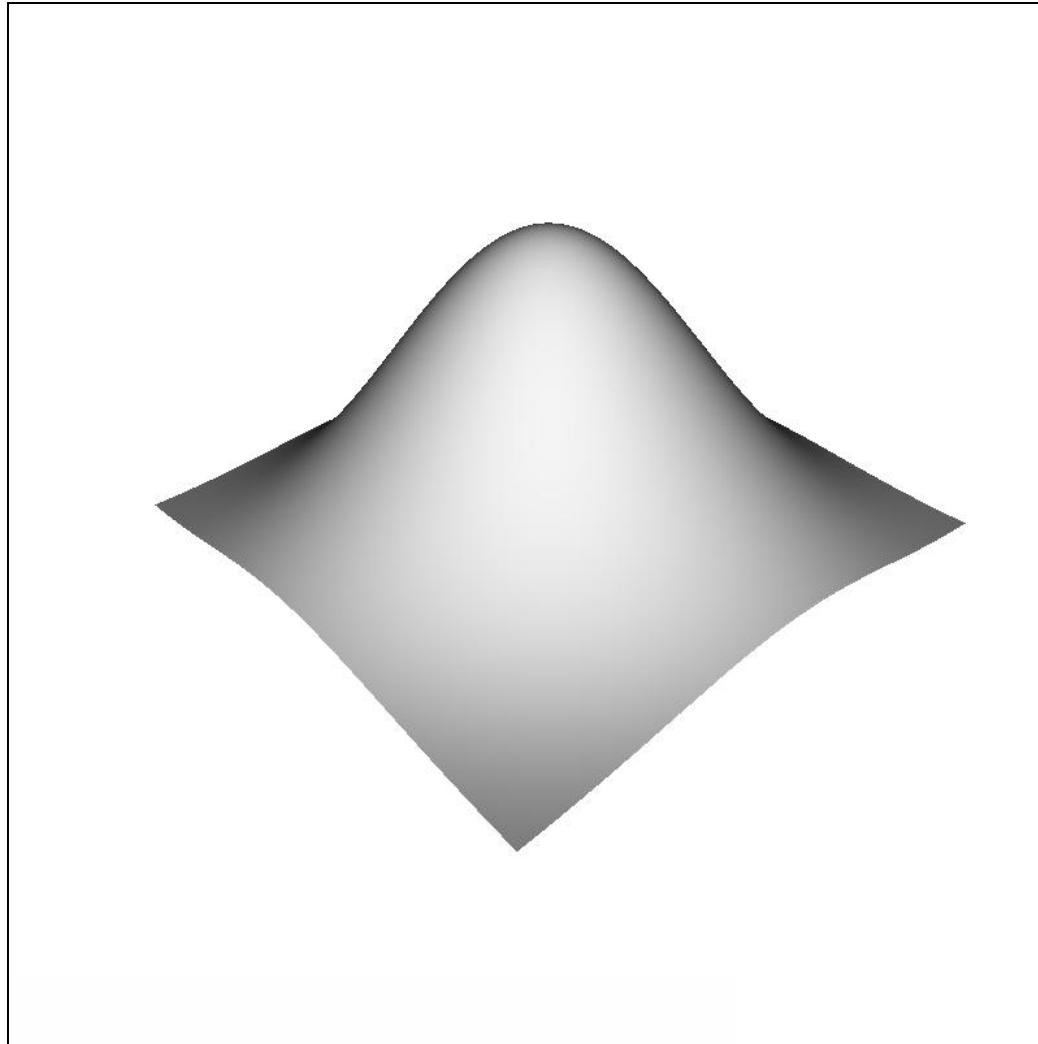
# Seeding and Spacing of Lines



0  1  2  3  4
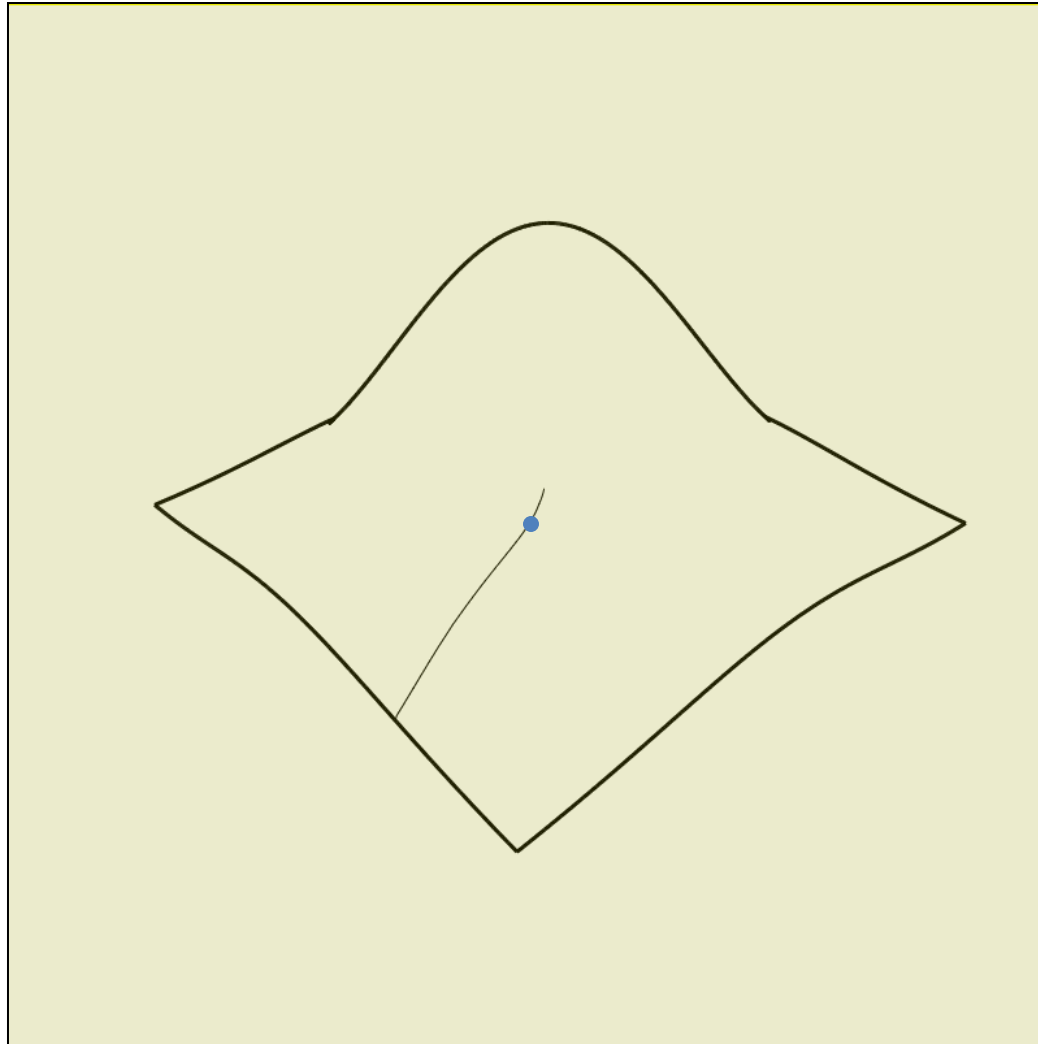
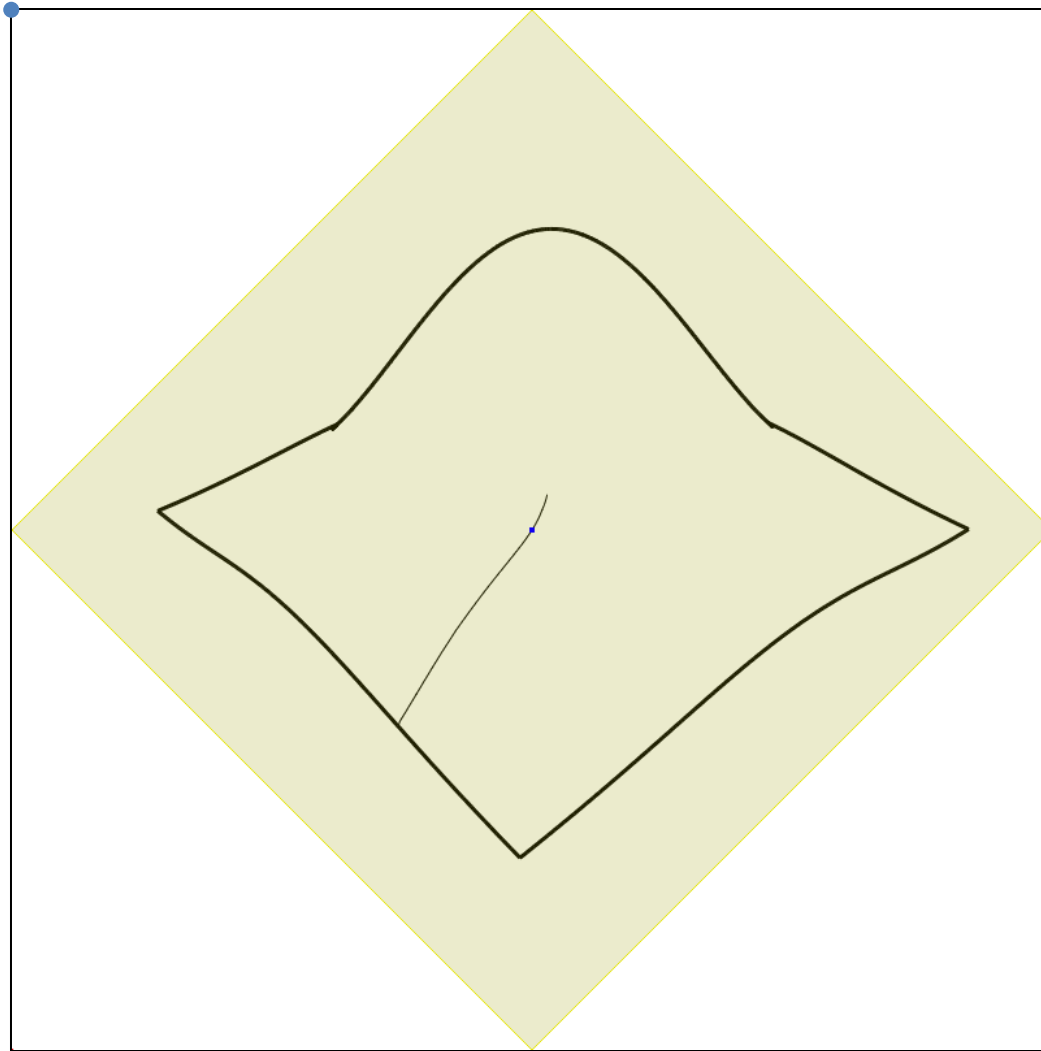5  6  7  8  9

**20 levels**

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

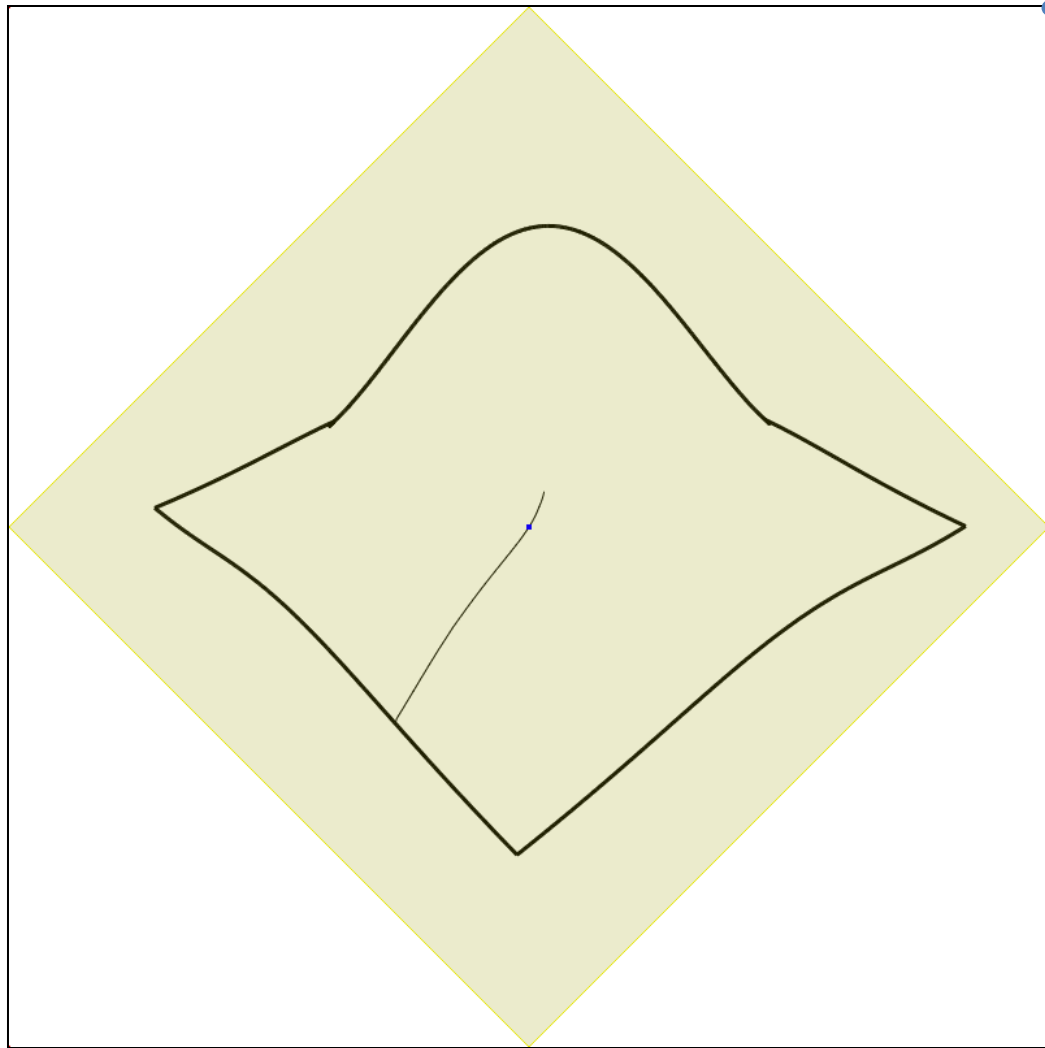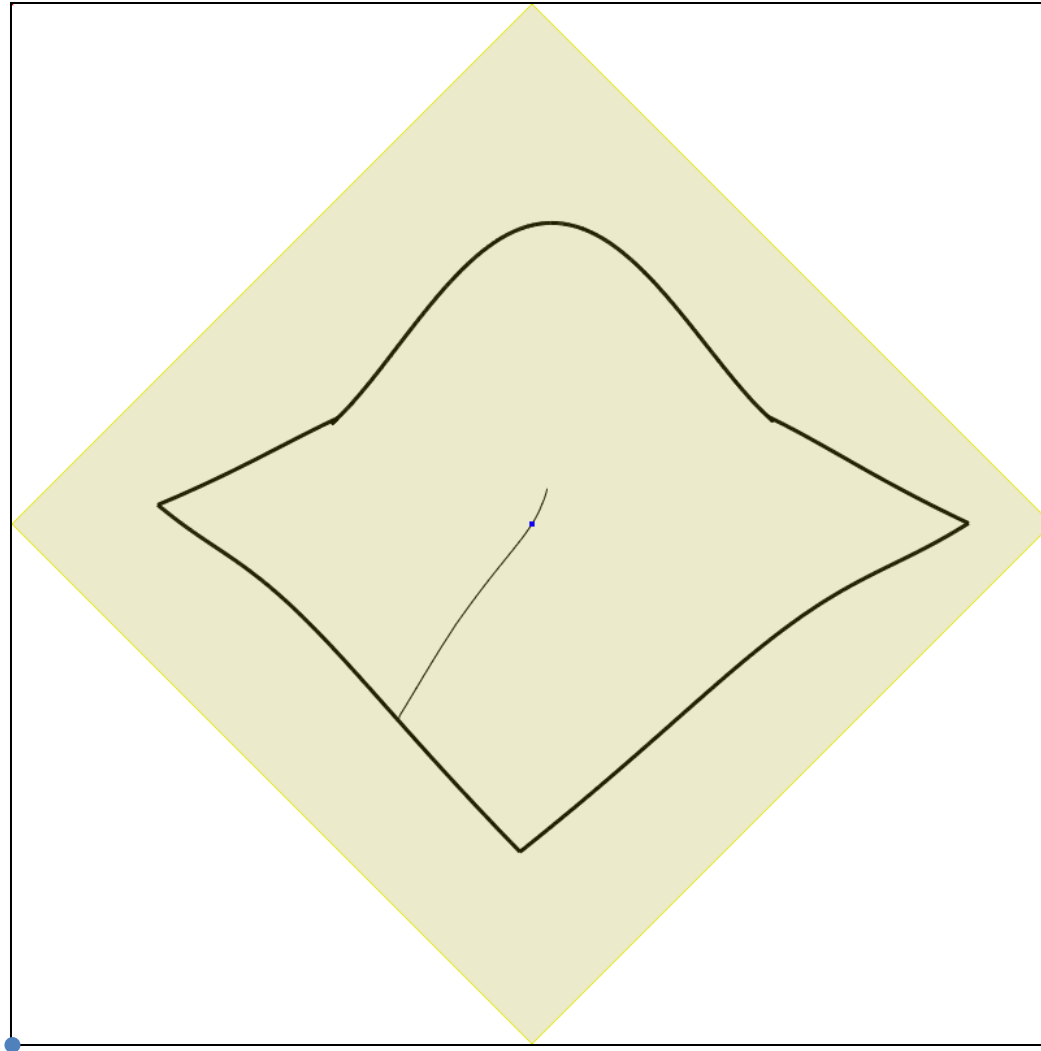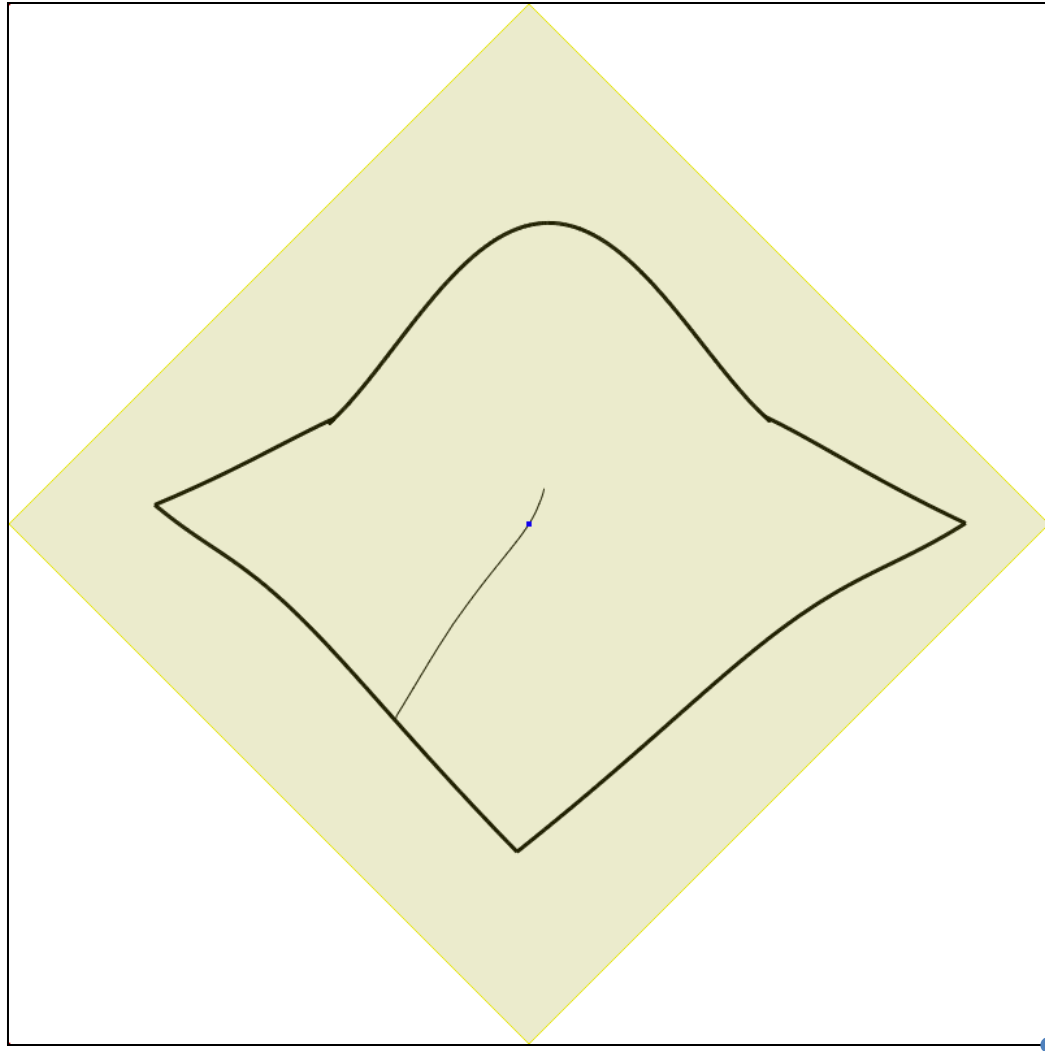# Seeding and Spacing of Lines

