



# **Curve stitching density plots**

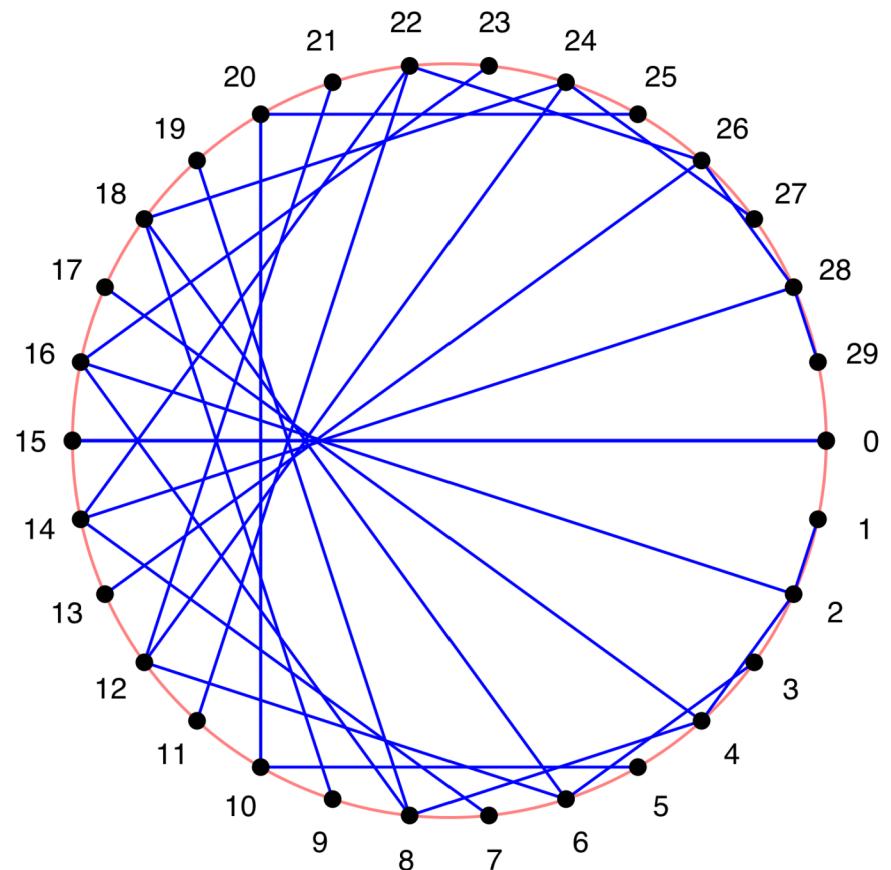
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# Basic curve stitching

- Traditional method
  - Place  $N$  points along curve
  - Connect pairs of points:  $(point_i, point_{f(i)})$
- Example
$$f(i) = (k * i) \bmod N$$
where  $k=2$  and  $N=30$



# Simple modification

- Change

Connect ( $point_i, point_{f(i)}$ )

$$f(i) = (k * i) \bmod N$$

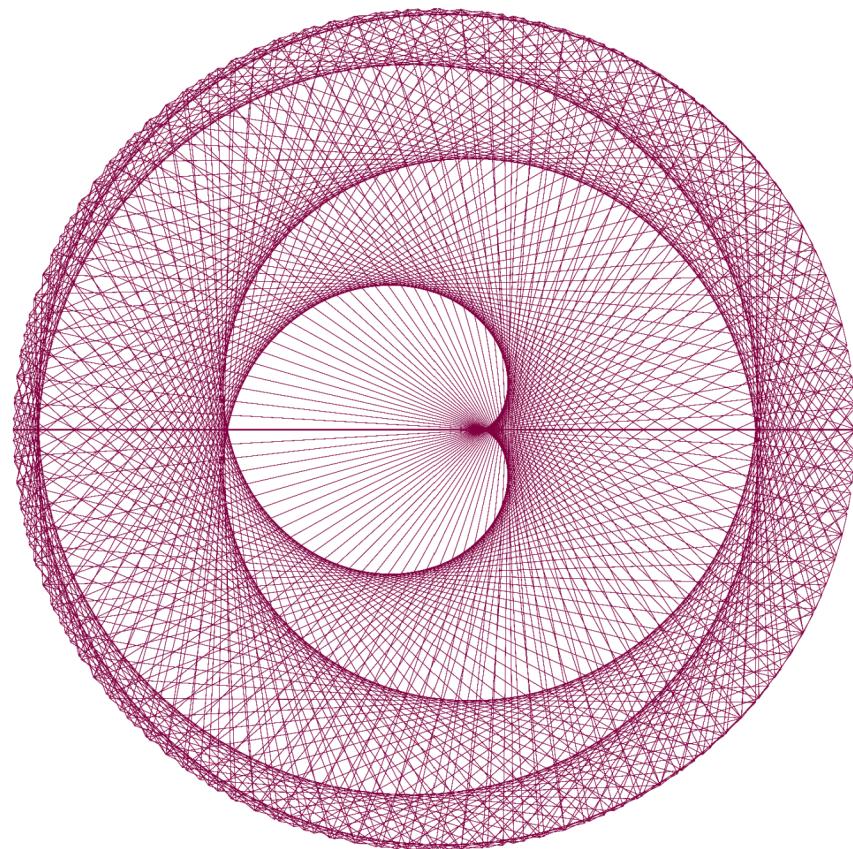
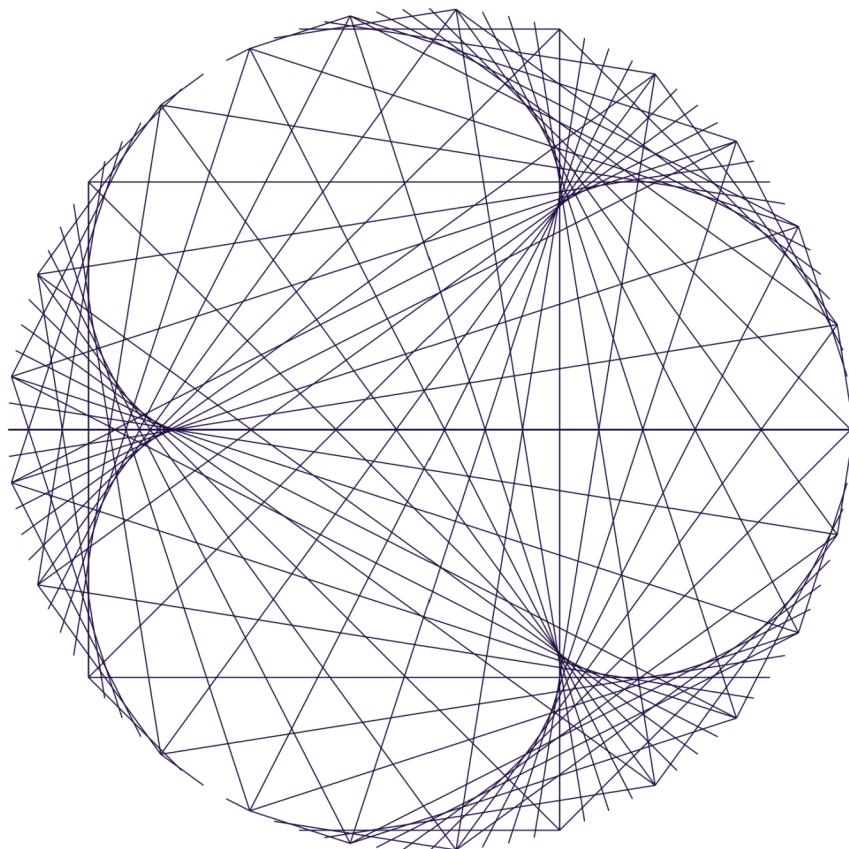
To

