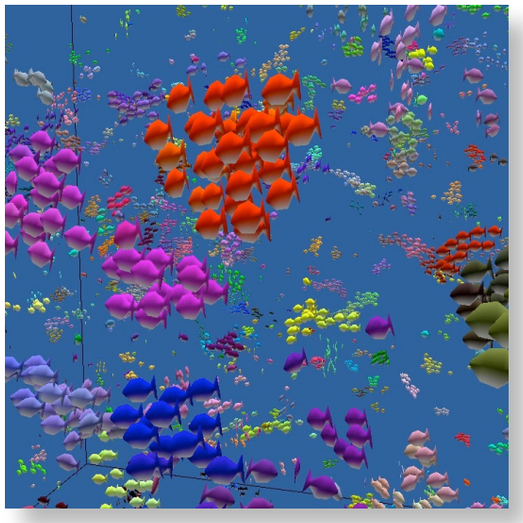


Self-Organization and Optimization for Graphics and Animation

Craig Reynolds

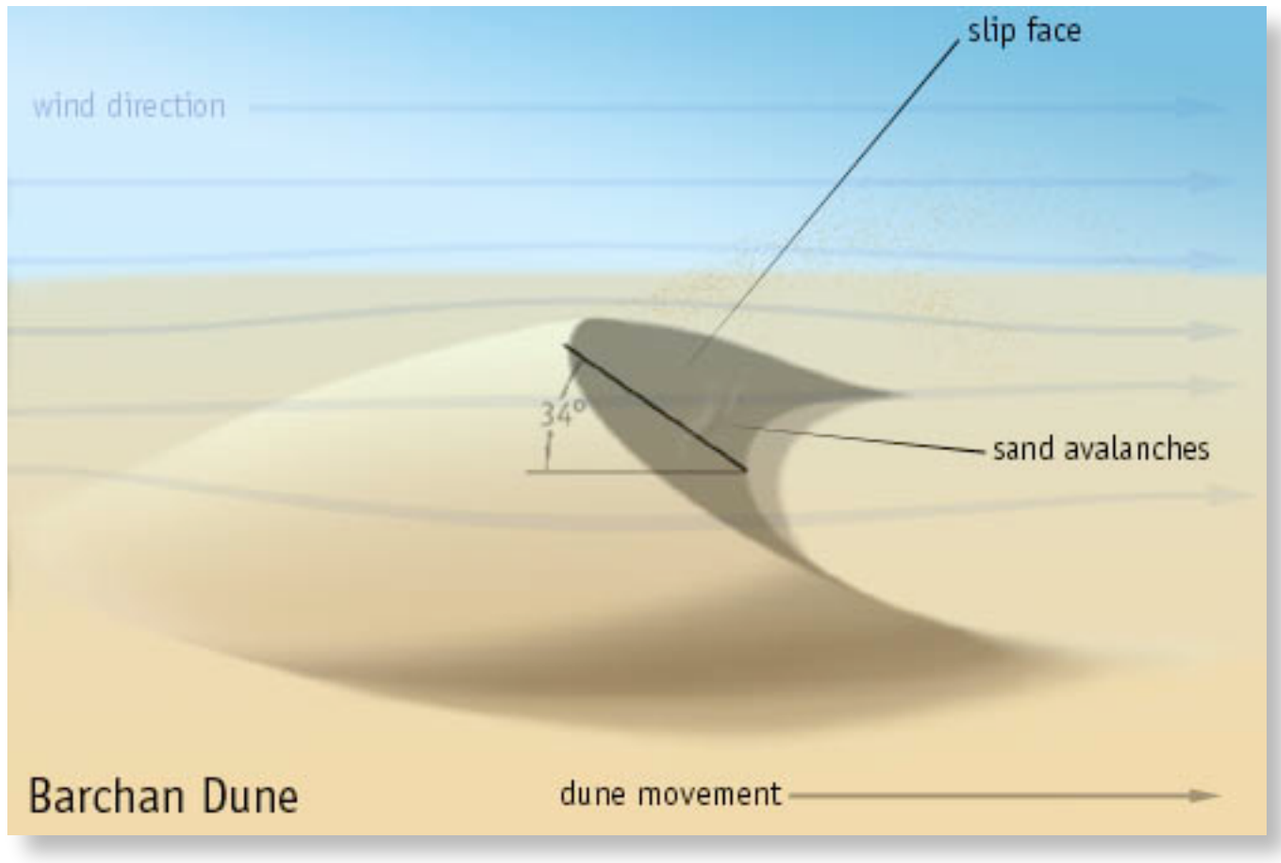
presented at:
EPGY 2013 - Artificial Intelligence
July 31, 2013

In this talk

- Self-organization
  - flocking boids
  - steering behaviors
- Optimization
  - steering behaviors
  - texture synthesis

Self-organization

- many autonomous *agents* ("multi-agent simulation")
- local interaction between neighboring agents
- emergence of global behavior or structure