# Seeding and Spacing of Lines
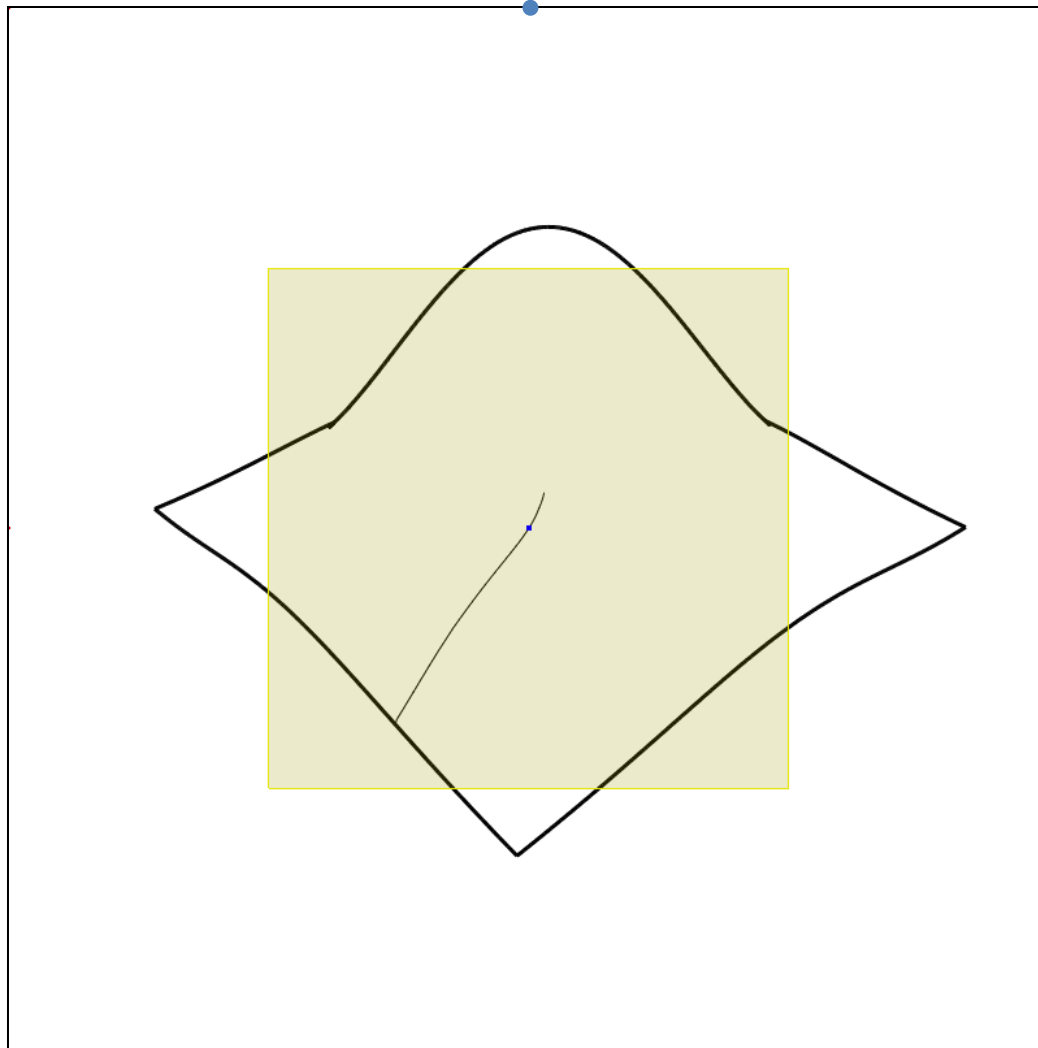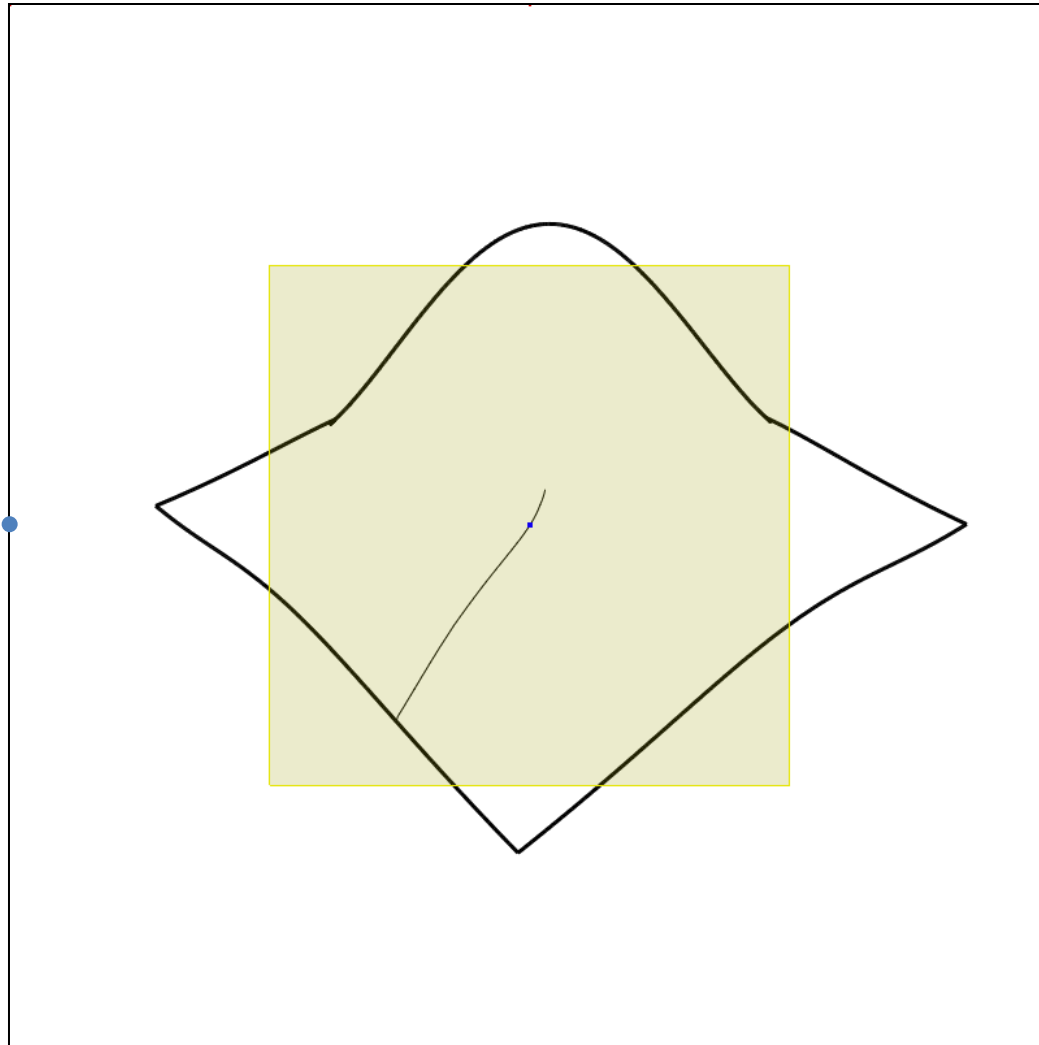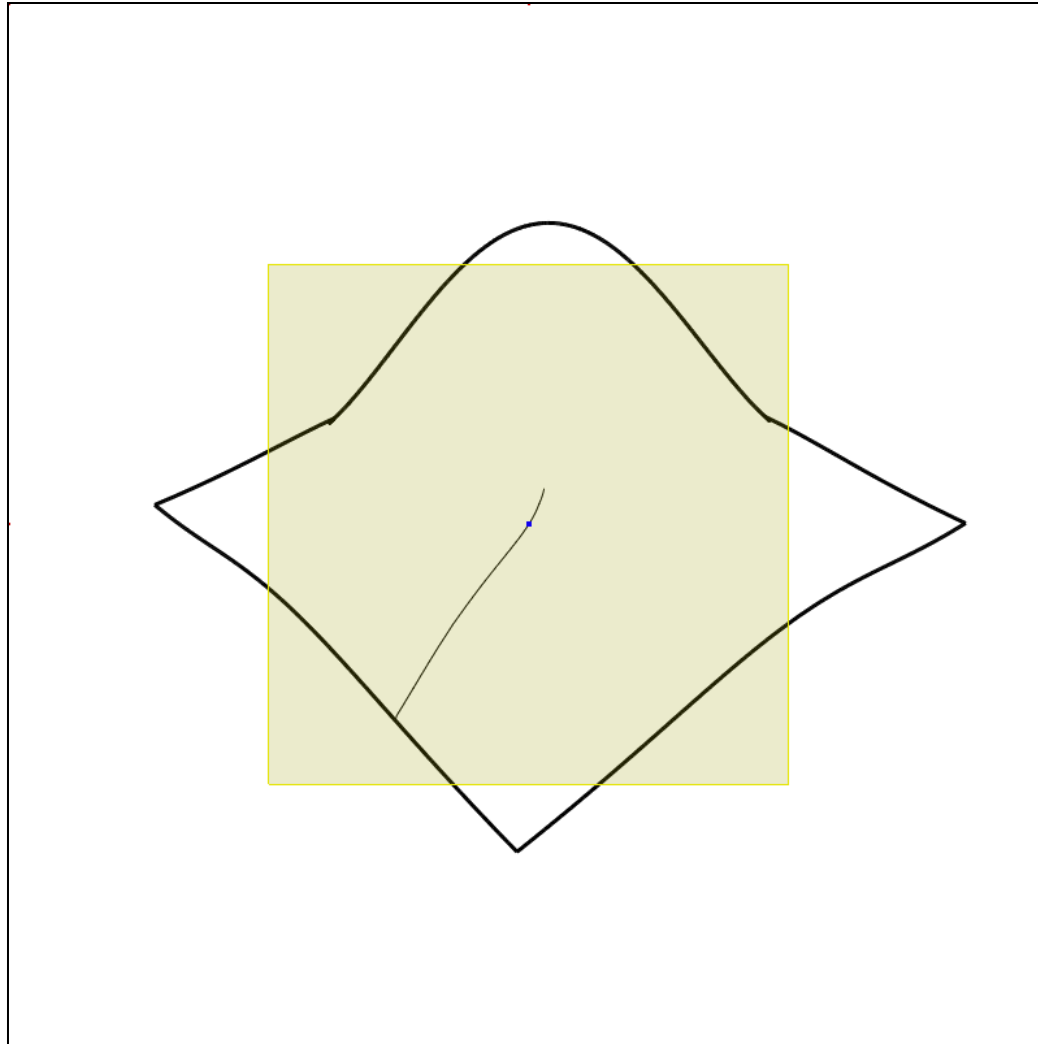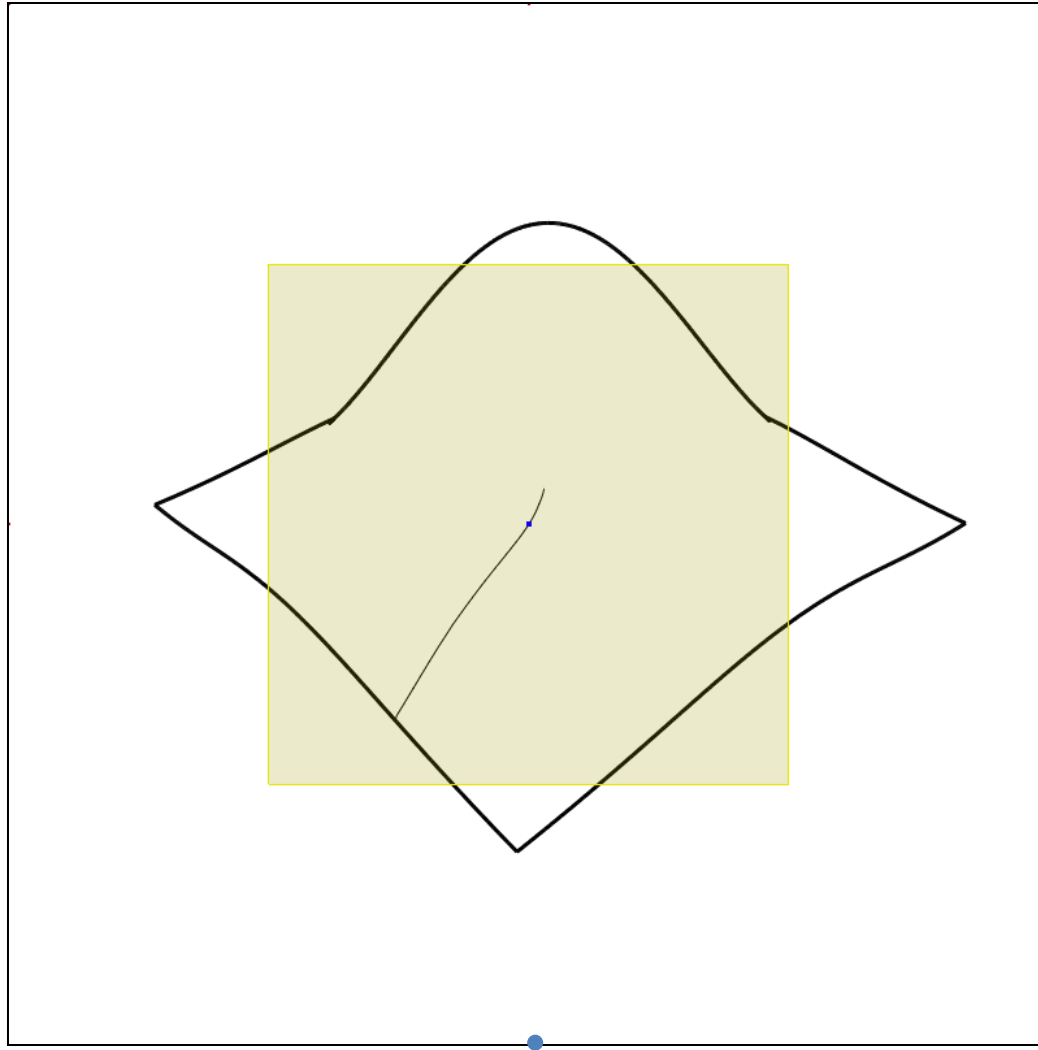
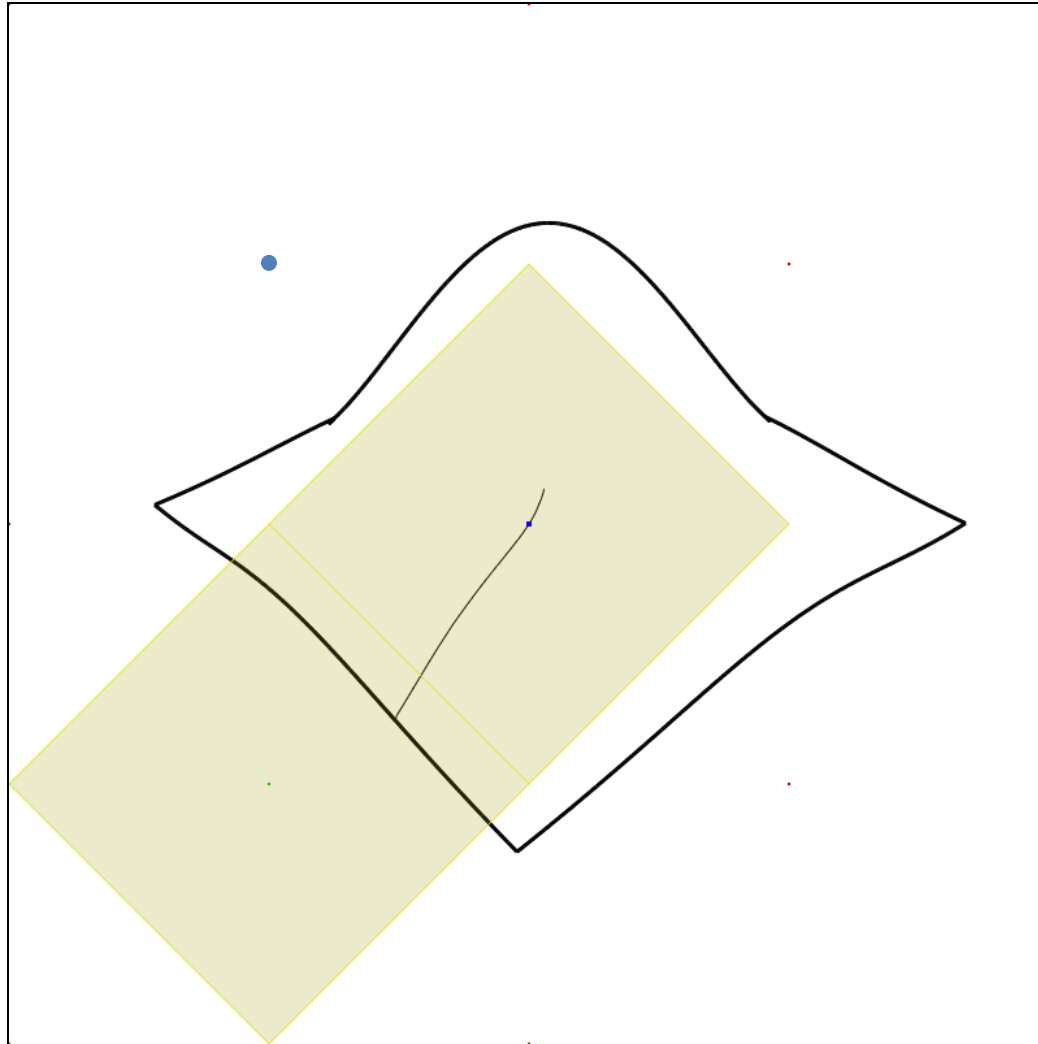# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines
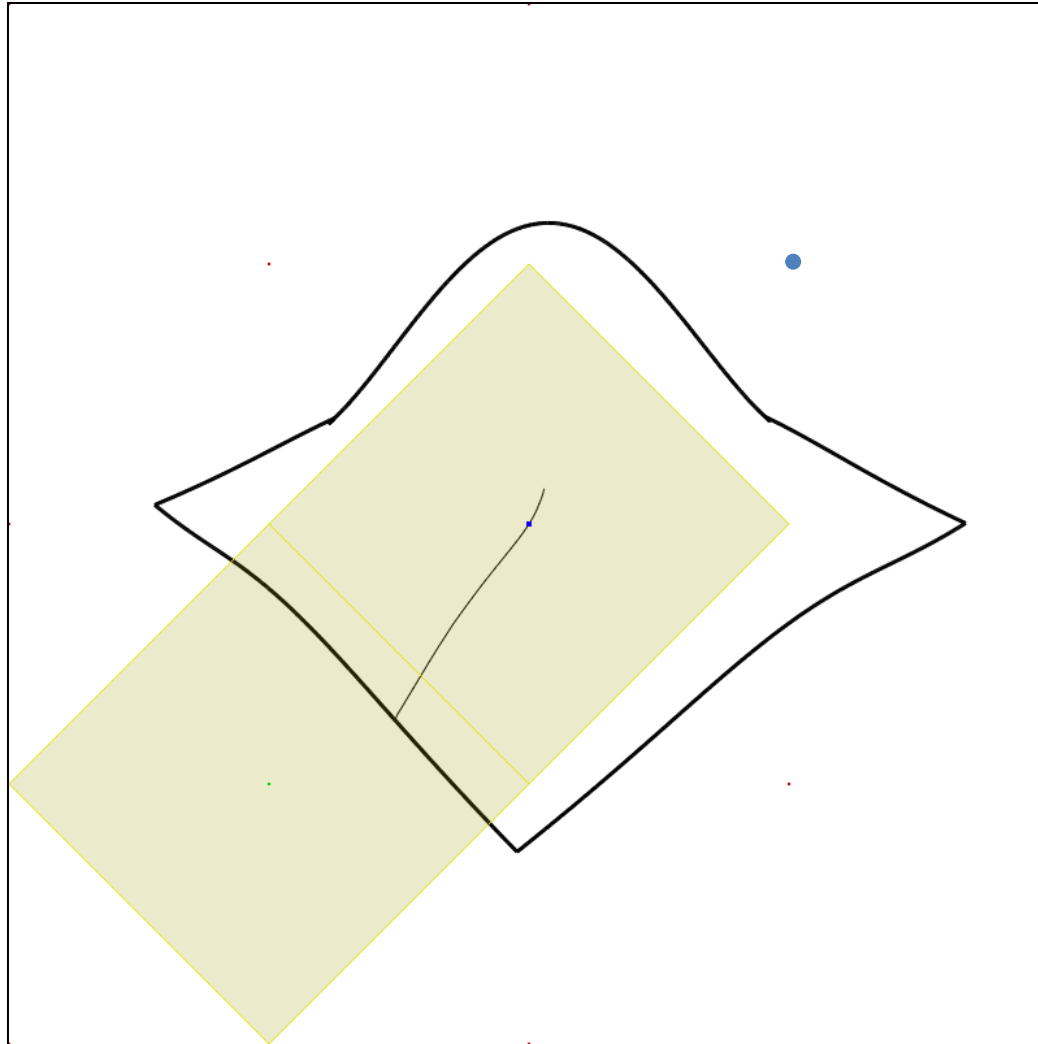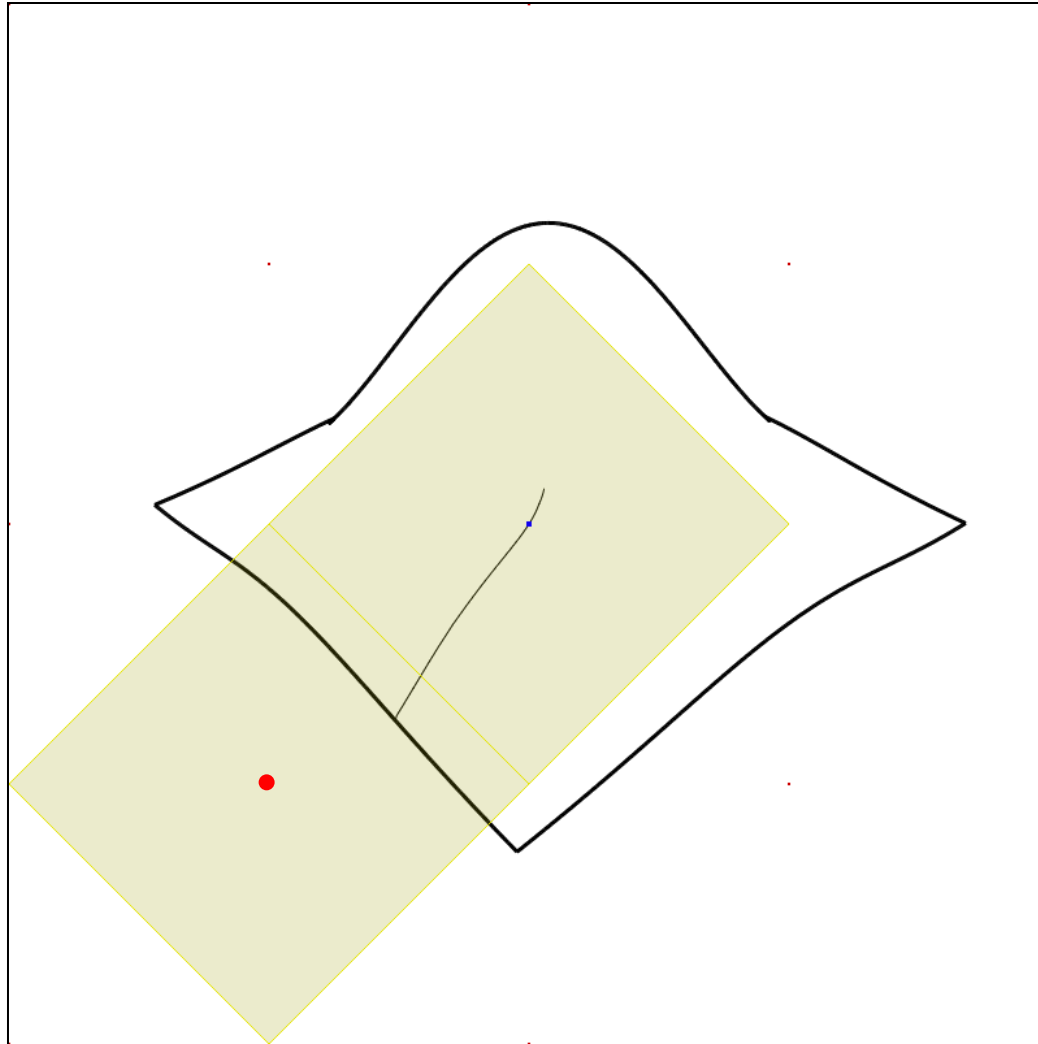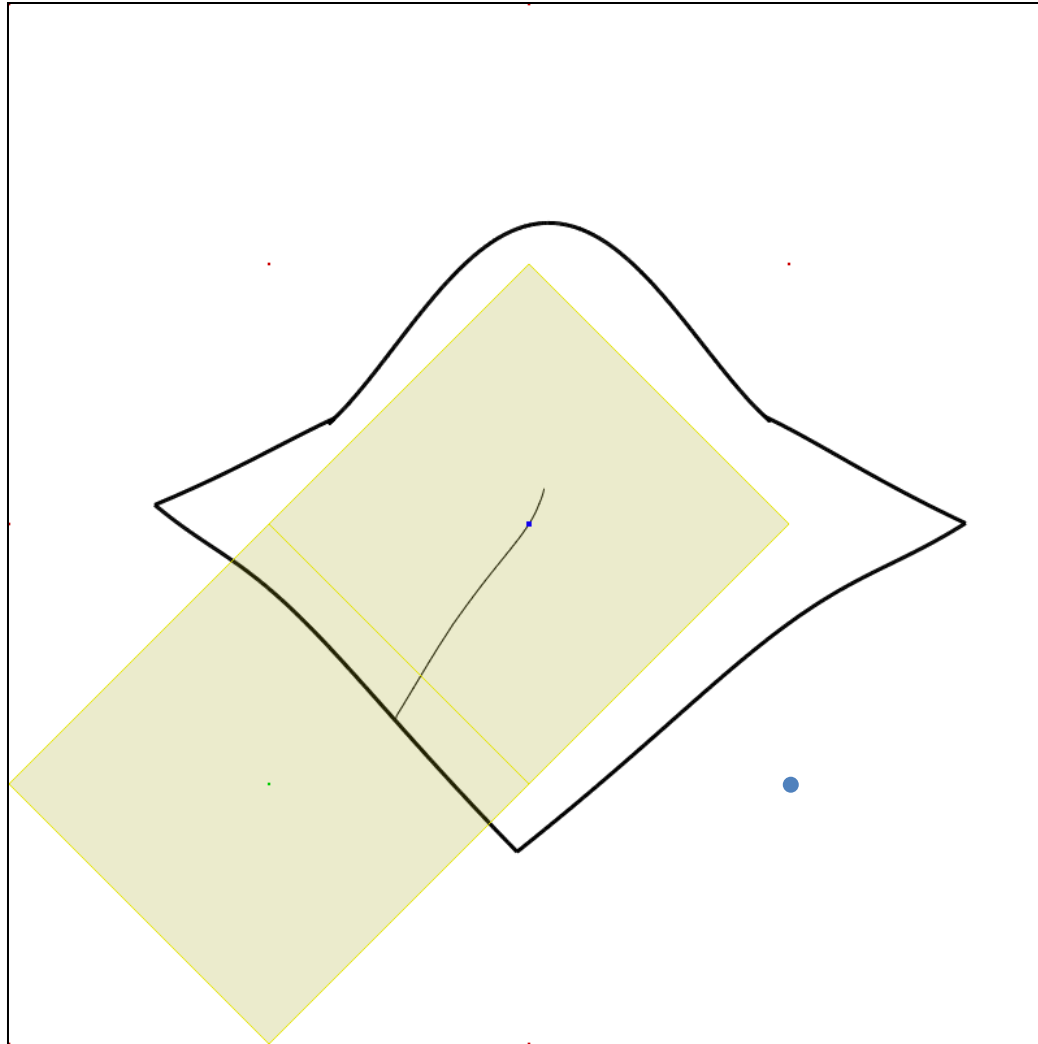
# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