Connect ( $point_\theta, point_{f(\theta)}$ )

$$f(\theta) = k * \theta$$

- Works with parametric equations
- Simplifies code

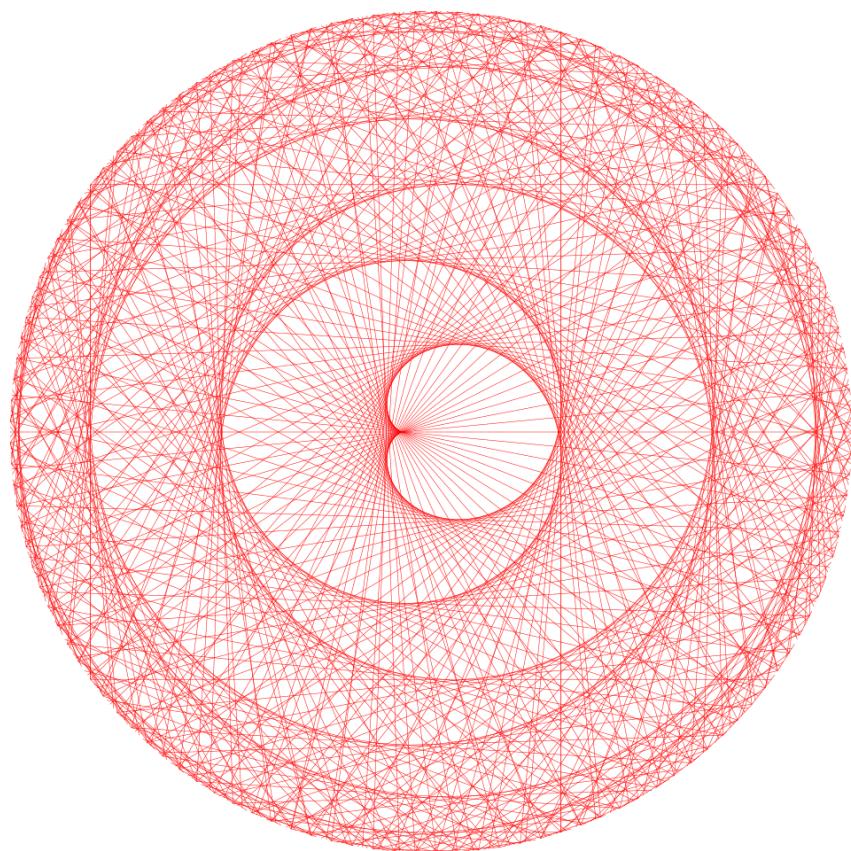
# Examples



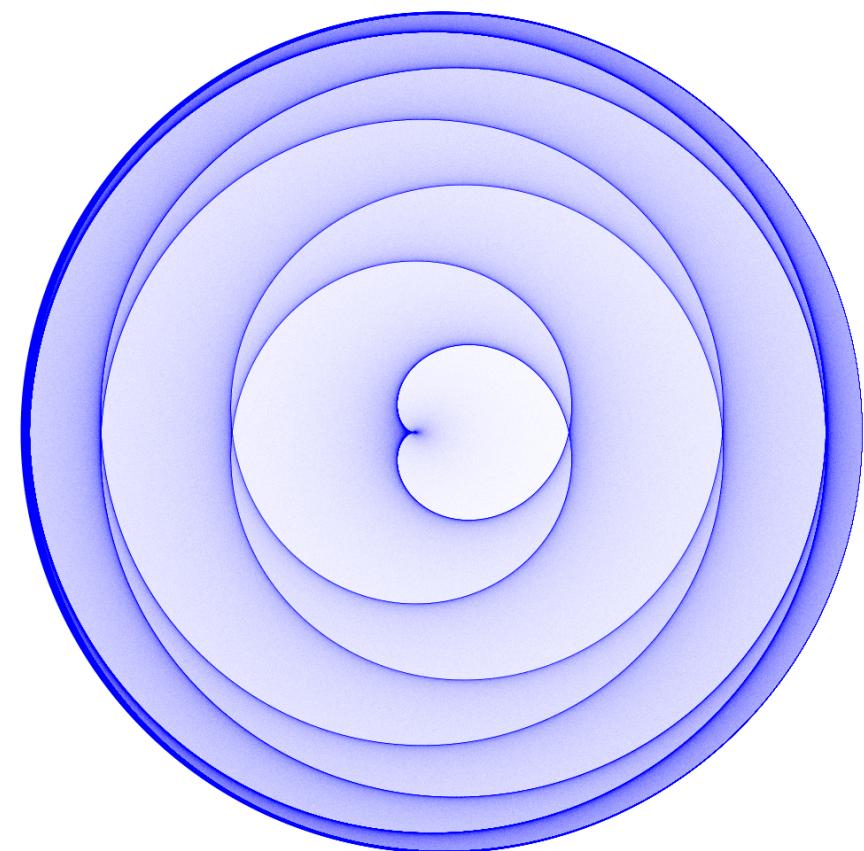
# Density Plots

- Create an MxN matrix and initialize all entries to 0
- Perform S times
  - Randomly choose  $\theta$  and calculate  $f(\theta)$
  - Randomly select a point P on line with points  $(point_\theta, point_{f(\theta)})$
  - Map point P to position in matrix
  - Increment value at position in matrix by 1
- Convert the counts in matrix to pixel colors in image