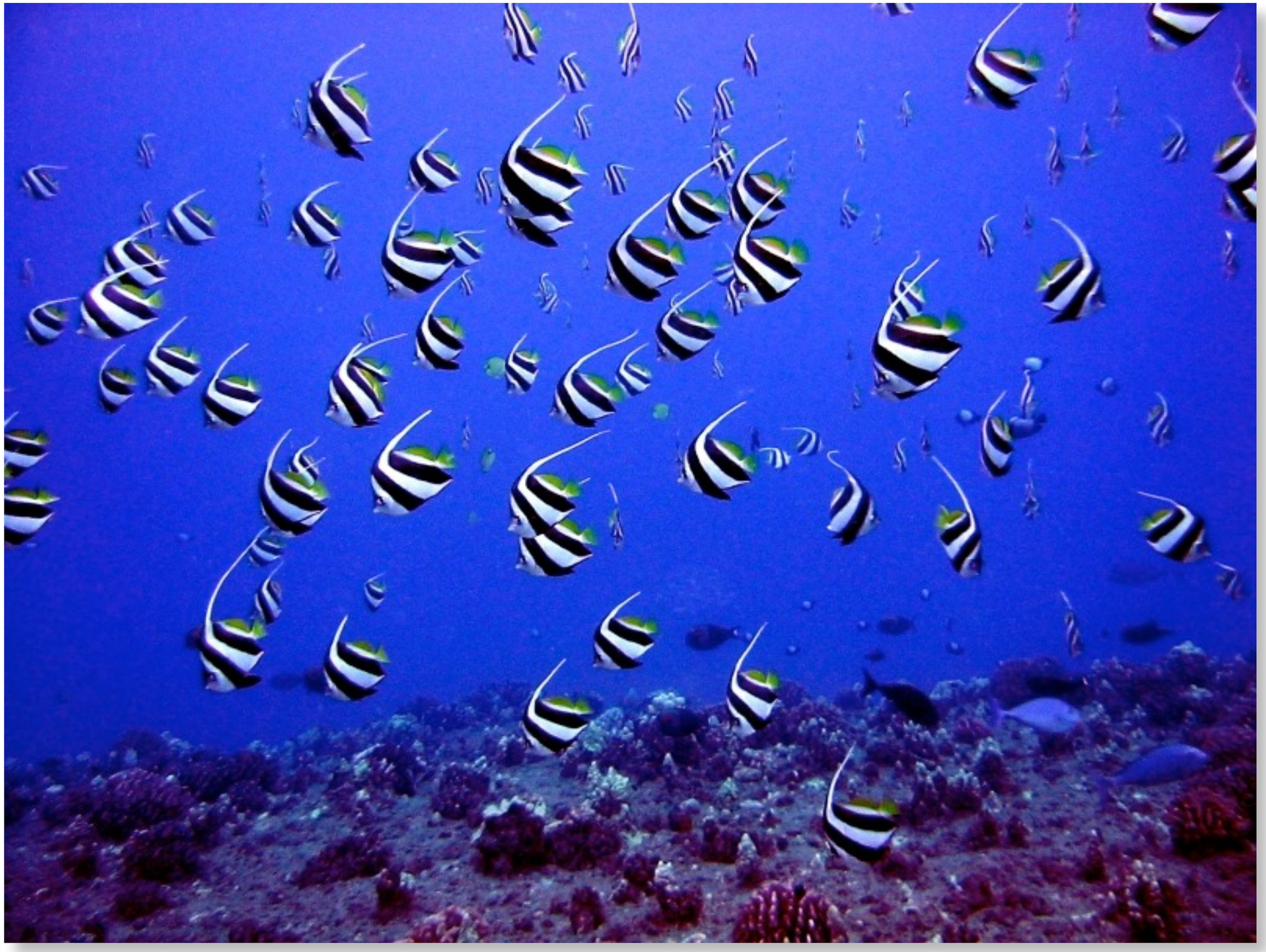
self-organized criticality
inorganic granular system

© 2006 Merikanto, Wikipedia

boids

©2007 by Natasha Mhatre, via Flickr, used with permission