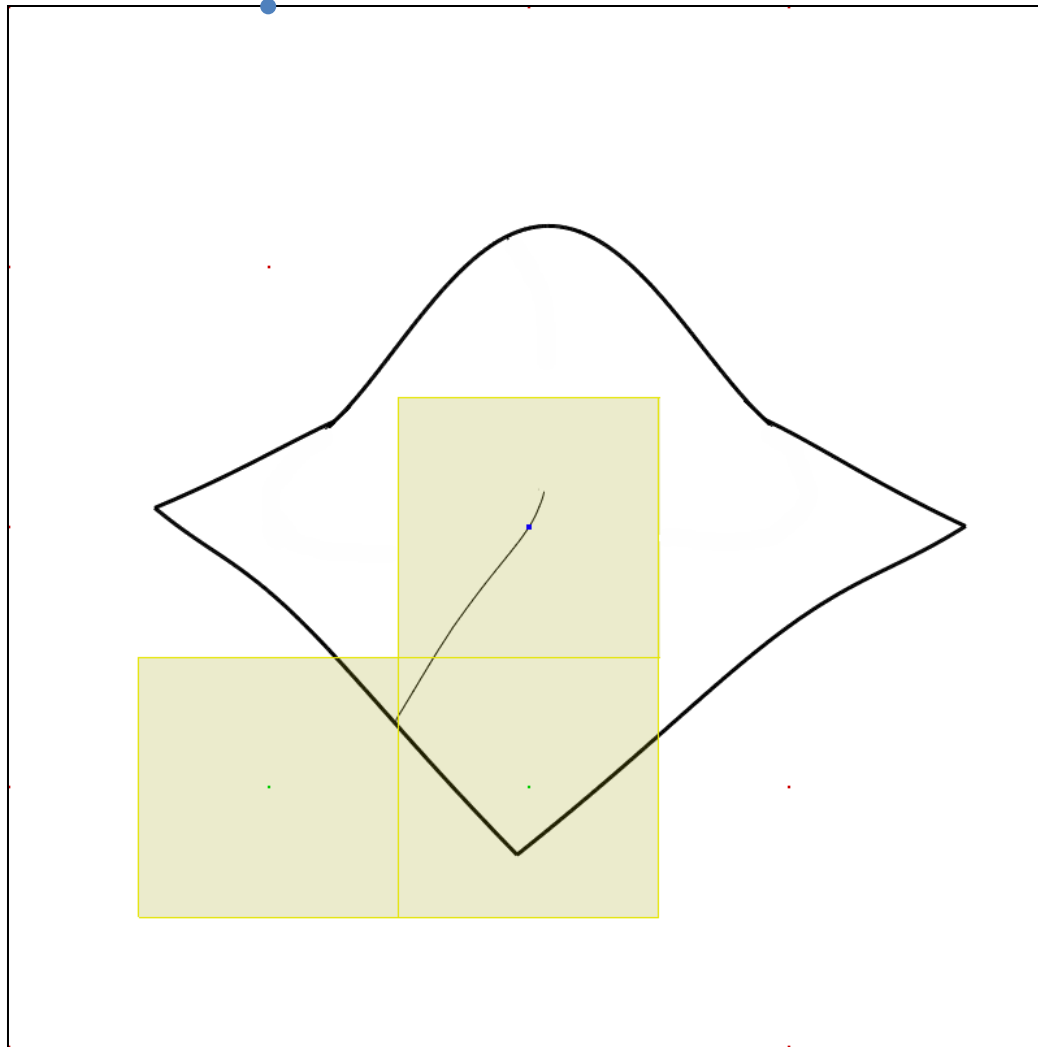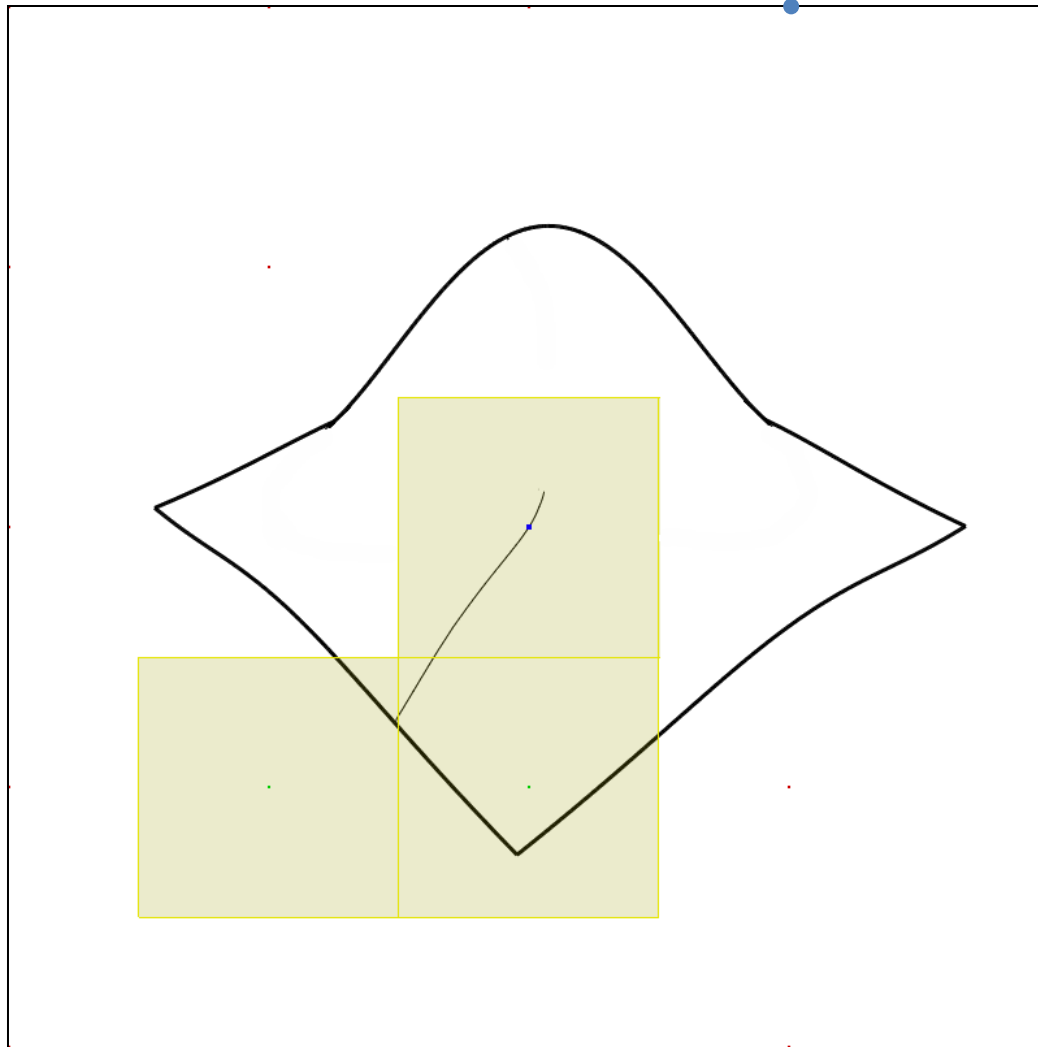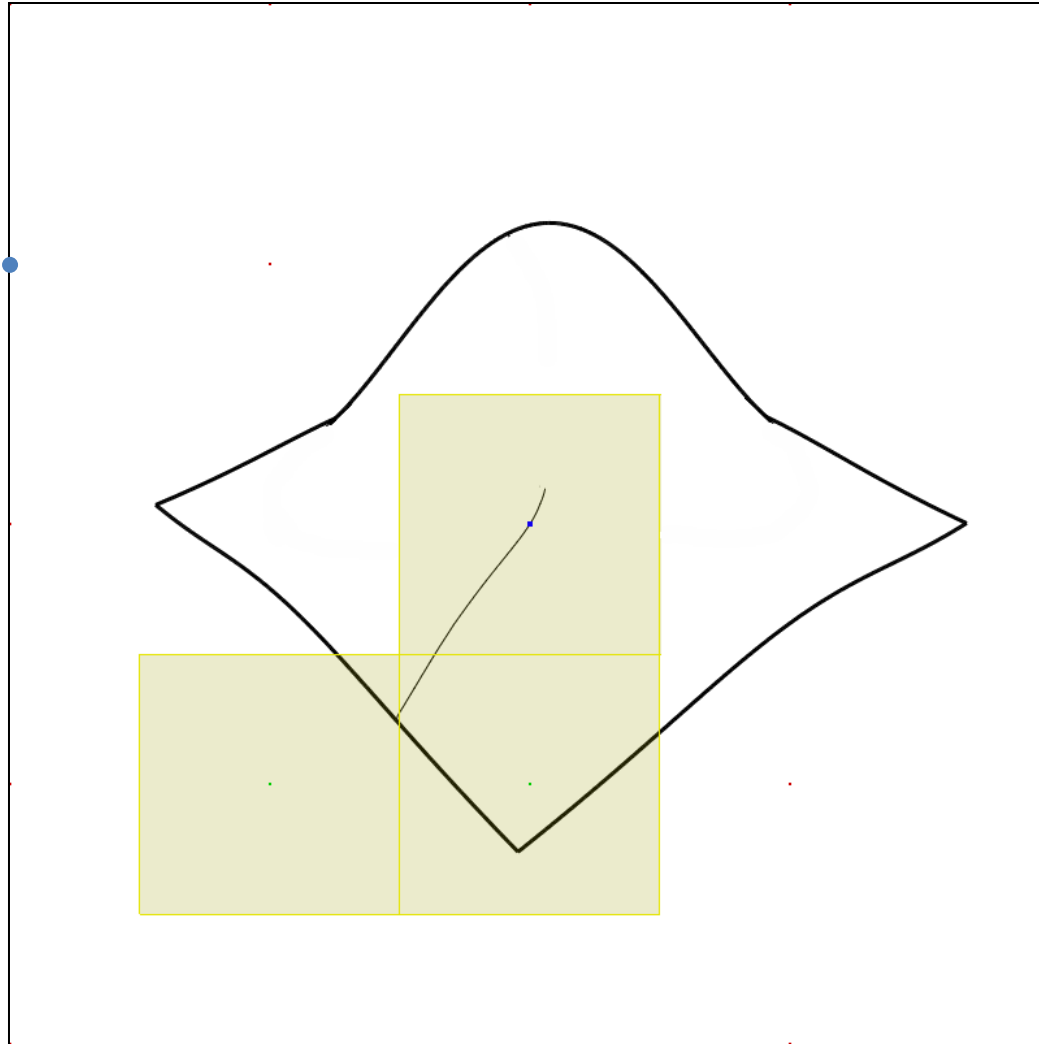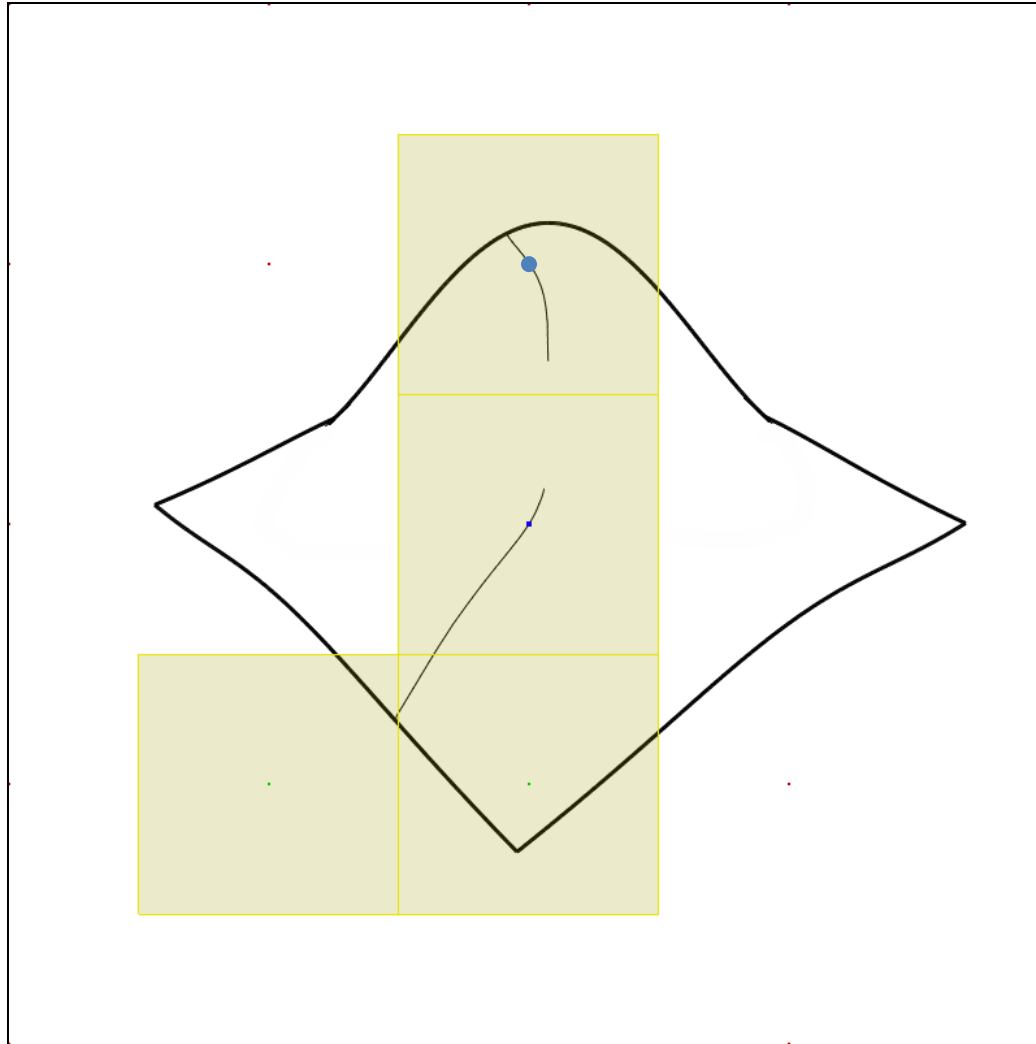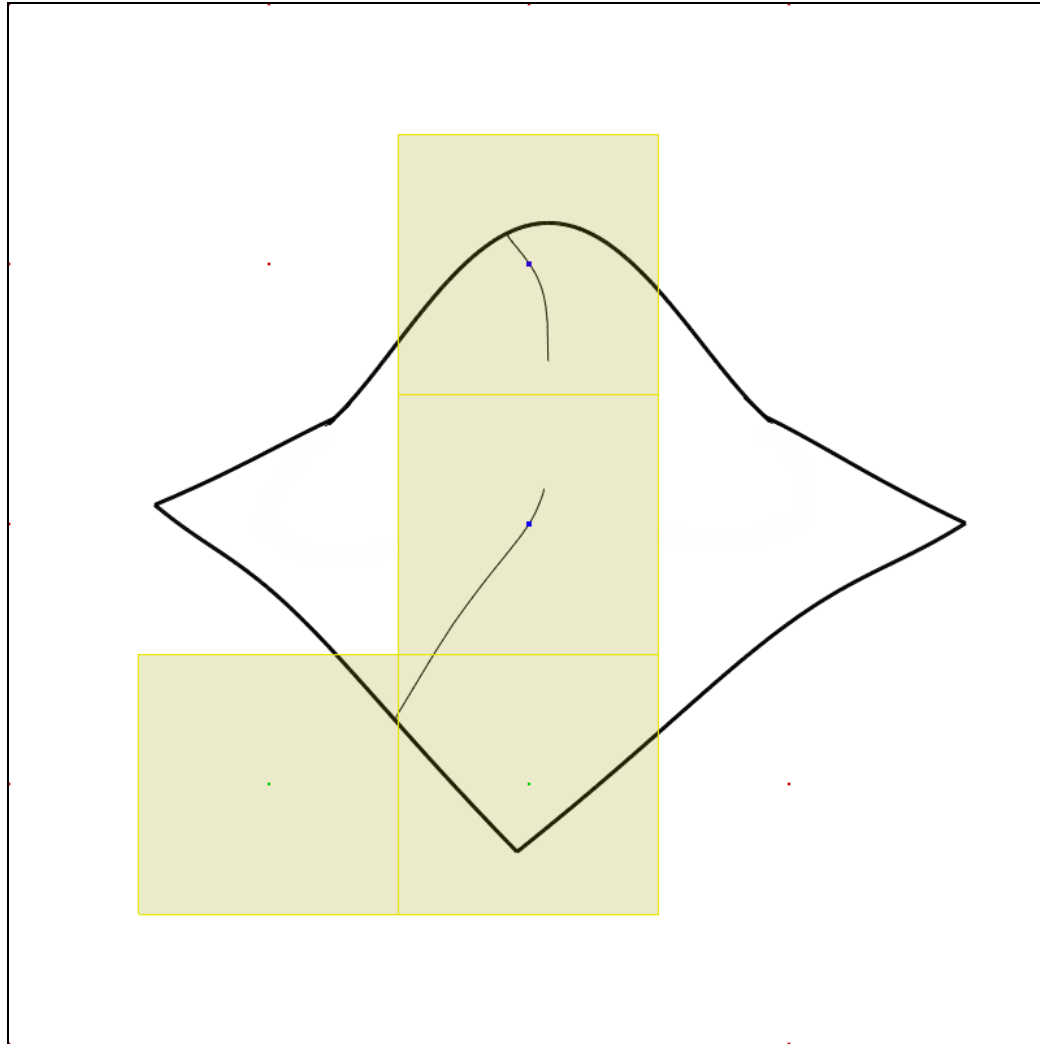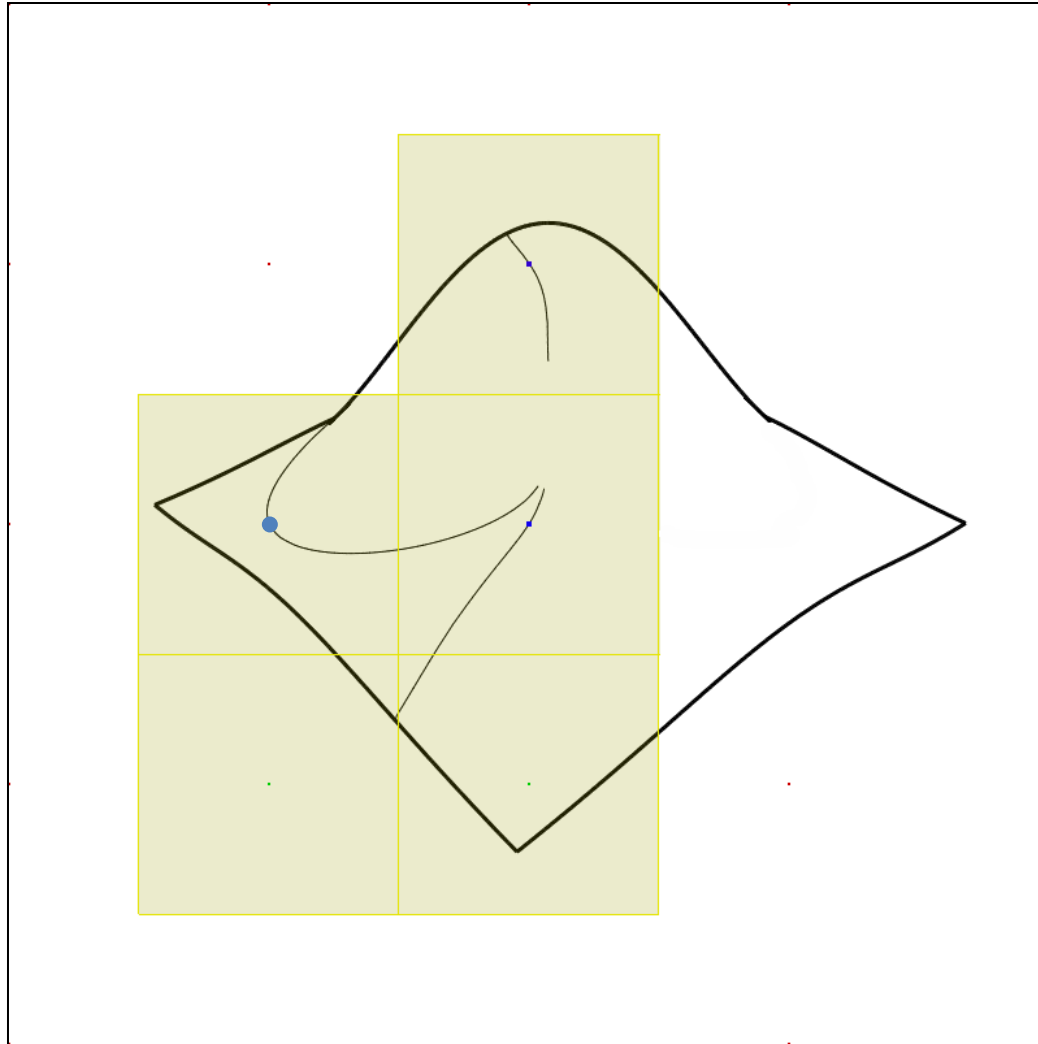# Seeding and Spacing of Lines
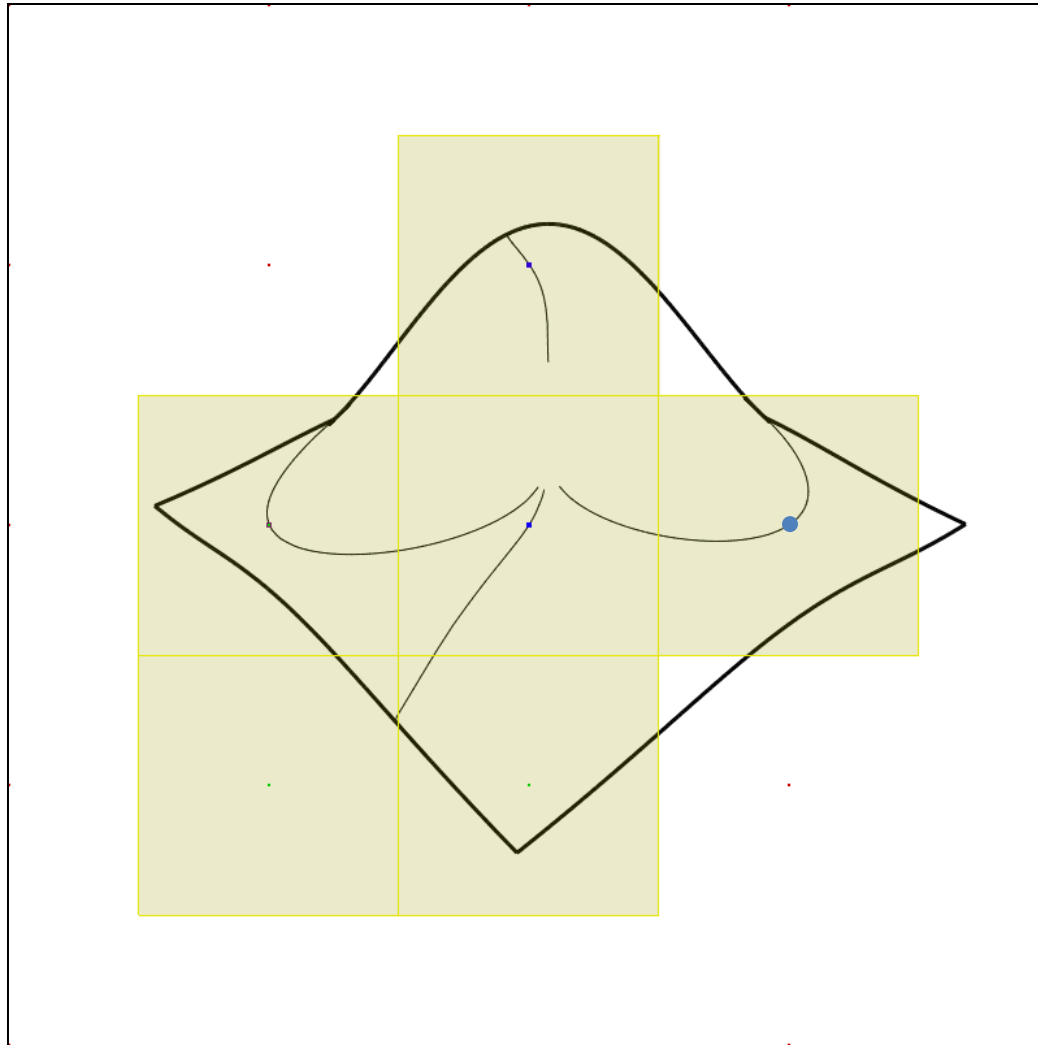
# Seeding and Spacing of Lines
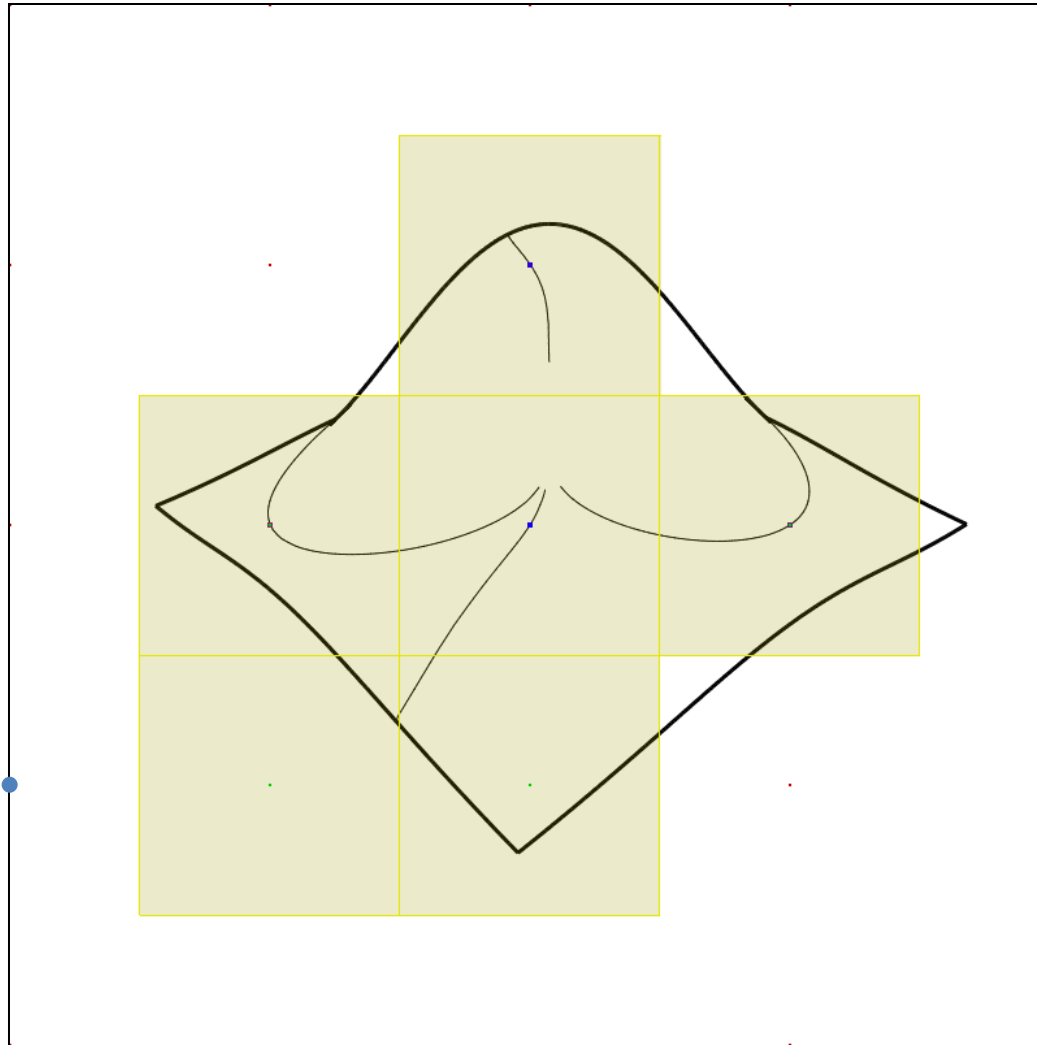
# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