# Comparison for $k = 1.125$

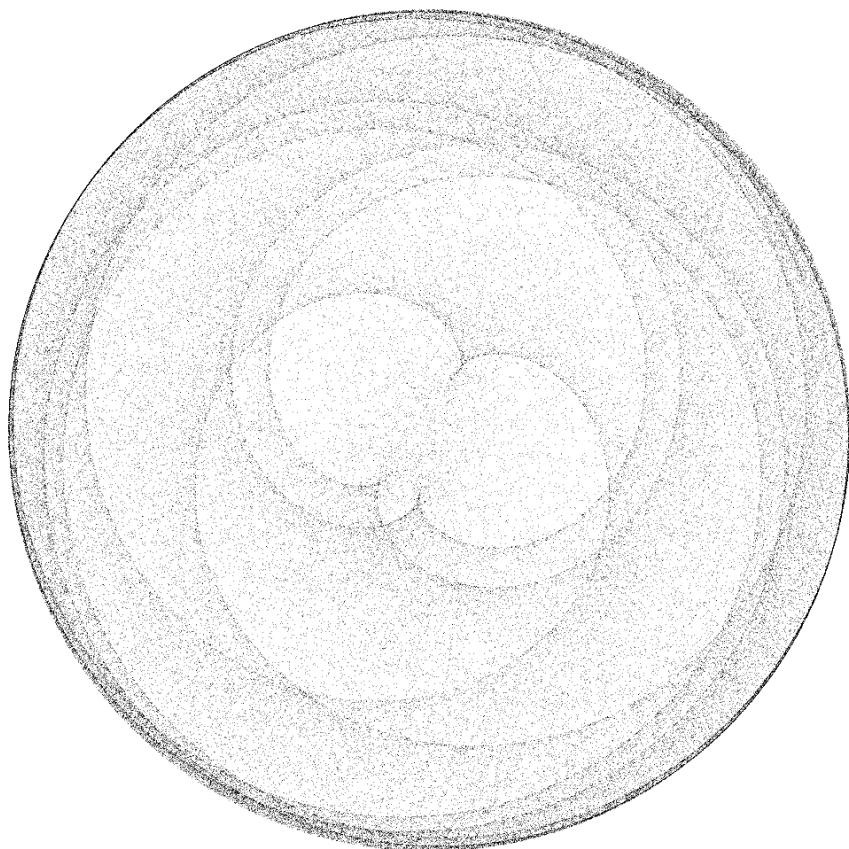


$N=500$

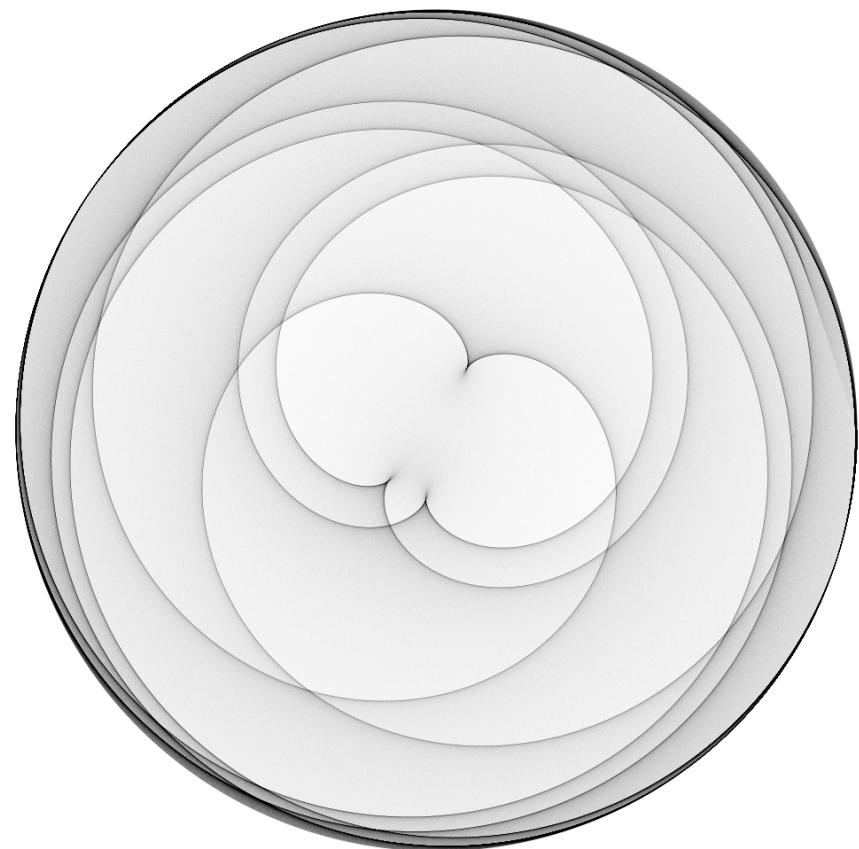


$S=100,000,000$

# Effect of S value



S=100,000, time=1.9 sec



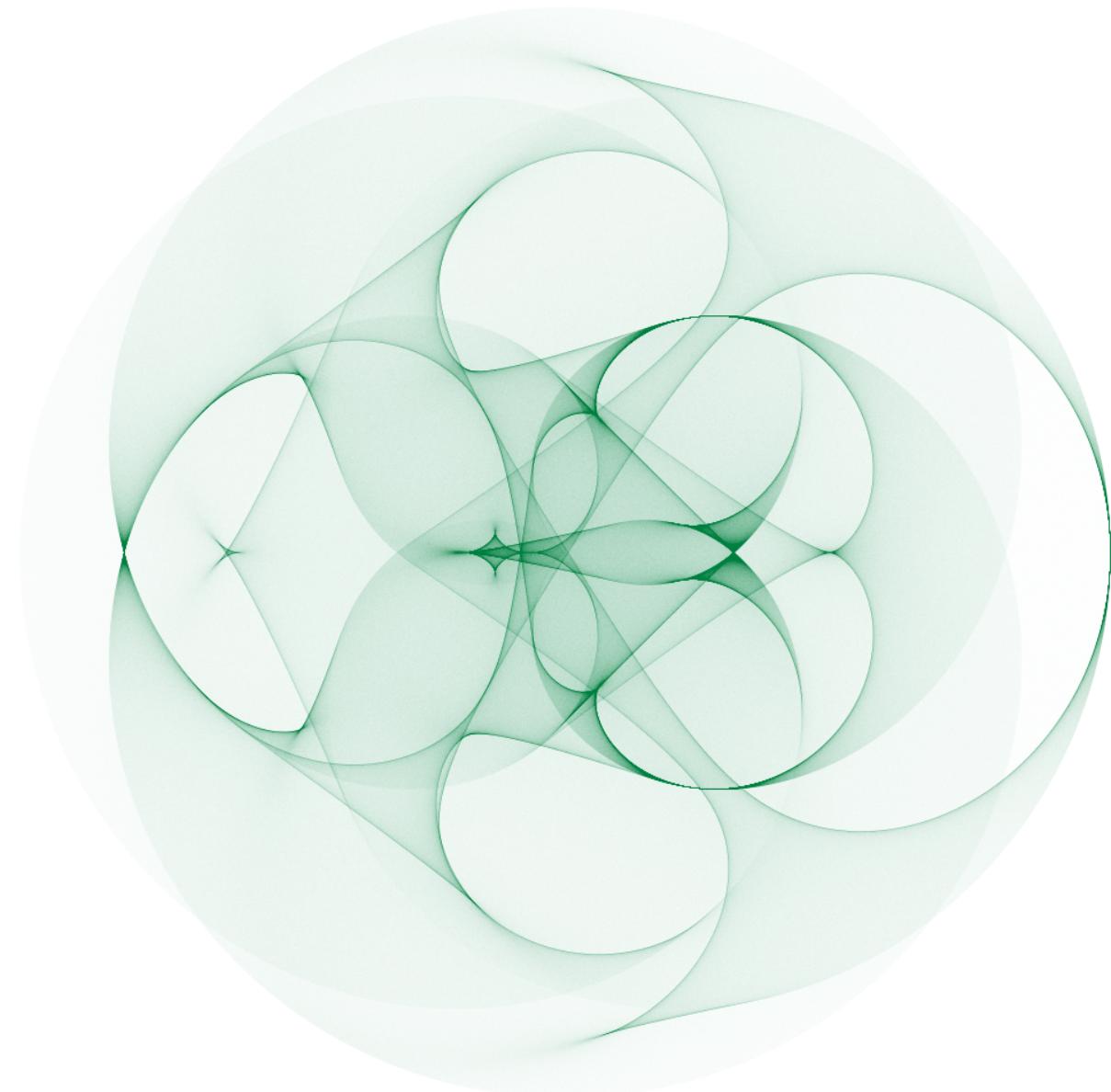
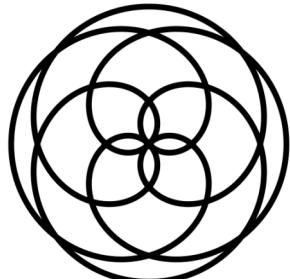
S=100,000,000, time=181.2 sec

# Curve variations

- No reason to limit curves to circles
- Density plots can be created from any set of parametric equations
  - Closed curves here, but not required
  - Equations used here based on  $\theta$ , but could be time-based as well

