Paper Reading for Advanced Computer Graphics Class #3
Artistic Tessellations by Growing Curves

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Artistic Tessellations by Growing Curves

The author propose to tessellate a region by **growing curves**:

Employs a **particle system** where particle trails from curves, control the final effects by variations of the initial placement, the placement order, curve direction, and curve properties.

With **smoothed vector field**, we can create image-based mosaic automatically, with other techniques we can reveal some irregular pattern shown in natural scenario, like cracks, scales and rivers and create the illusion of 3D shapes.

I Related work & drawback

- regular tessellations:

region-based methods, not suitable for natural patterns with elongated, irregular, or curved tiles; control over site placement is insufficient.

- non-photorealistic rendering (NPR):

deal with images either with region-based methods like mosaics or with stroke- based methods **separately**

II Proposed method

- instead of tessellating with individual tiles (or regions), we build the boundary of each tile by the growth of curves

- employs a particle system where **particle trails** form curves
- propose an automatic mosaic method with good texture suggestion
- expand the idea to present both abstract and natural patterns, introducing two variations, a splitting technique and a stacking technique.

III Particle system

Physical simulation implemented with forward Euler integration. Each time step ($\Delta t = 0.01$), the particle system updates a new position x from previous velocity v_0 and previous position x_0 based on the dynamics. The sequence of positions constructs a curve.

The key calculations are as follows:

$a = \frac{F}{m}$ for a force F, $v = v_0 + a \times \Delta t, x = x_0 + v \times \Delta t$, and we use unit mass $m = 1$. We use **different force configurations for different purposes**.

IV Different force configurations for different purposes

IV.1 mosaic styles

we read $\overrightarrow{F}$ from a vector field (smooth first).

IV.2 other abstracts and natural patterns

we use the Lorentz force, previously used to generate magnetic curves:

We use a constant $\overrightarrow{B} = 0, 0, -1$, which generates a 2D curve forcing the particle to move in the xy plane:

$$\overrightarrow{F} = q\overrightarrow{v} \times \overrightarrow{B}$$

The value of the charge q controls the curvature of the curve, and we assign it as $q = s * f(t)$, so change $f(t)$ we get what we want, there are four types demonstrated in this paper.

- Type I, $f(t) = (500 - t)^{0.8}$
- Type II, random irregular curve
  - Used in Splitting Technique to generate cracks or leaves like curve
- Type III, a slightly flatter curve $f(t) = 0.001 * (t - ((int)(t/500)) * 500$
  - Used in Stacking Technique to create the illusion of 3D shapes
- Type IV, $f(t) = sgn(AngleChange(f(t_0)) > (t))) * (f(t_0) + Random(0.0001, 0.01))$
  - Jigsaw-like example

V In conclusion

- we can change different $\overrightarrow{F}$ to get different forms
- the study of a group of particles and the management for the collision intersections might bring very convincing illusions of 3D shapes (as pointed out by the author).