iStockPhoto



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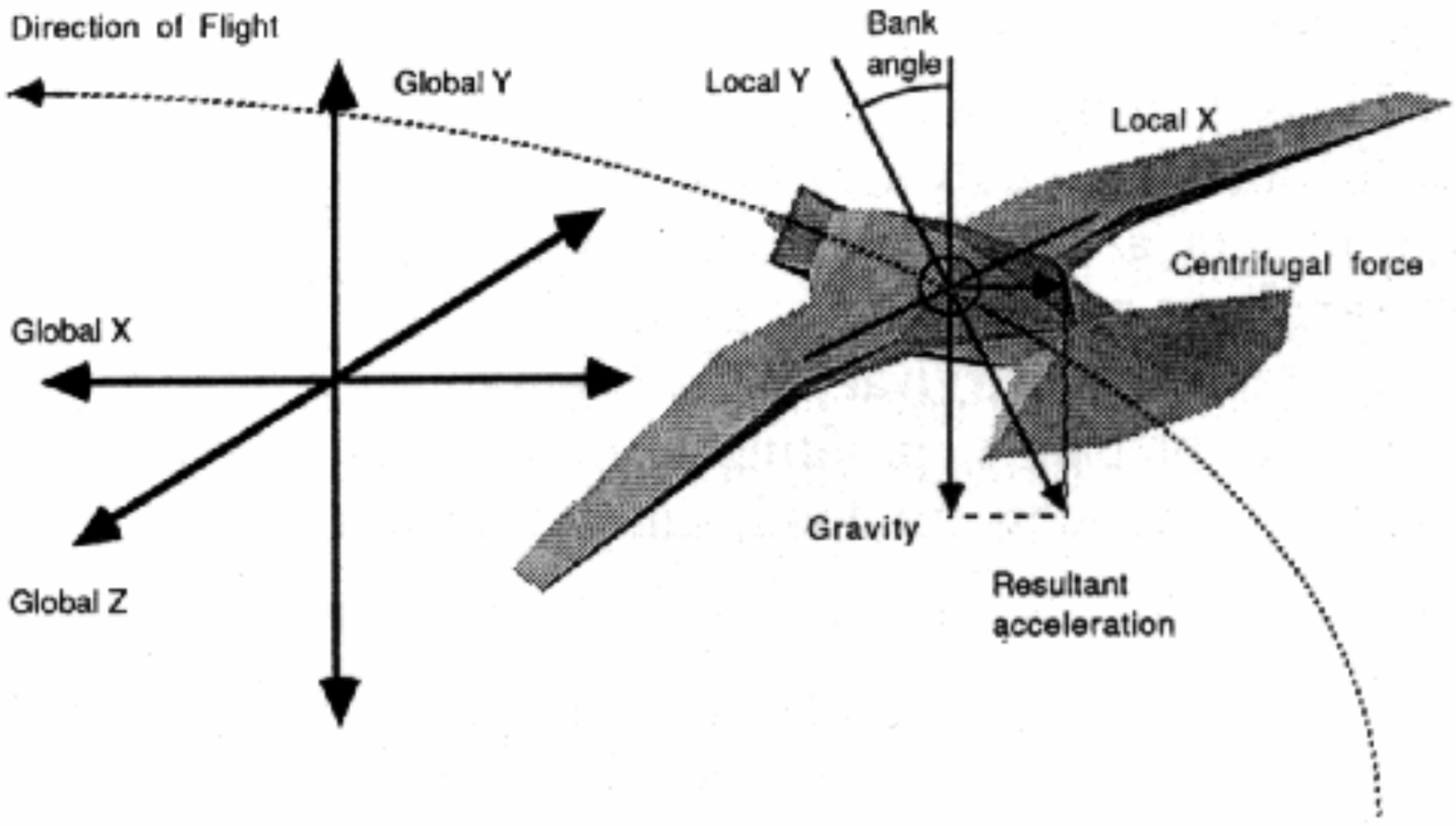
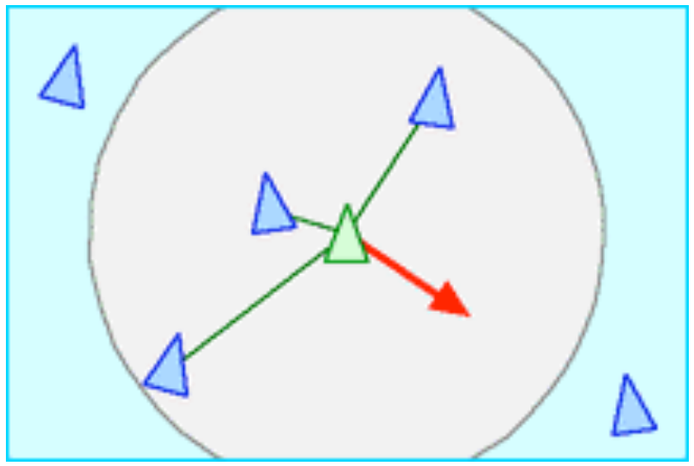
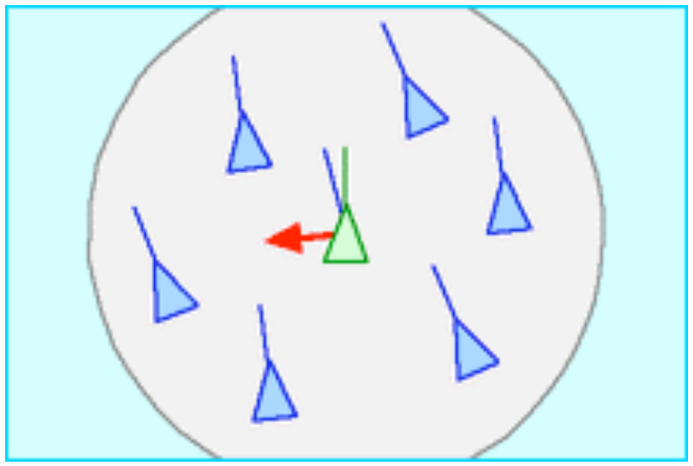


