Mathematics and the Arts

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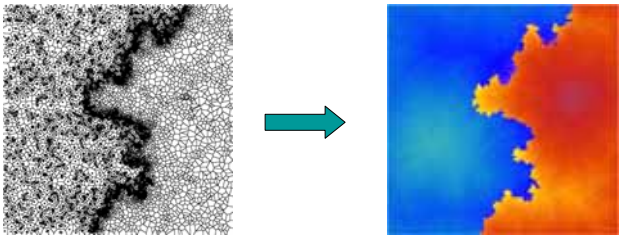
1. Fractal Voronoi Diagrams

The Voronoi diagram represents the partition of the plane into territories, where each territory consists of points nearest to the associated generators.

Starting with a small number of generators, we add generators at random, simulate territory competing, and assign colors to the resulting diagram. Then, we get something like artistic patterns.



Result of territory Competing

Colors assigned to the territories

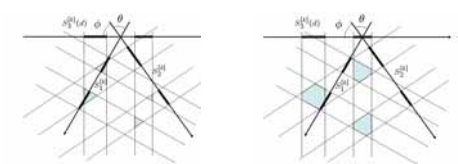
Pictures are adopted in the covers of a magazine

2. Computer-Aided Design of Solid Logo

(with Tomohiro Ohgami)

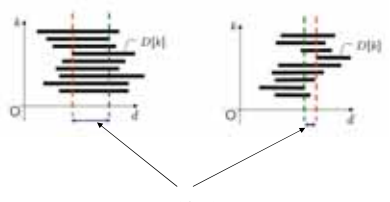
Given three silhouettes, search for a solid having all the silhouettes.

Once we fix θ and φ, the realizable values of d can be found efficiently.



Degree of realizability is defined by

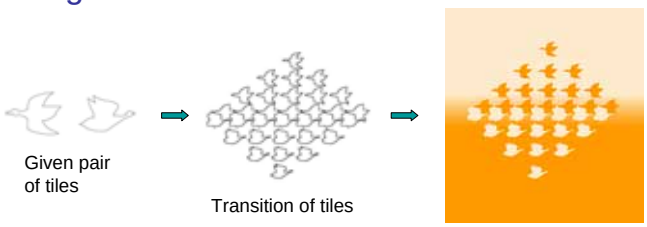
$$F(\theta,\varphi) = \min_{0\le k\le K} \max D[k] - \max_{0\le k\le K} \min D[k]$$



$F(\theta,\varphi)$

Search for the point with the maximum $F(\theta,\varphi)$ in the (θ,φ) space.

3. Generation of Escher's *Sky and Water* Tiling Patterns



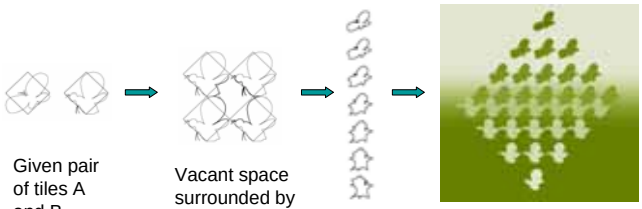
Given pair of tiles

Transition of tiles

Sky and Water pattern

Generation Algorithm

1. Adjust the sizes of the given tiles A and B by fitting them to a common rhombus.
2. Generate the vacant space surrounded by four copies the tile B.
3. Generate a sequence of gradually deforming tiles from A to the vacant space.
4. Place the resulting tiles in the Sky and Water pattern.
5. Assign colors so that the figure-ground reversal appears.



Given pair of tiles A and B

Vacant space surrounded by copies of B

Morphing

Assign colors