# Seeding and Spacing of Lines

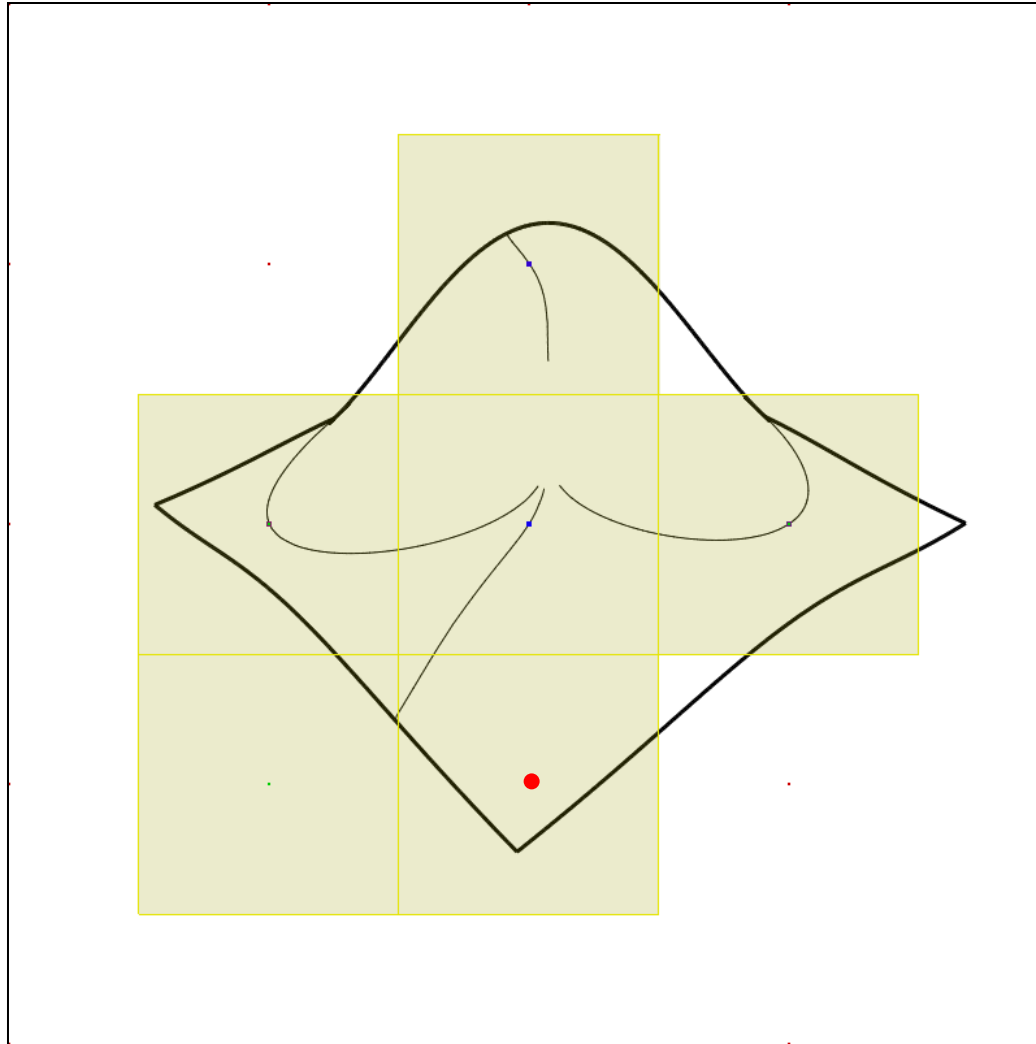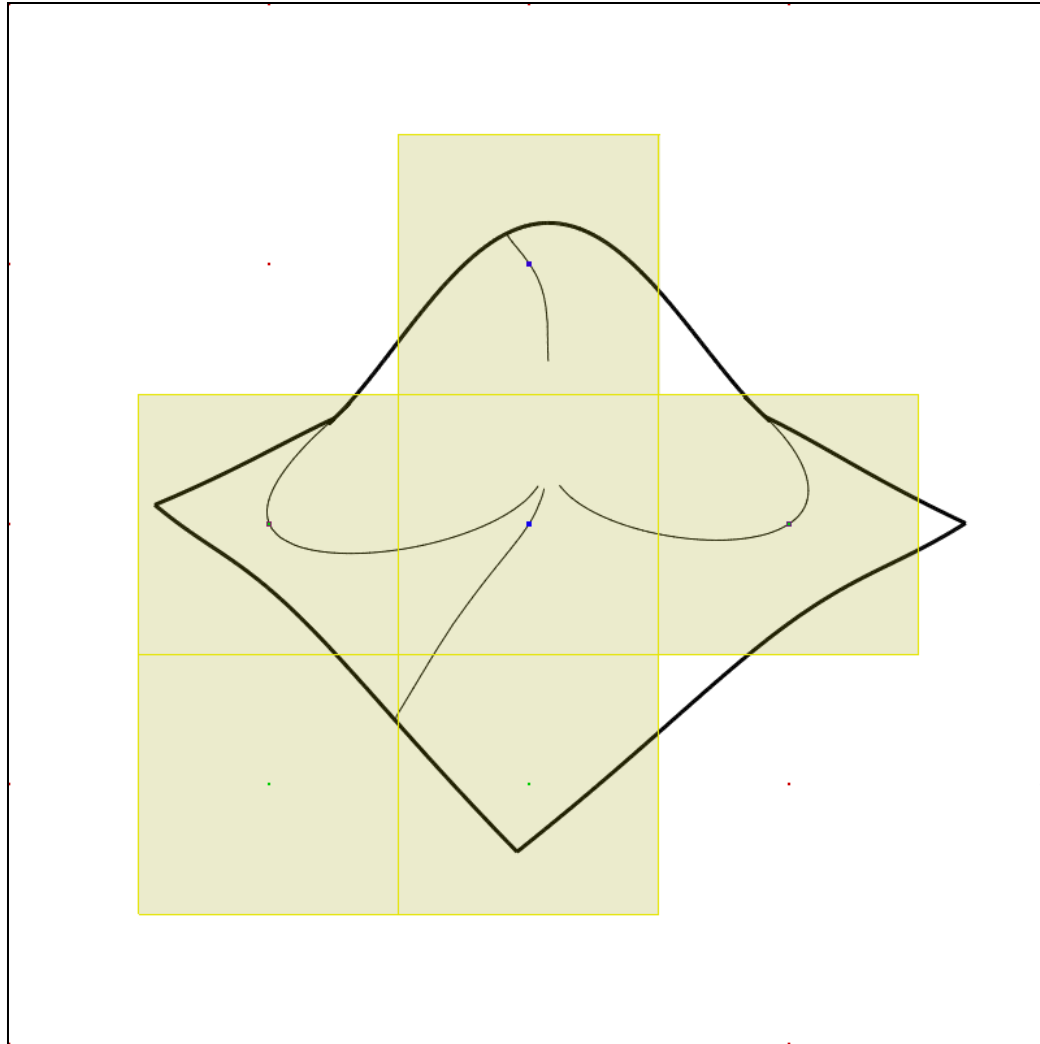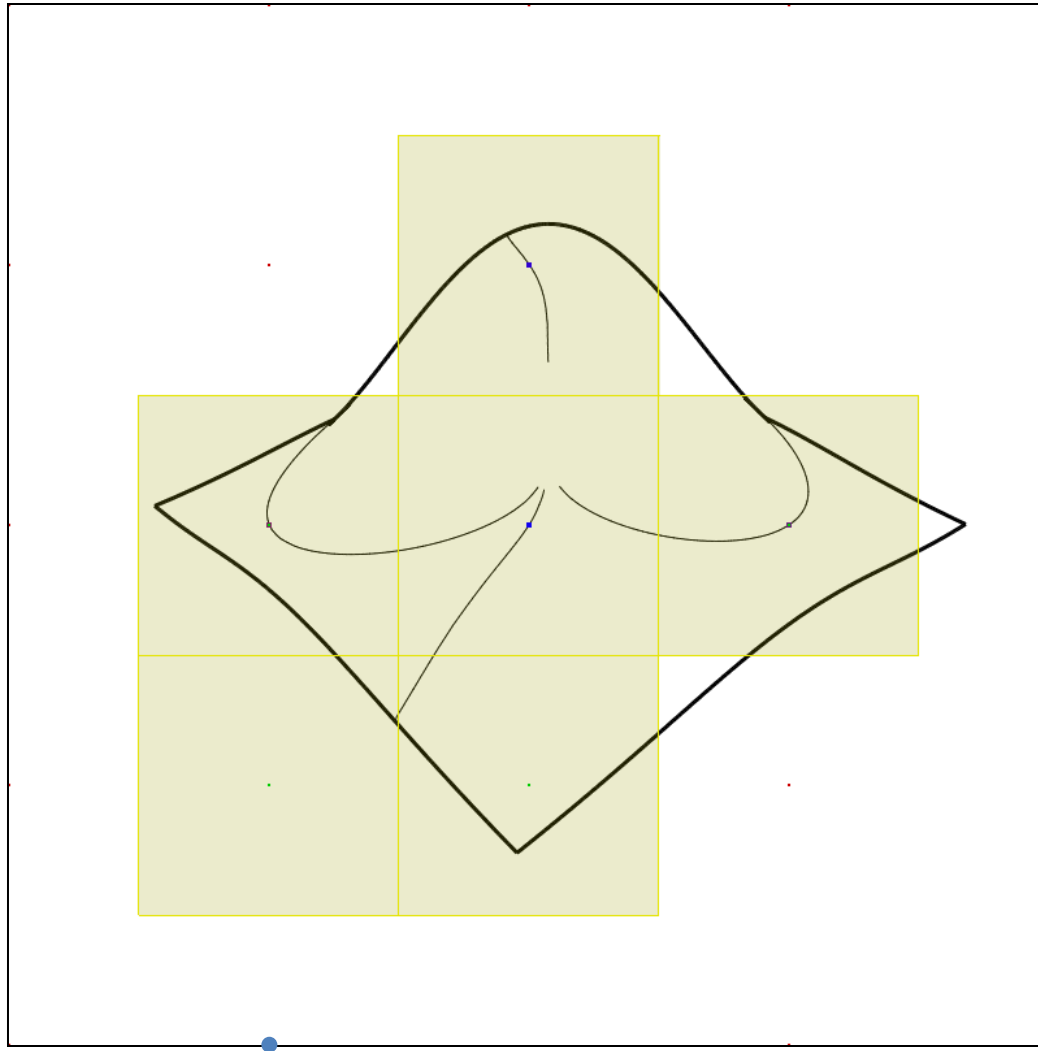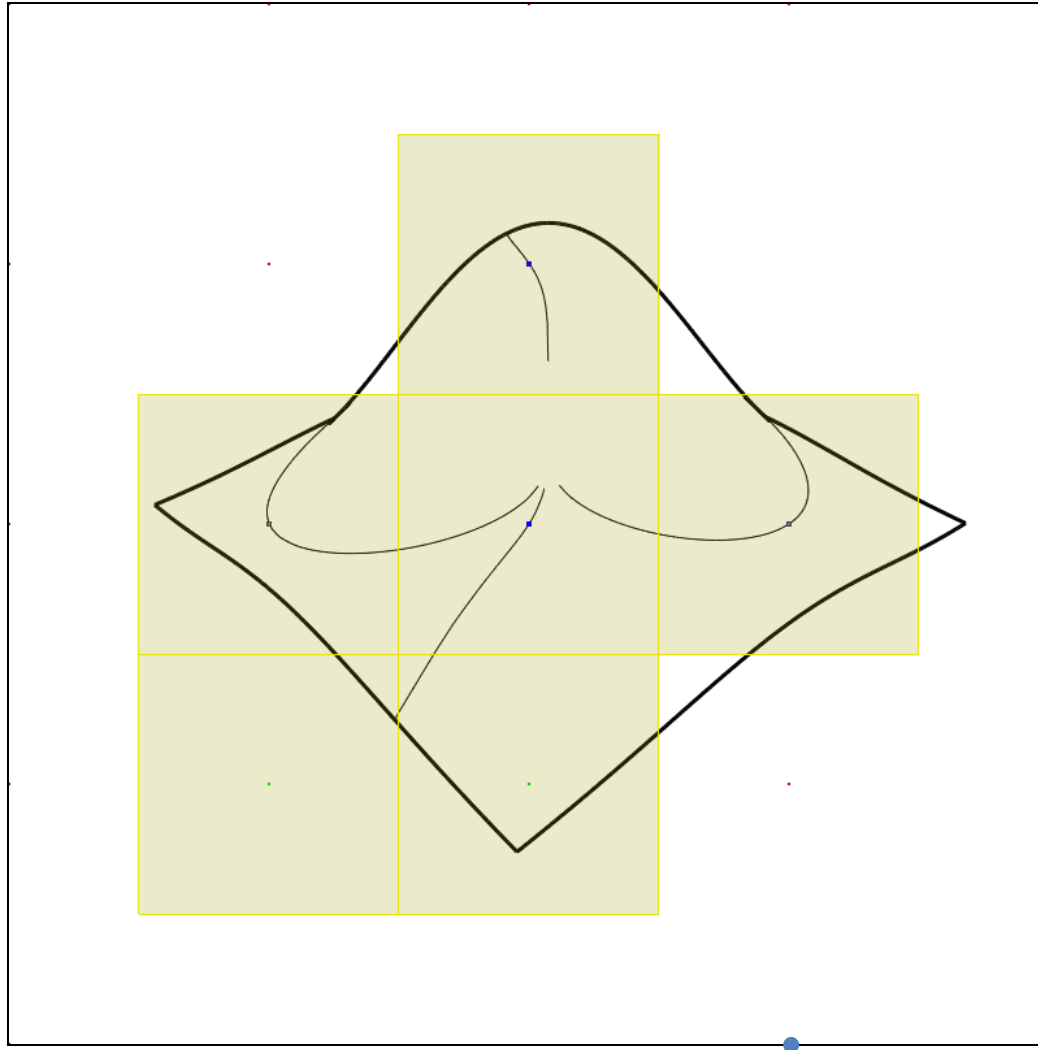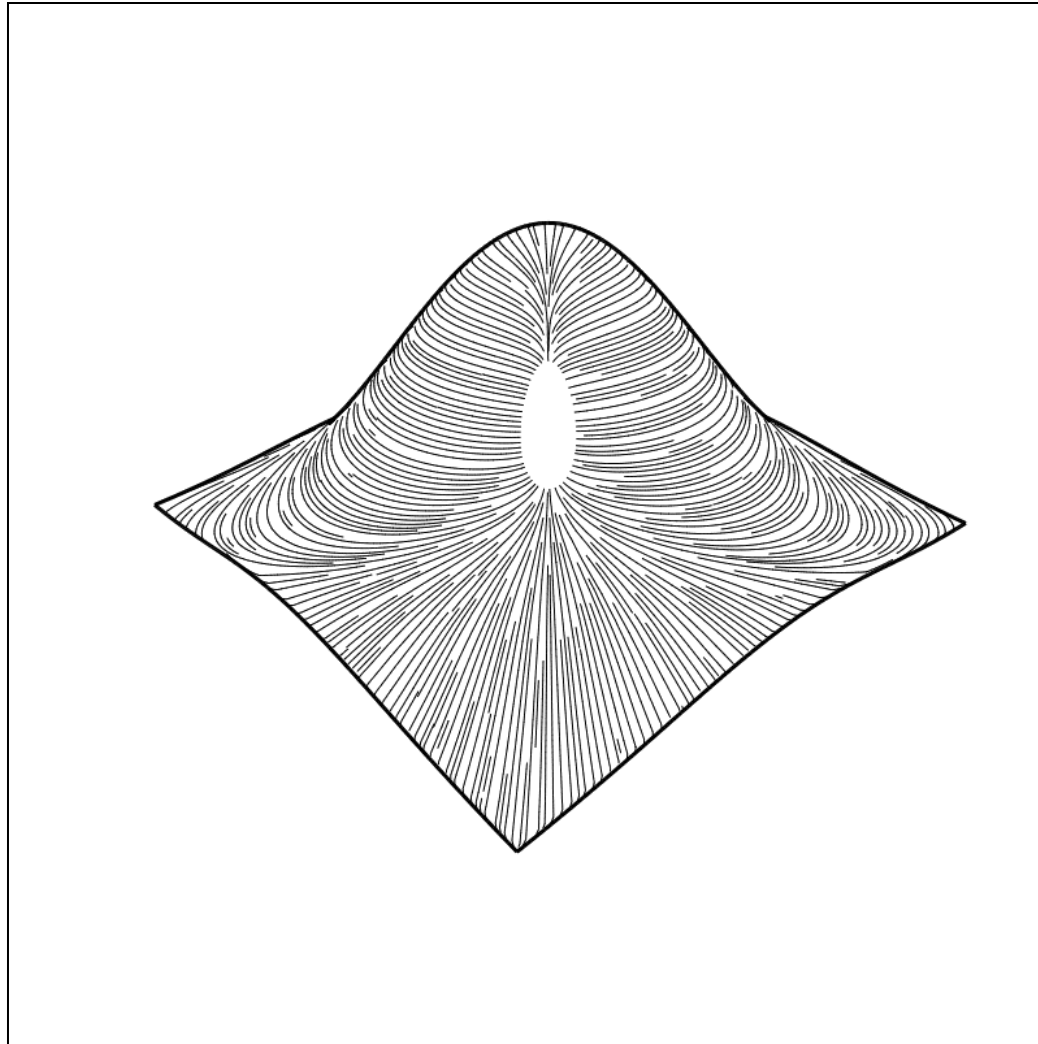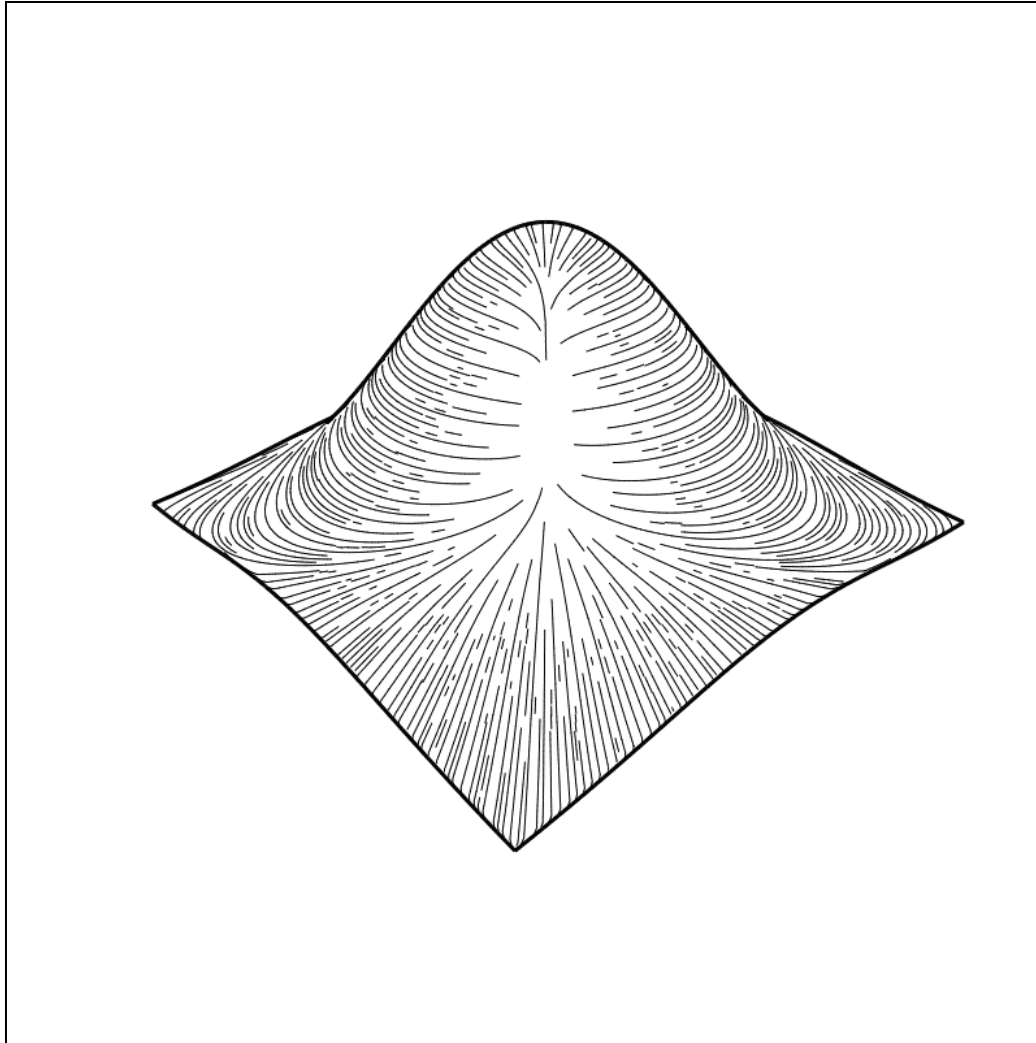