boid's local coordinate system and *banking*

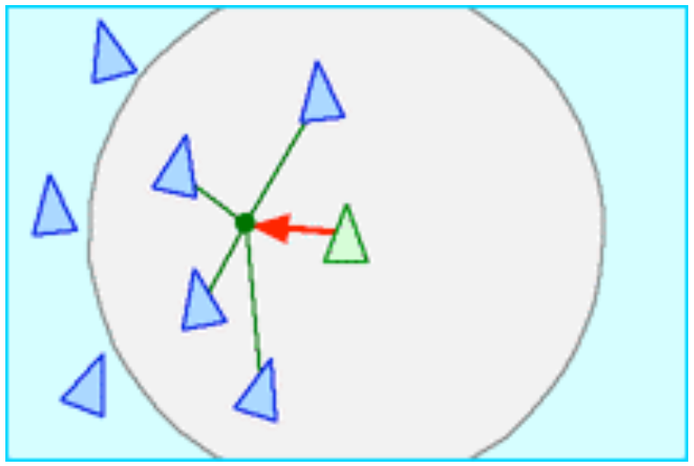
Three component steering behaviors of flocking:



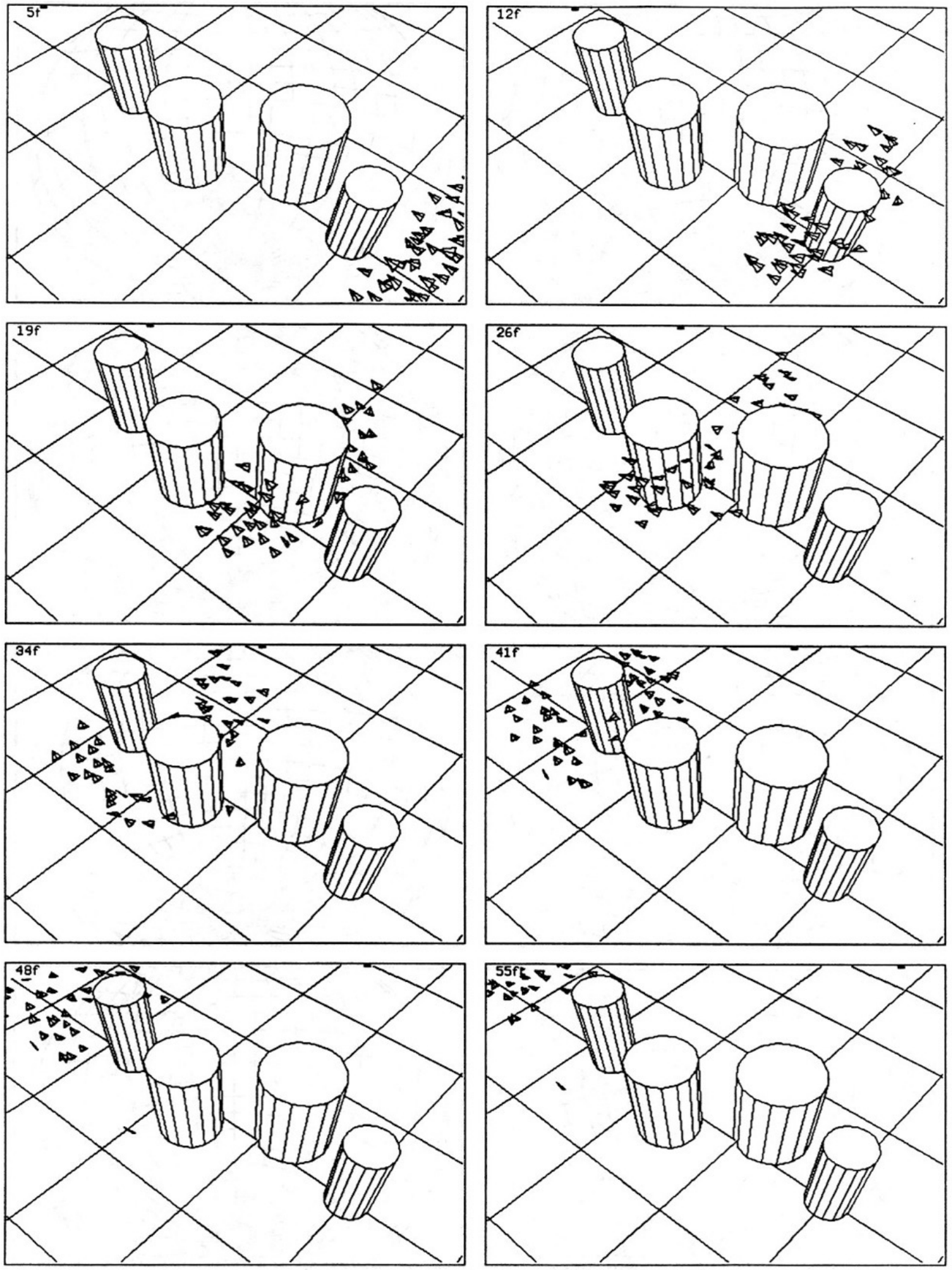
Separation



Alignment



Cohesion



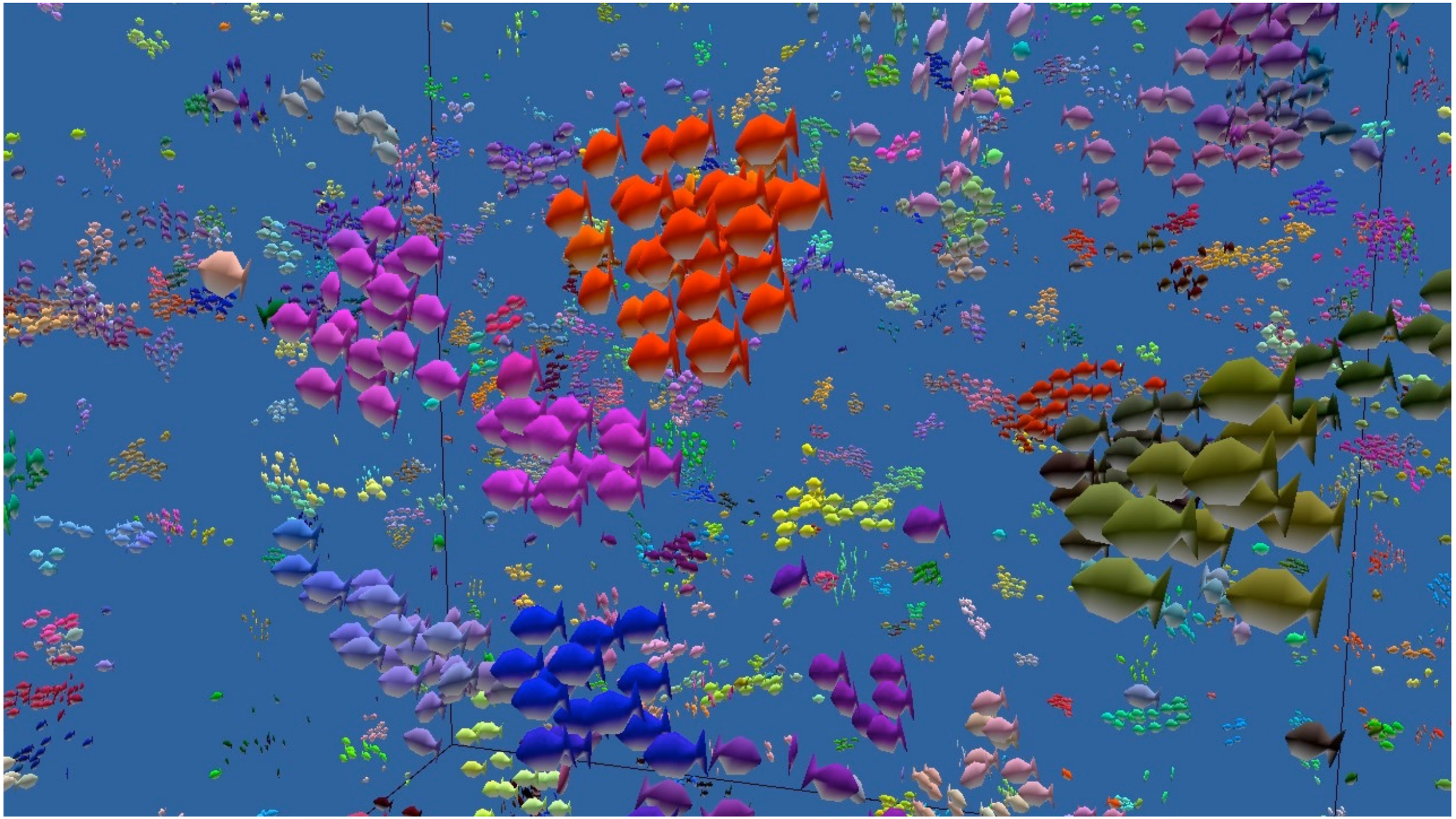
Early boids motion test:

- flocking
  - separation
  - alignment
  - cohesion
- seek
- obstacle avoidance

1986 screen grabs from Symbolics Lisp Machine

(Stanley and Stella in) Breaking the Ice
1987

video: Btl



Real time boids on PS3 — about 10,000 at 60Hz — PSCrowd, 2006

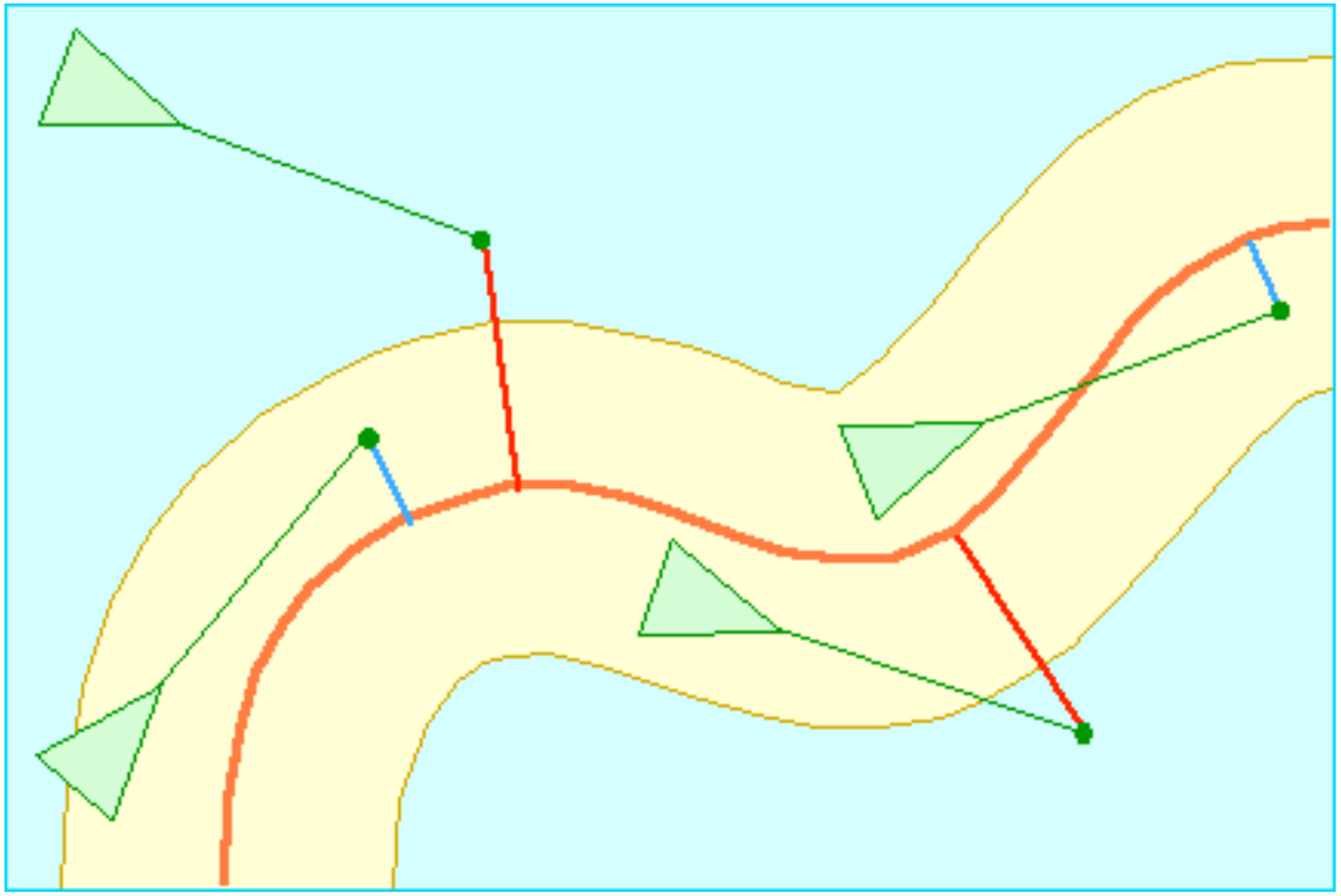
video: 12k fish

steering behaviors

Steering behaviors

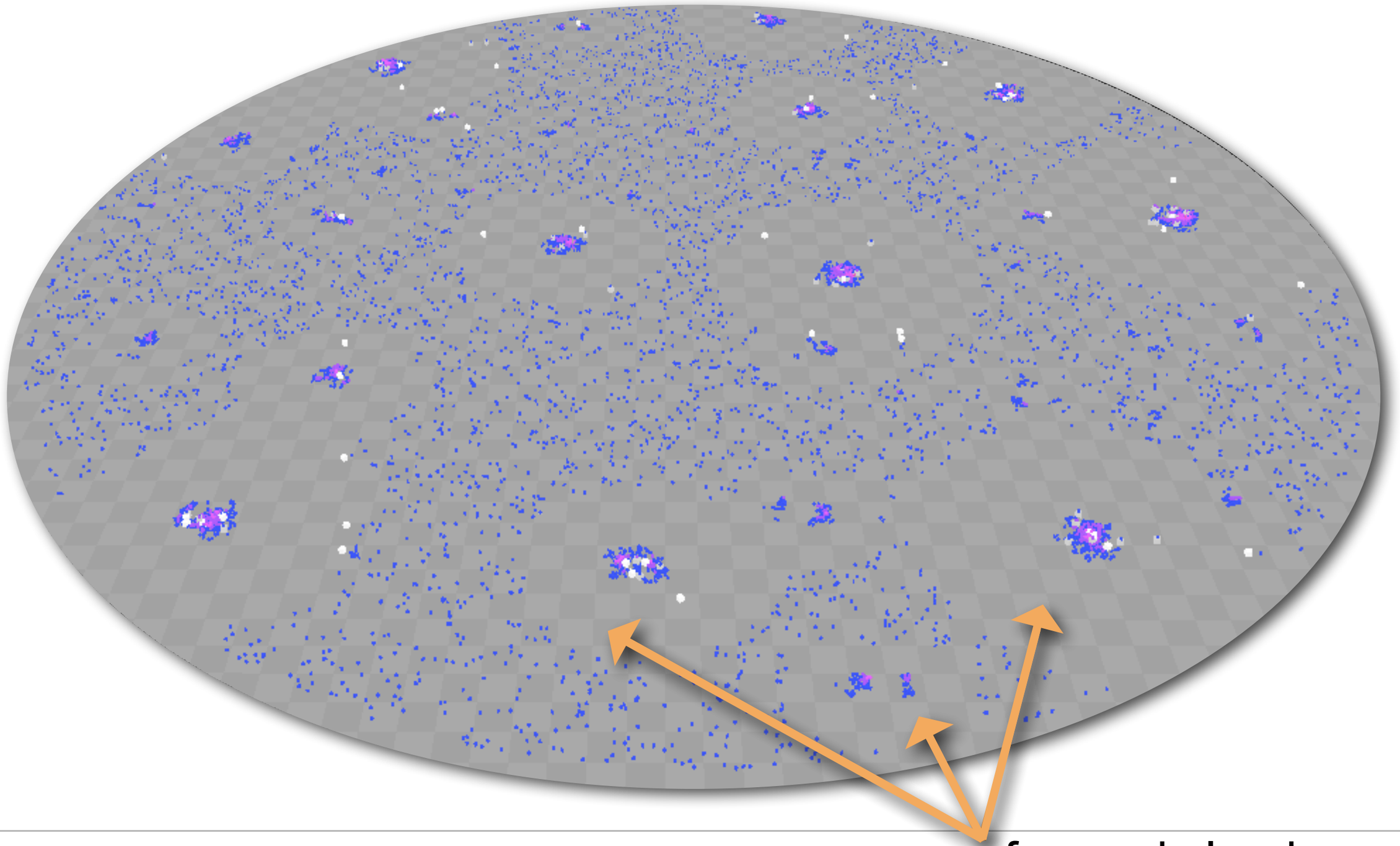
- Generalization of flocking and related ideas
- Other kinds of navigation behaviors for agents:
  - seek, flee, pursue, evade, obstacle avoidance, path following, leader following, queuing, ...
- Released as Java demos and OpenSteer C++ library