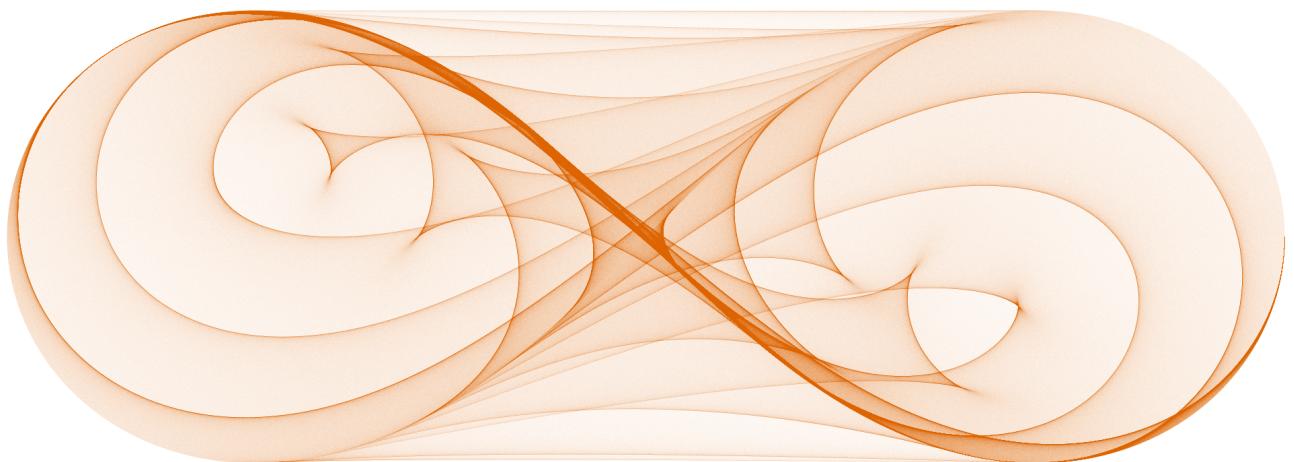
# Example: rose curve

- Source



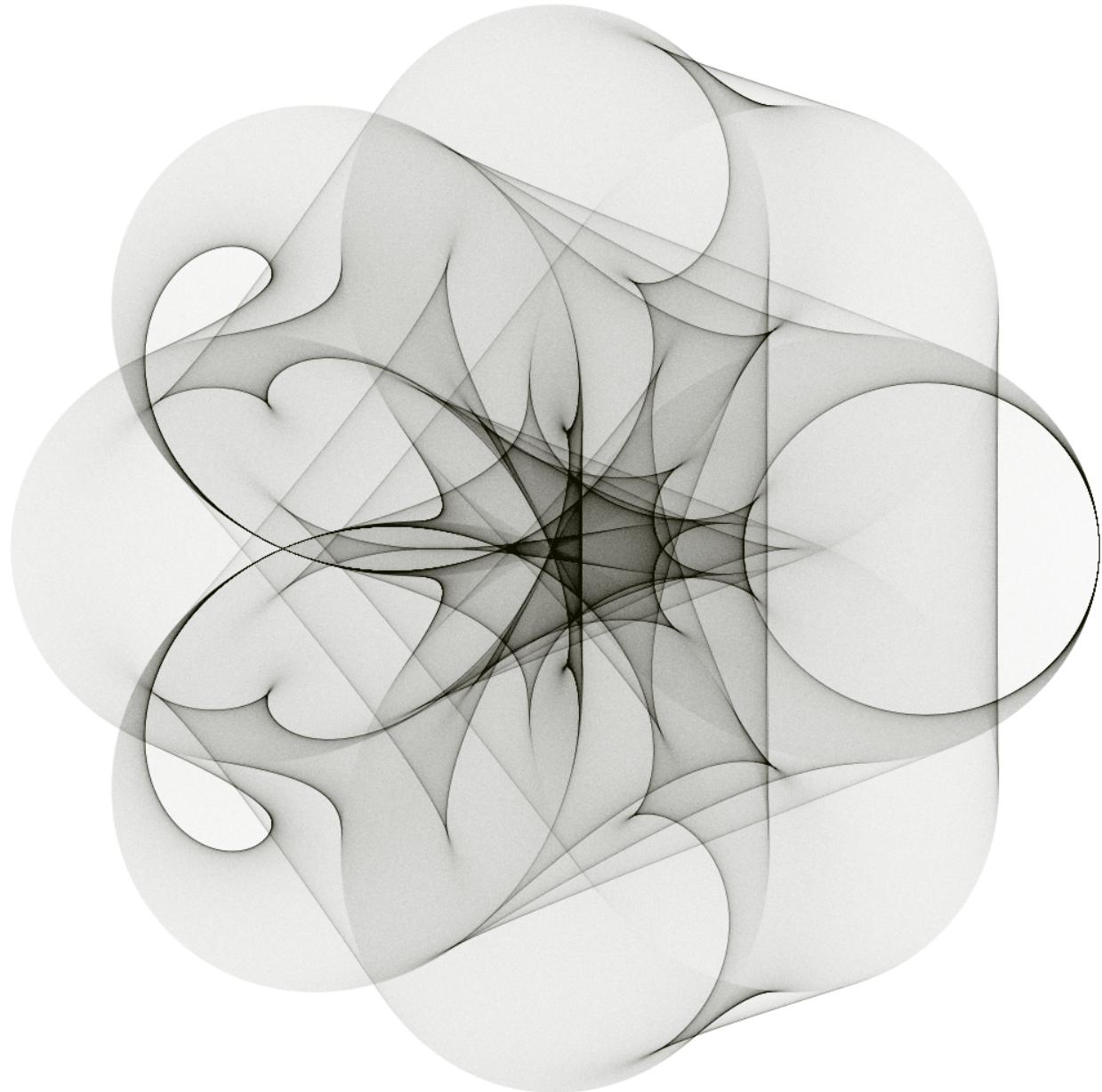
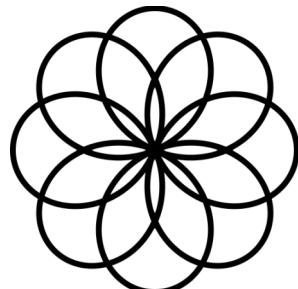
# Example: lemniscate