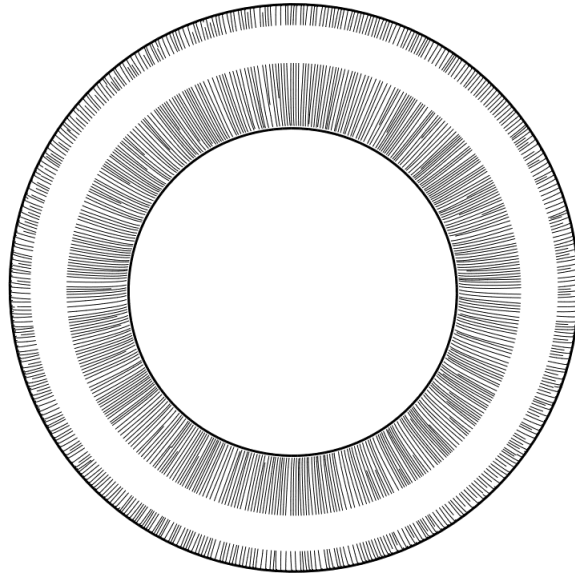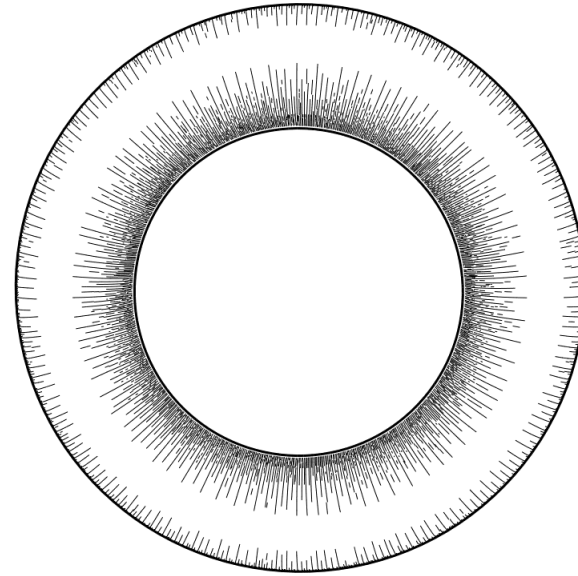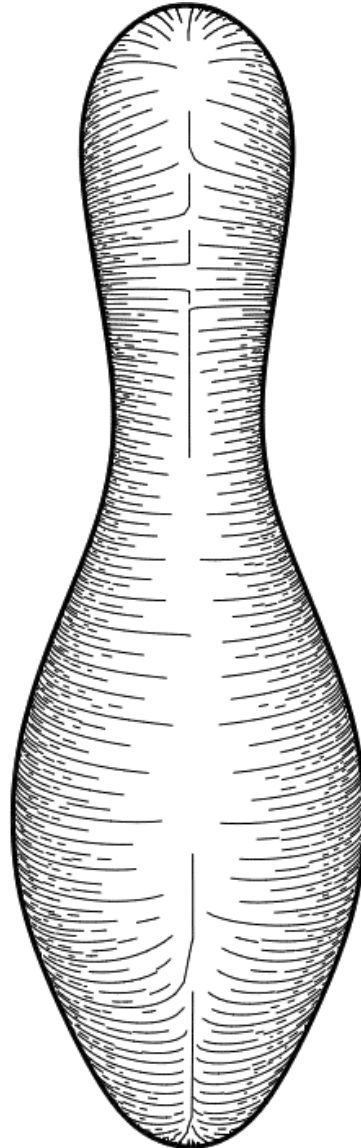# Seeding and Spacing of Lines

# Density of Lines



Uniform

Adaptive

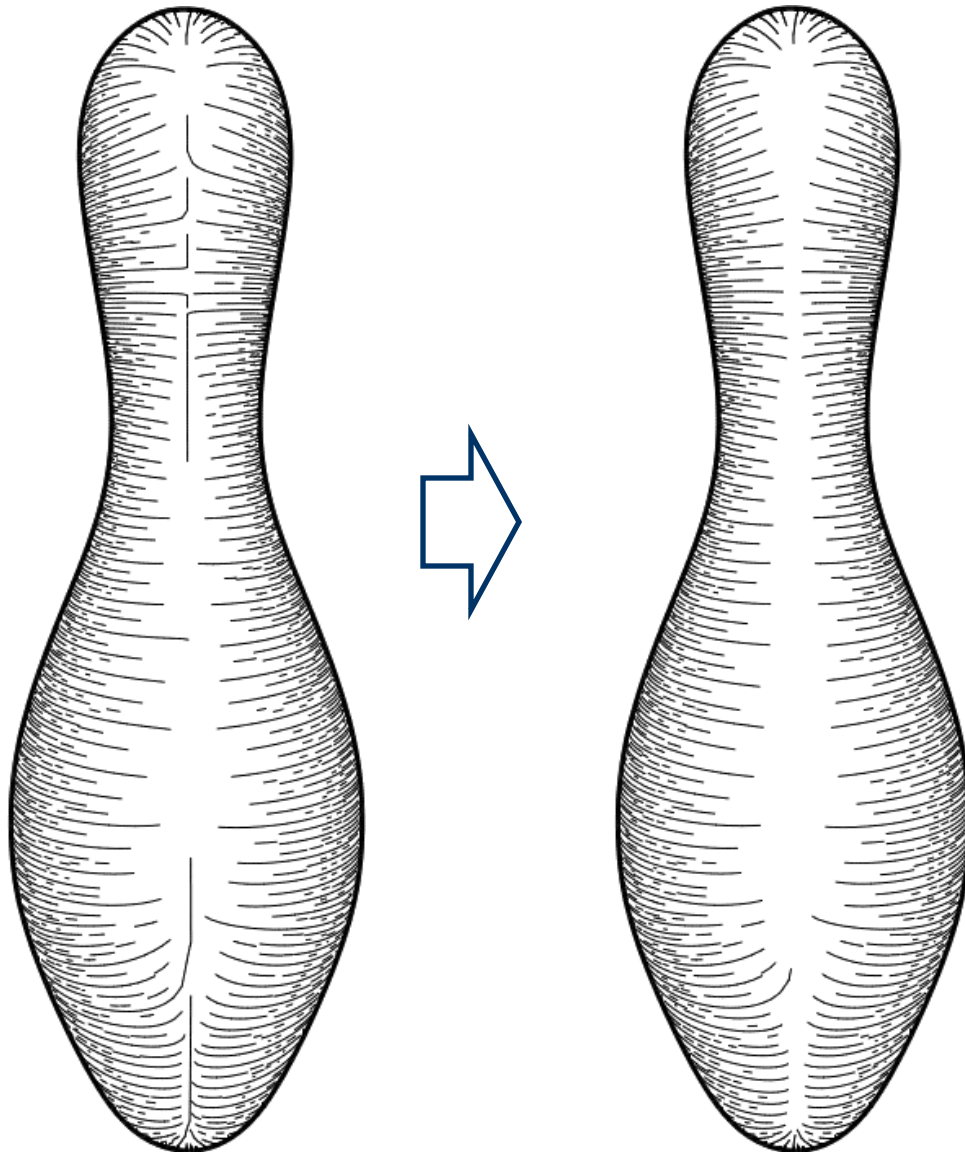$$\text{Density}: 1/(\frac{w}{\sqrt{2}^{d}})$$