Steering behavior example, path following:



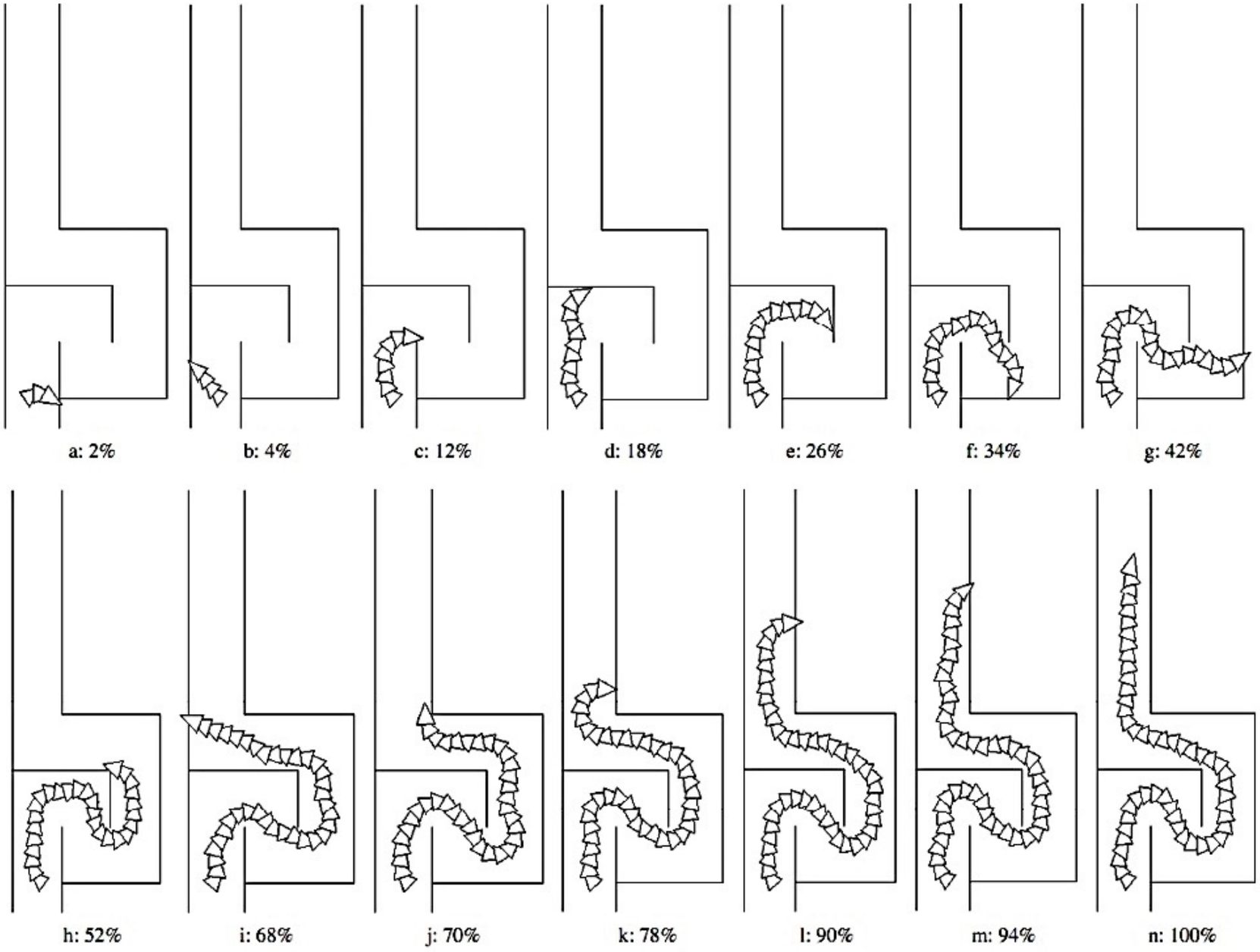
demo: OpenSteer

Stigmergy: emergent team construction



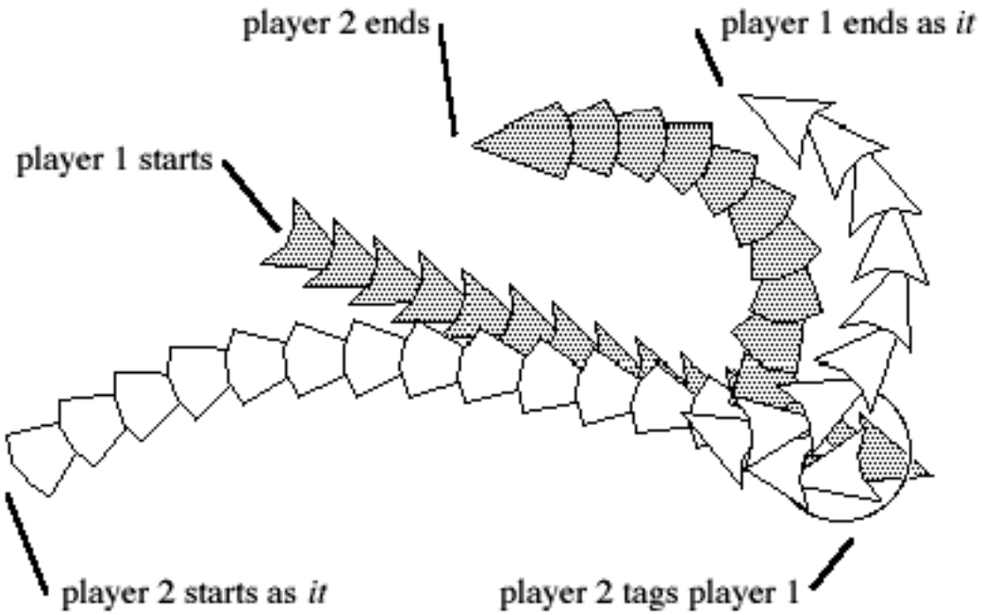
optimization for steering behaviors