- Source



# Example: hypotrochoid

- Source

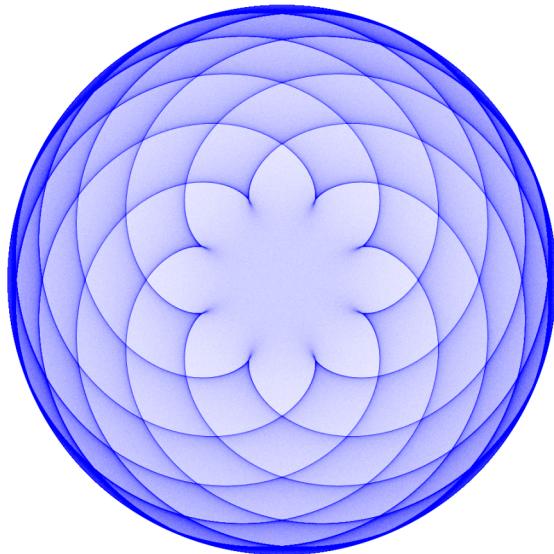


# Curve displacement

- Previous images connect two points traveling at different speeds on one curve
- Two curves can have
  - Different sizes, and/or
  - Different positions

# Examples

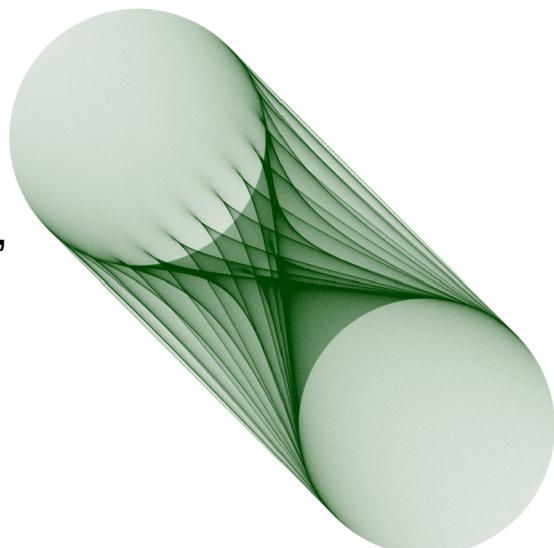
One circle



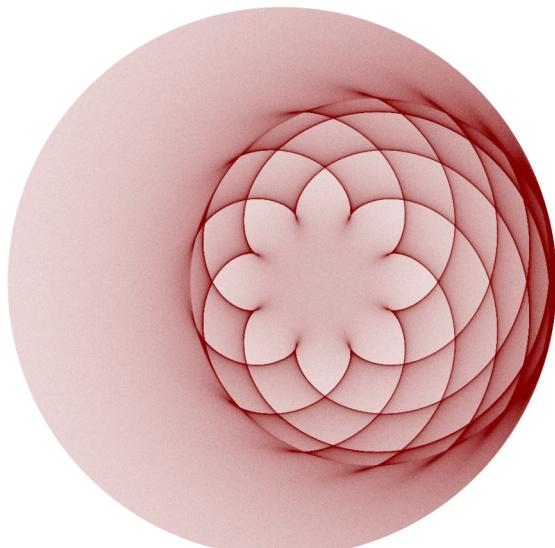
Two circles,  
different radii



Two circles,  
different  
positions



Two circles,  