$$d = 2\log_2(w(1 - I(x)))$$

# Intensity Ridges
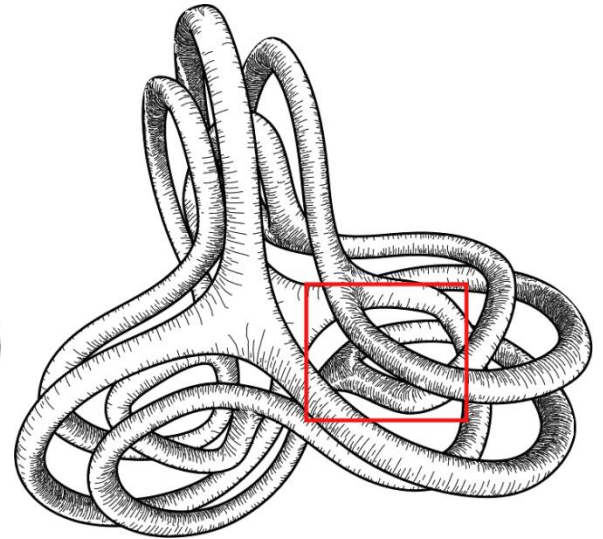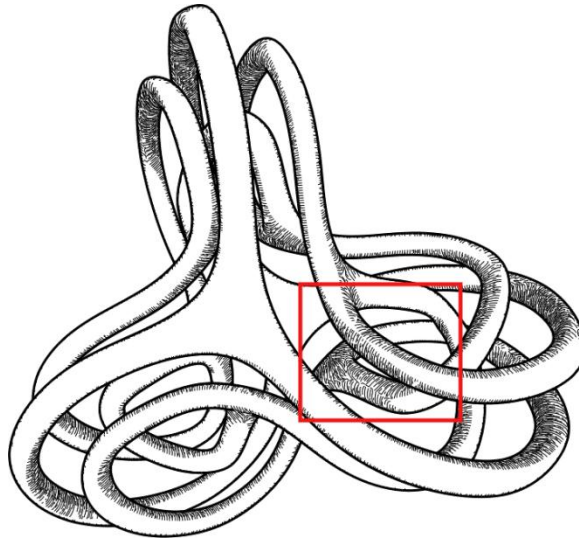
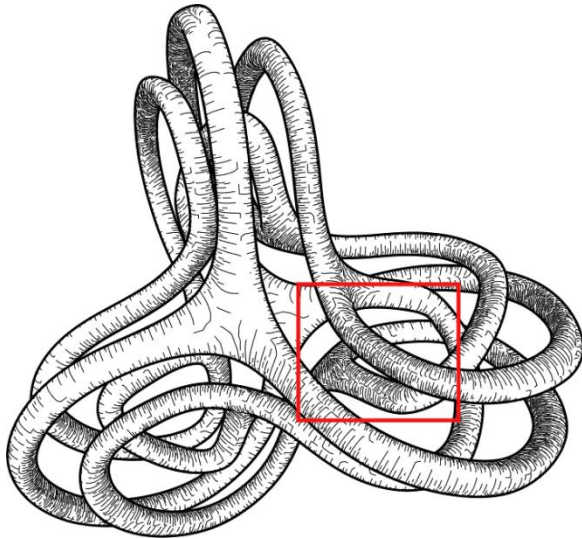# Intensity Ridges

# Intensity Thresholding
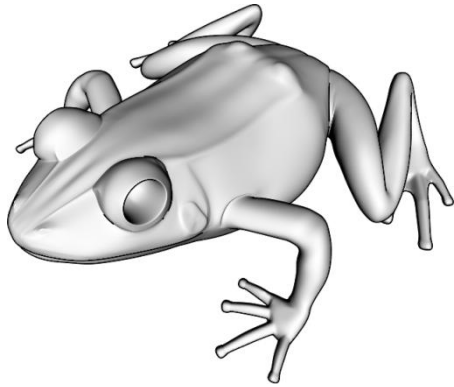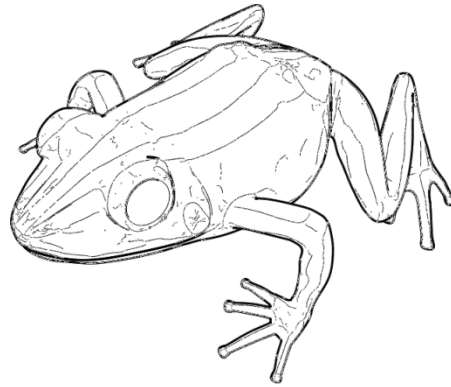


Ridge Removal

# Comparison – Ridges
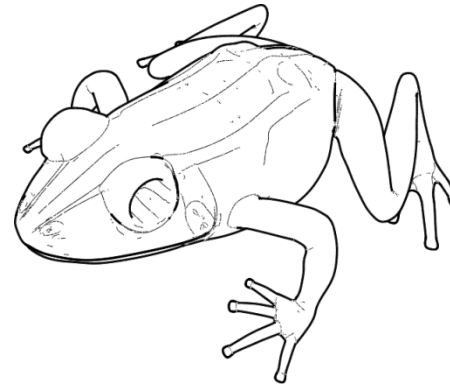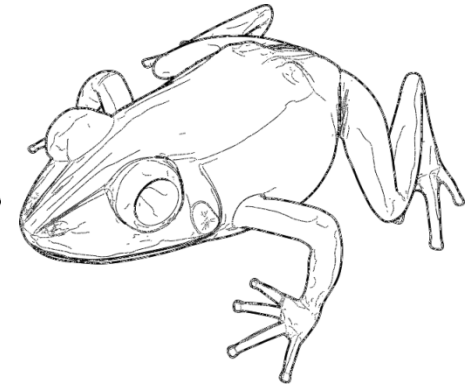


Diffuse Shading

Surface Ridges

Surface Valleys

Apparent Ridges

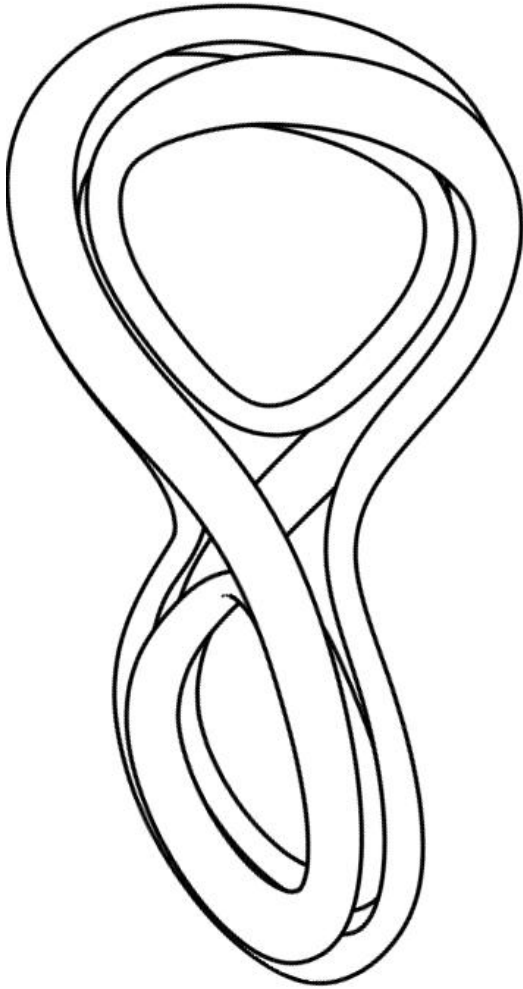Suggestive Contours

Suggestive Highlights

Principal Highlights

Intensity Ridges
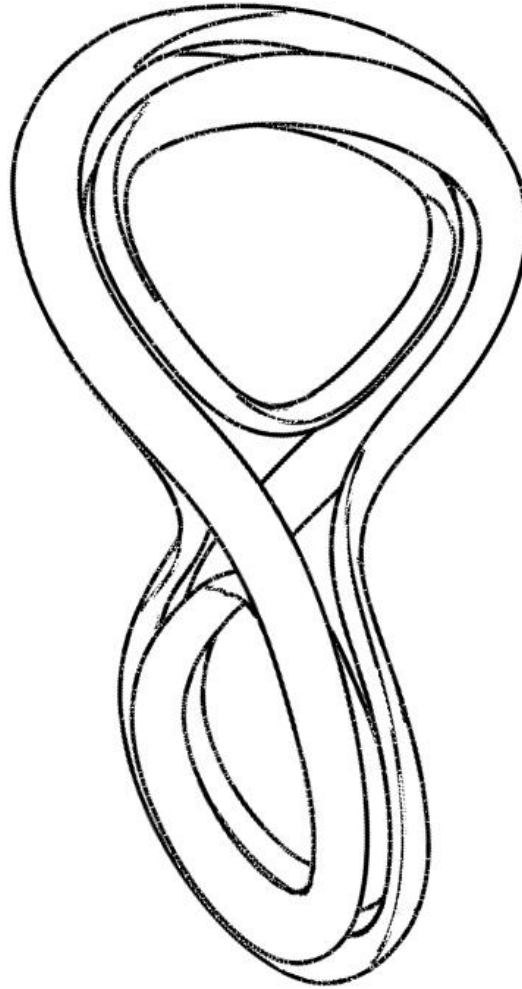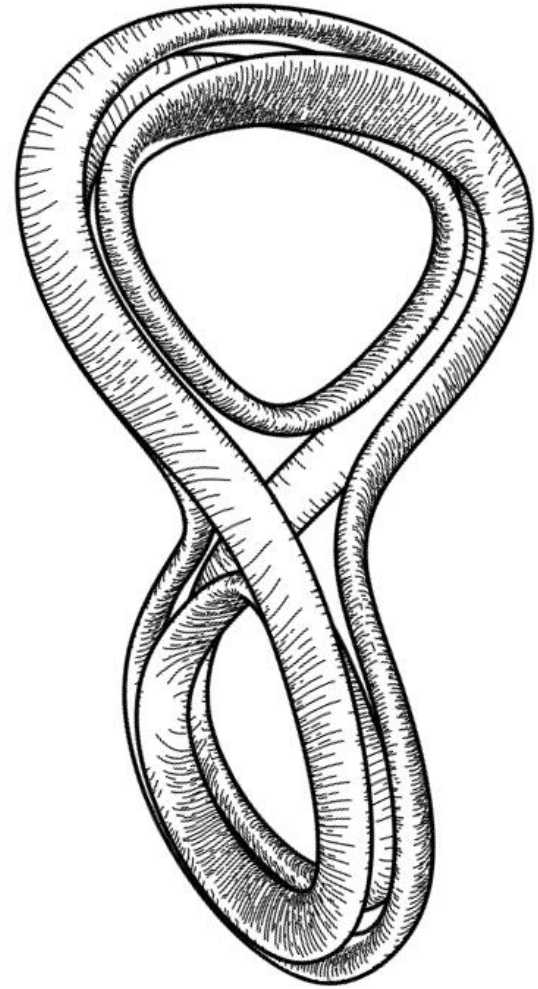
# Comparison – Line Drawing



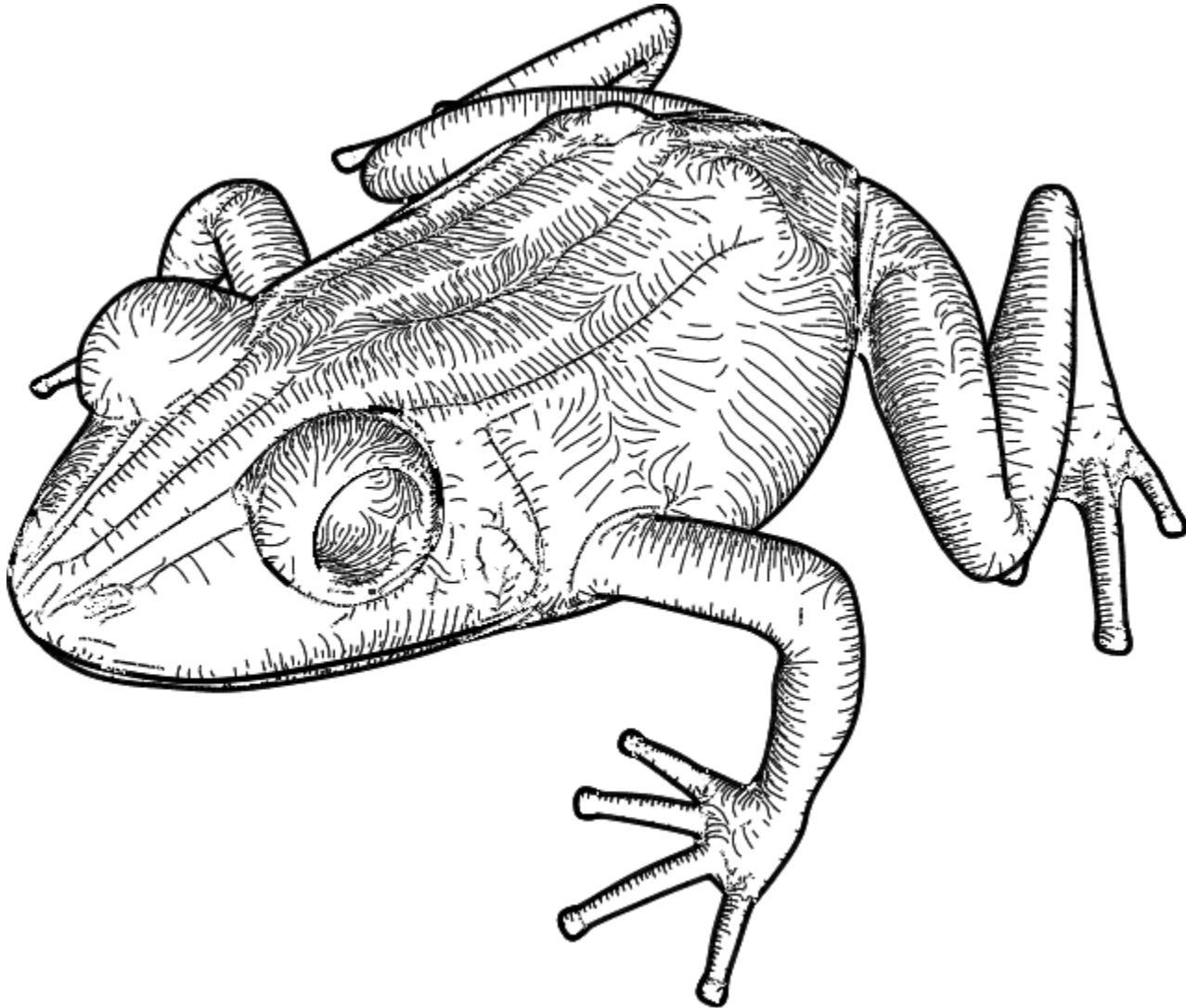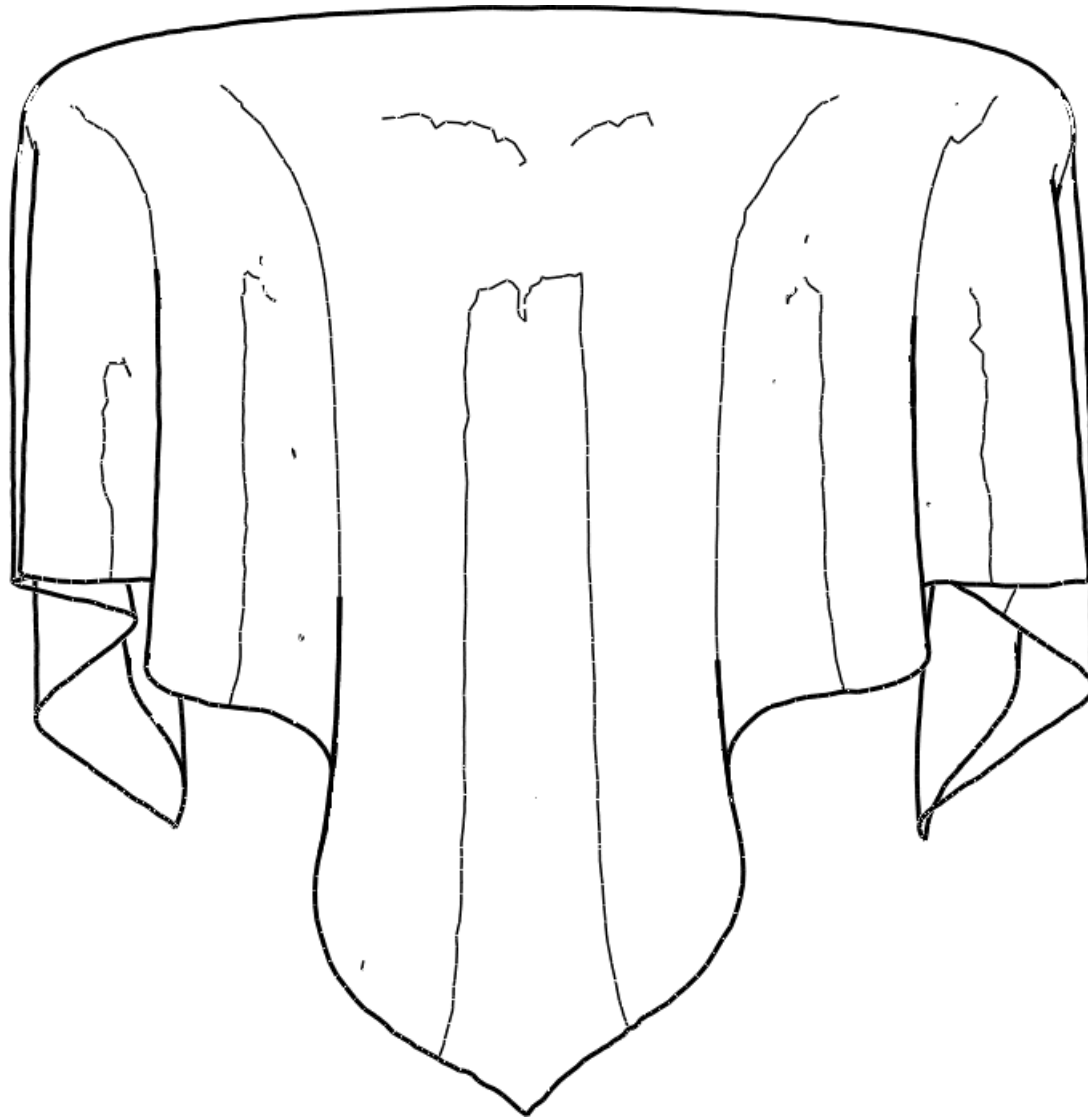Suggestive Contours    Apparent Ridges    Suggestive Hatching