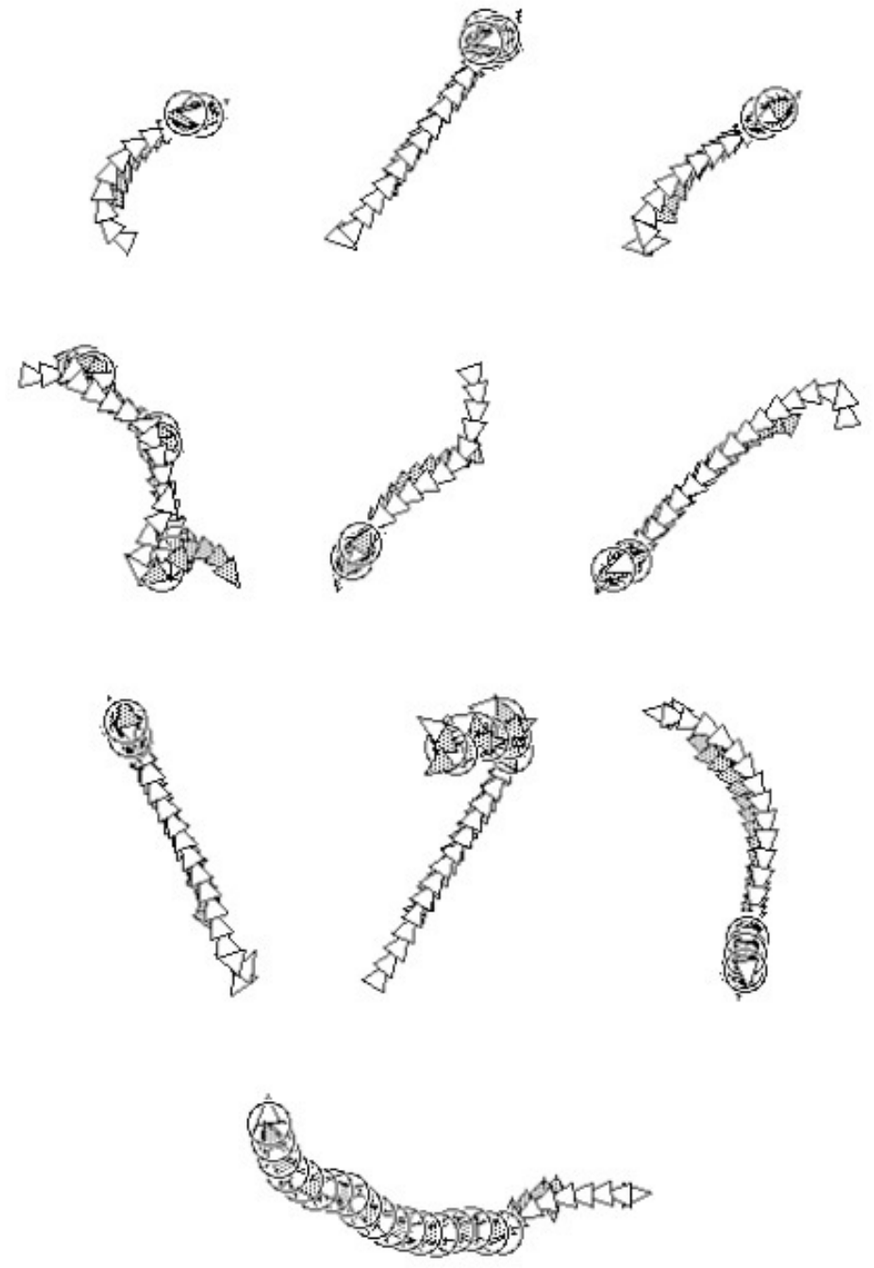
Evolutionary Steering



Evolution of Corridor Following Behavior in a Noisy World — SAB 1994

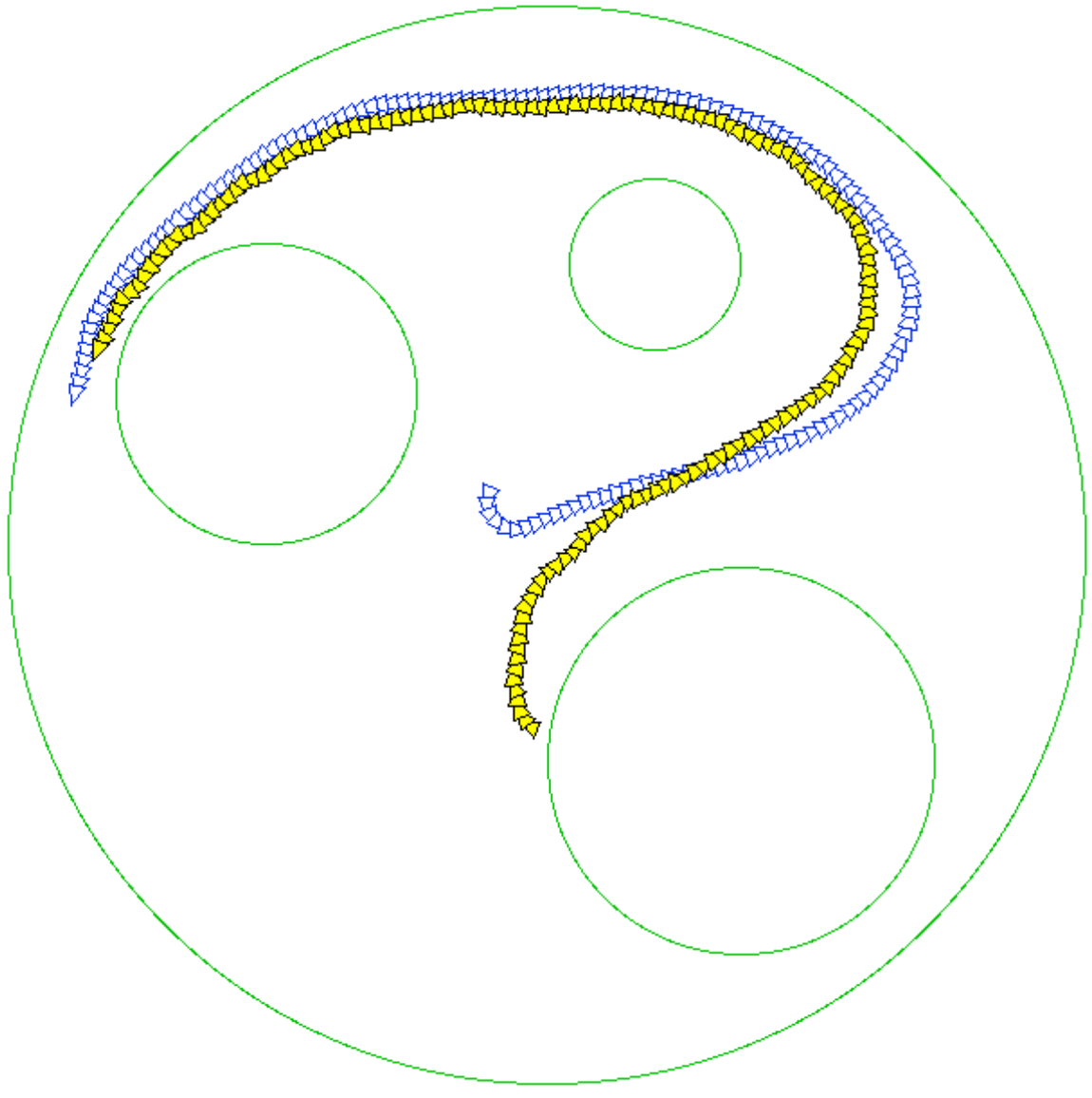
Evolutionary Steering