different sizes  
and positions

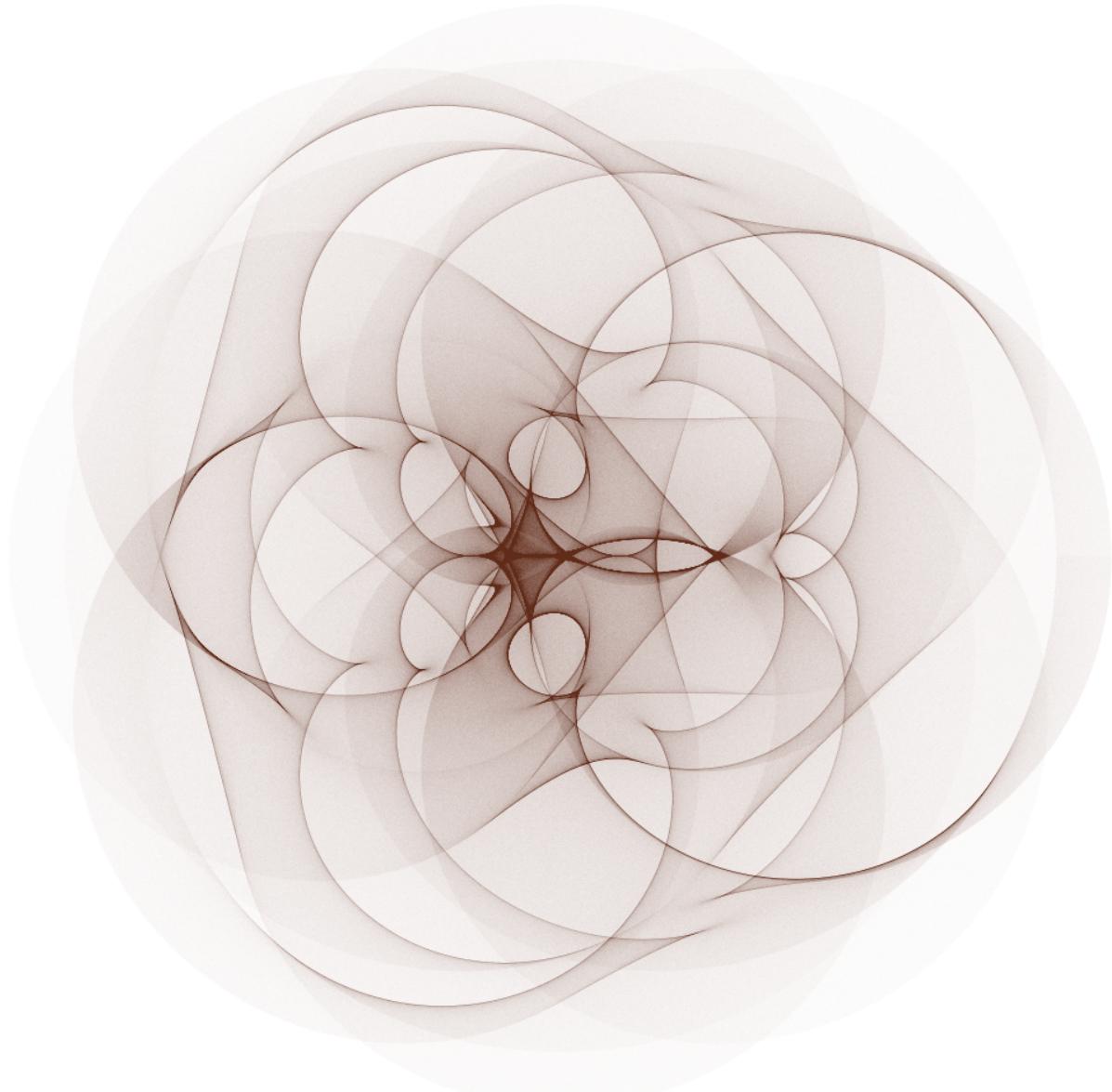
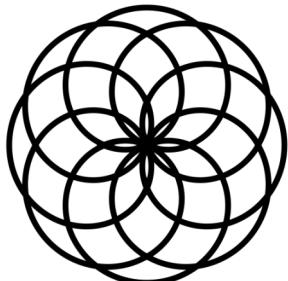
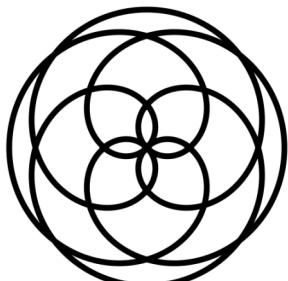


# Combining curves

- Additional variations quickly become obvious
  - Same curve, different parameters
  - Two different curves
  - More than two curves

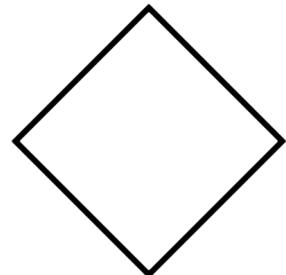
# Example: two rose curves

- Source

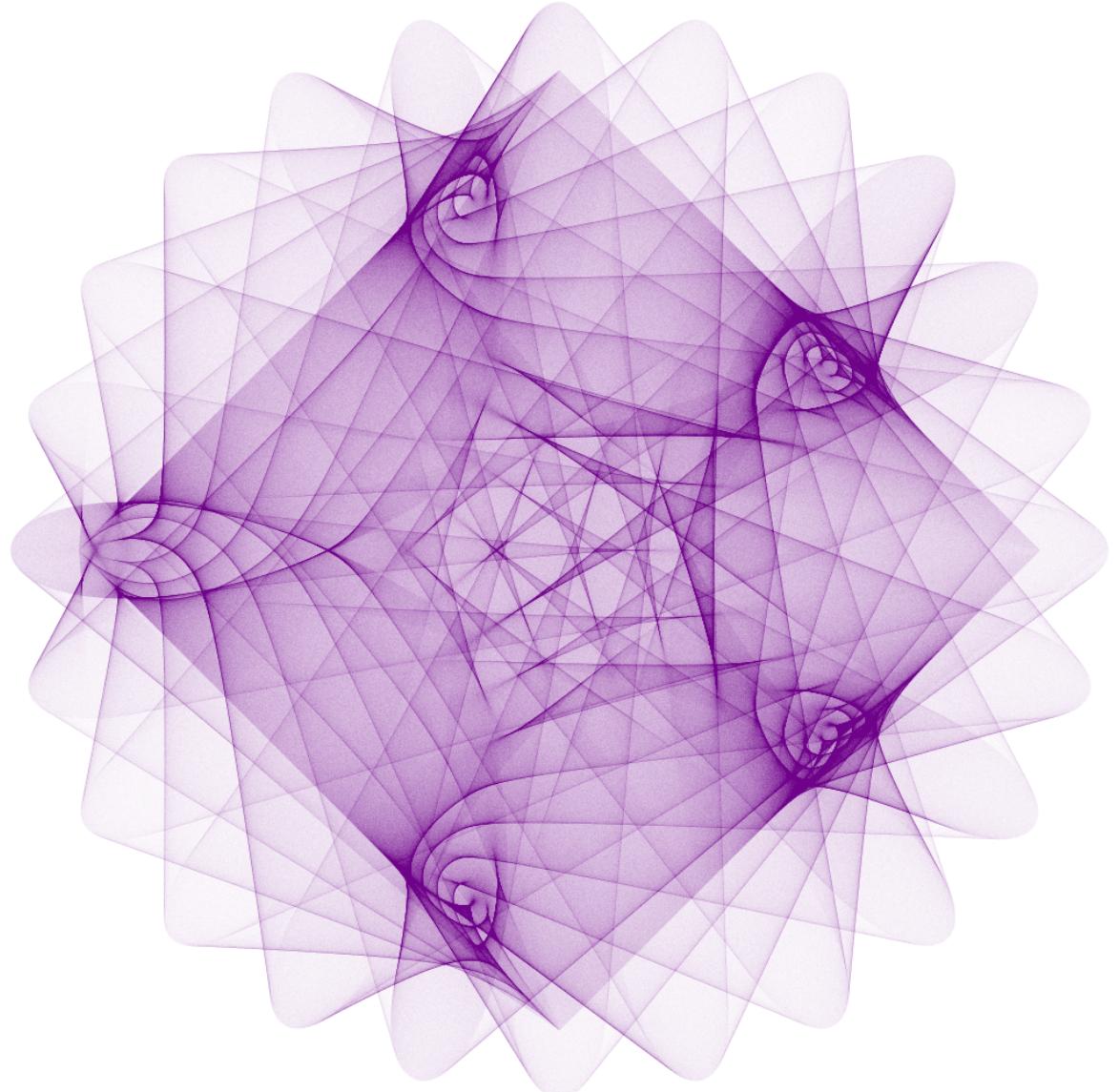
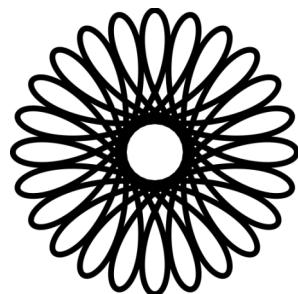