# Suggestive Contours

# Suggestive Hatching

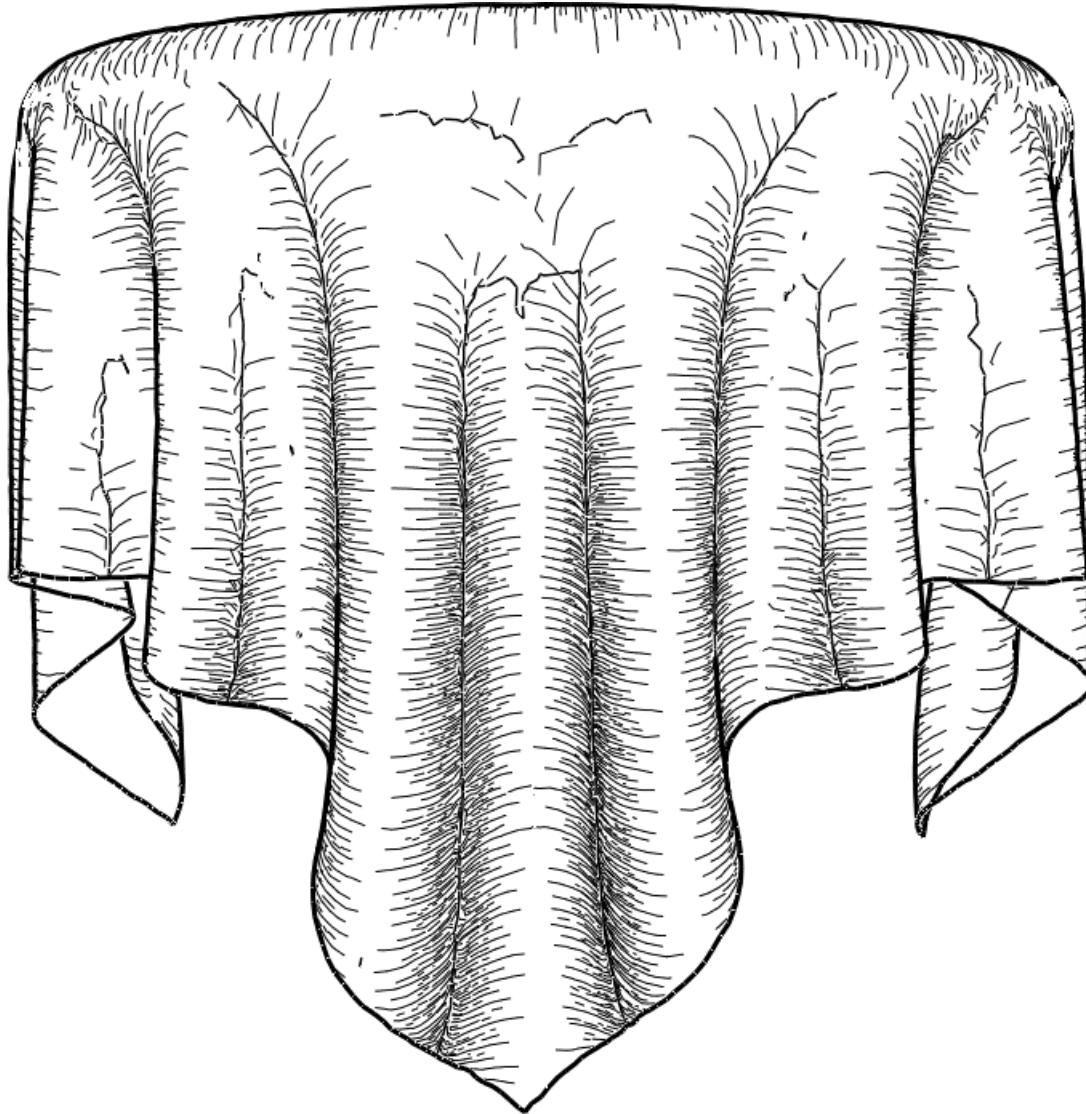# Suggestive Contours

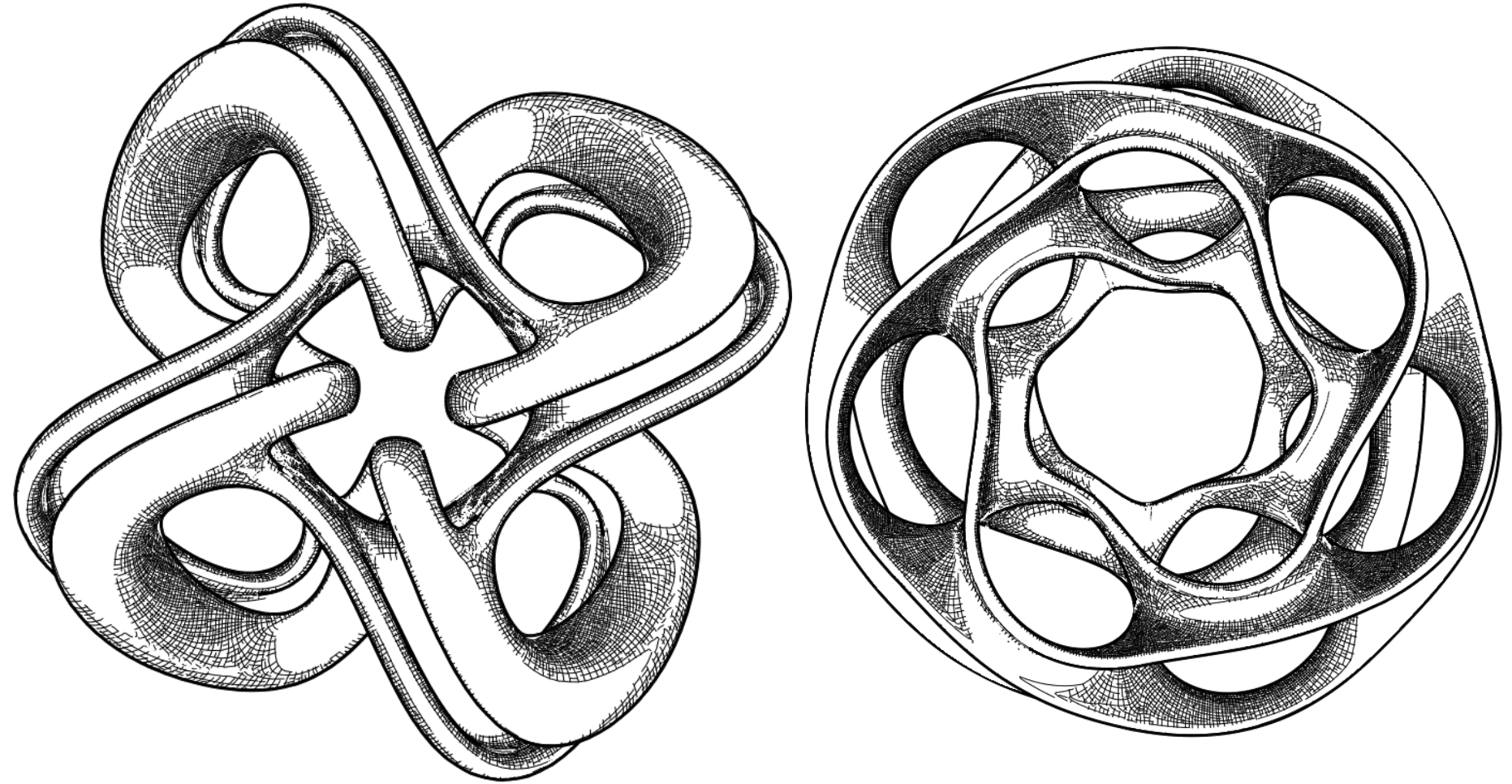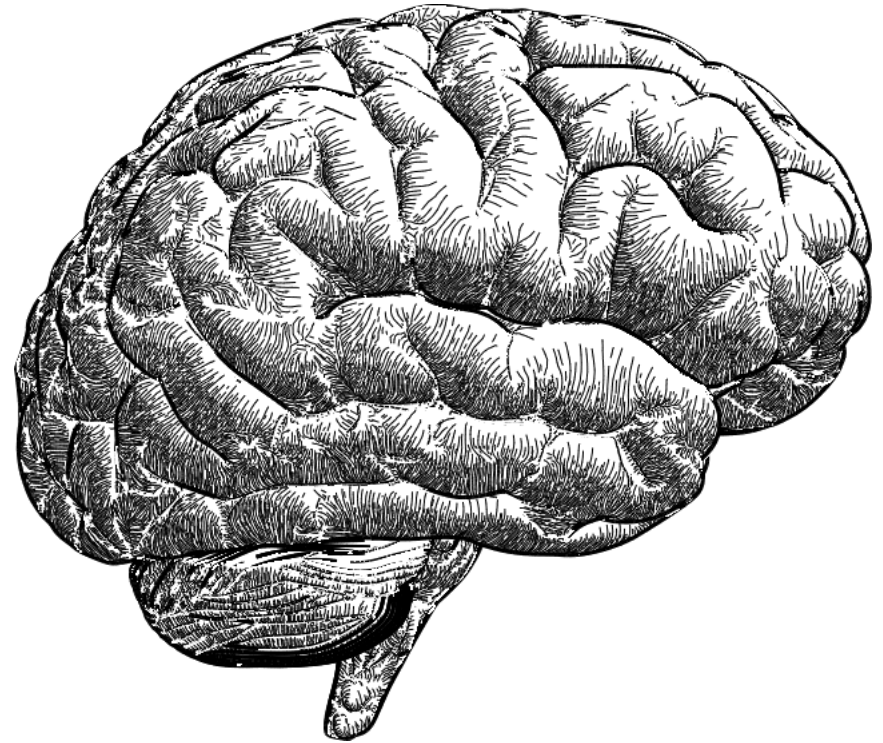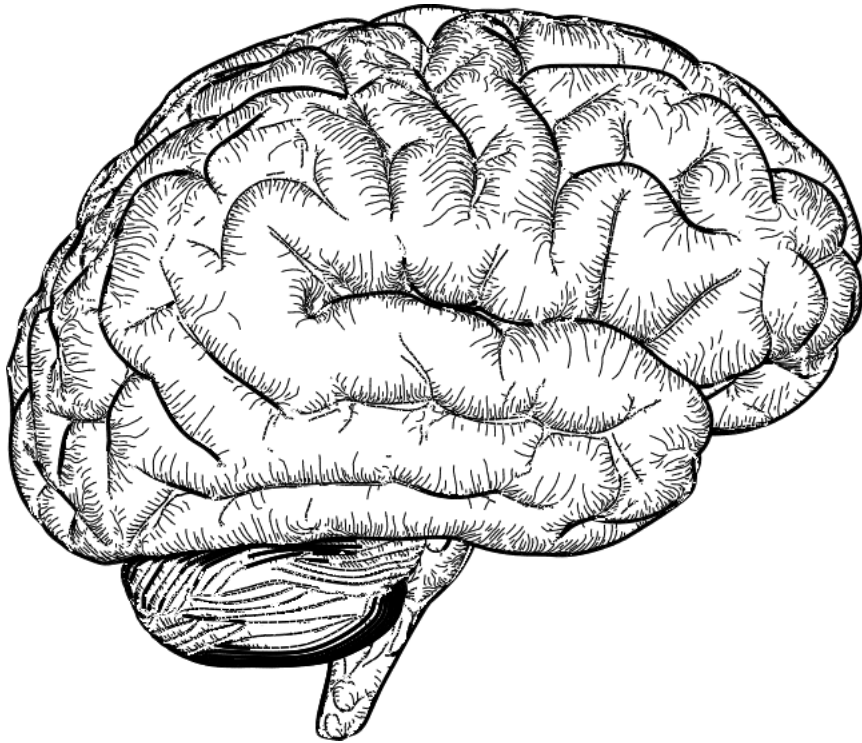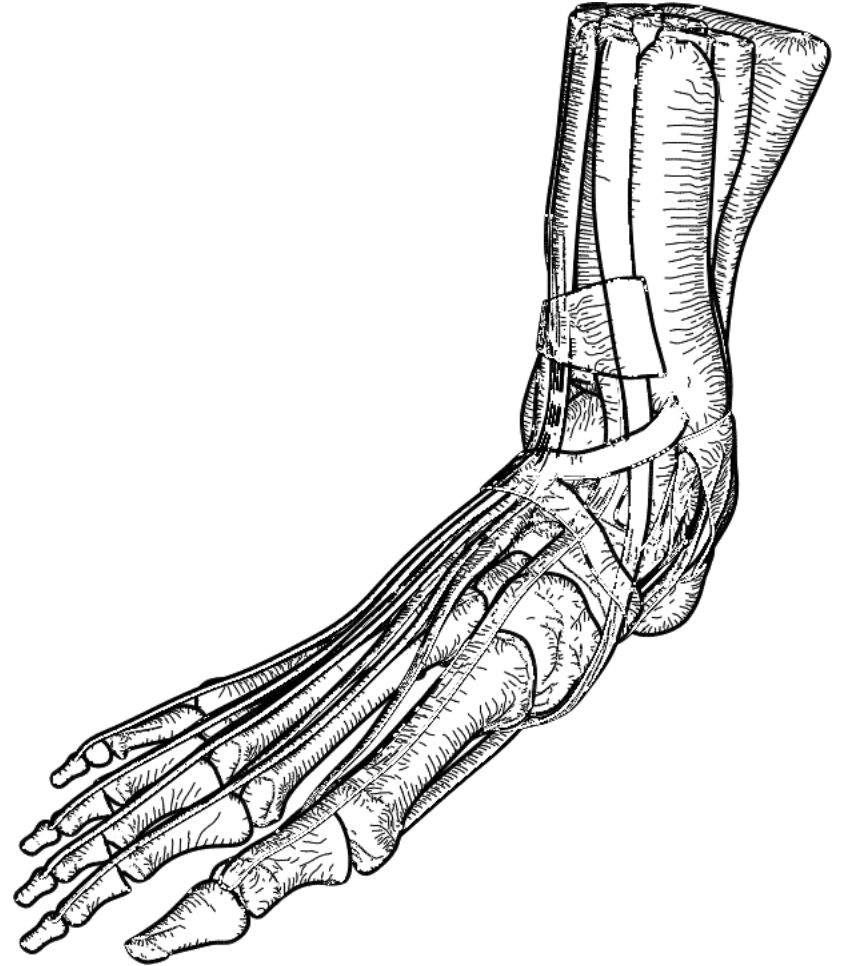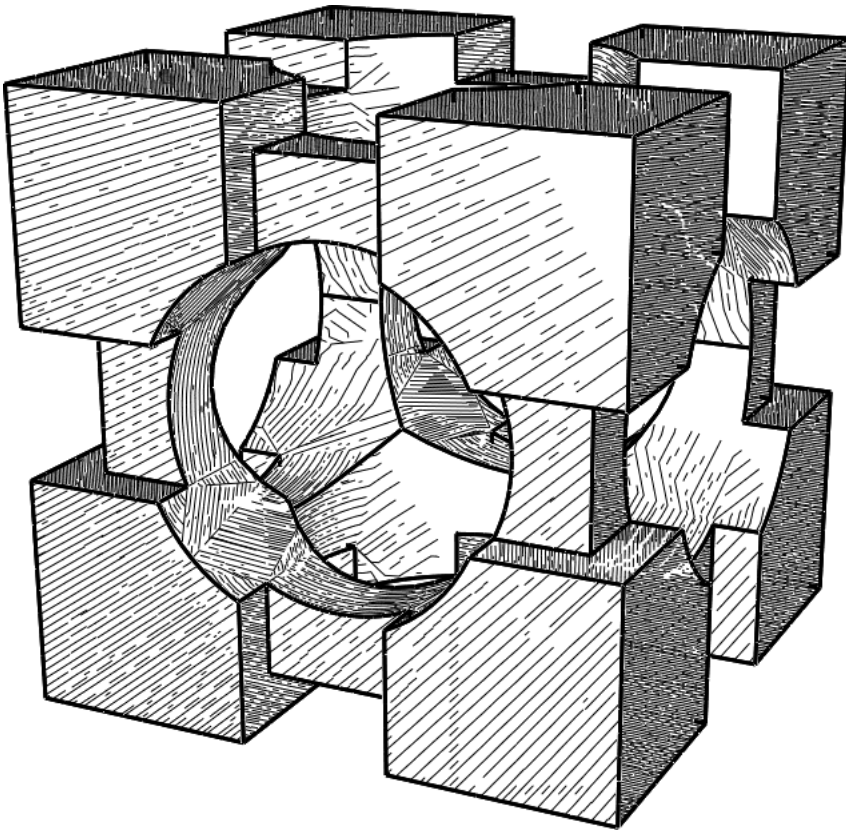# Suggestive Hatching

# Cross Hatching

# Moving Light Around

# Examples

# Examples

# Questions