# Example: square and hypotrochoid

- Square

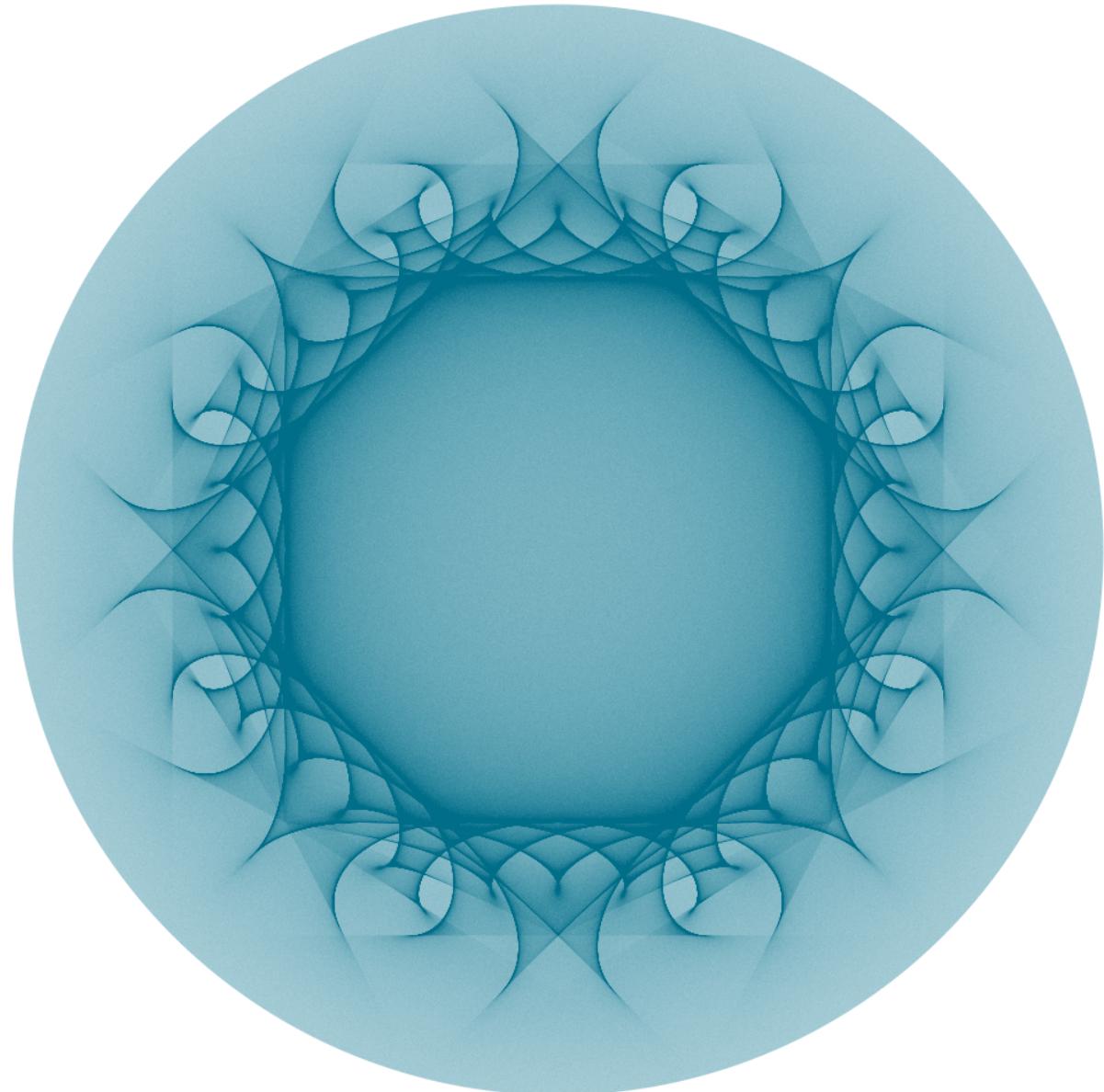
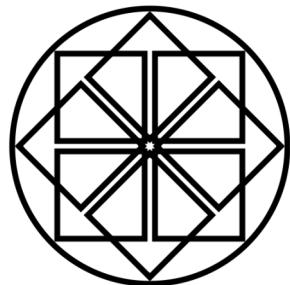


- Hypotrochoid



# Example: circle with 8 squares

- Source



# Current and Future Work

- 3d
- Animation
- Coloring strategies

# Code examples

- Sample Python code available at  
<https://github.com/nicholsonja/Bridges-2019>

# Questions?