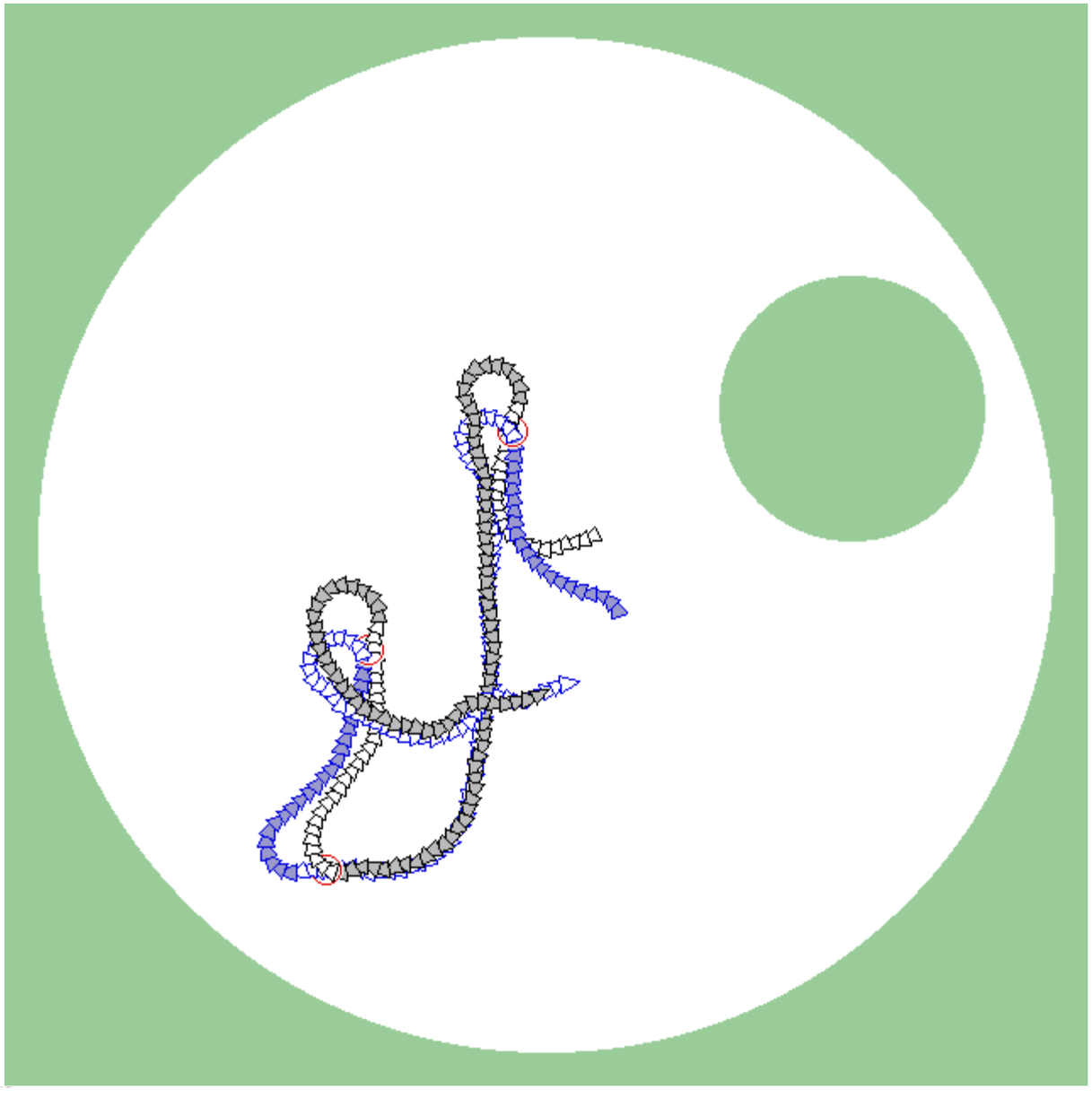




Competition, Coevolution and the Game of Tag — ALife 1994

Evolutionary Steering





subsequent work on “tag” with obstacles — unpublished

optimization for texture synthesis

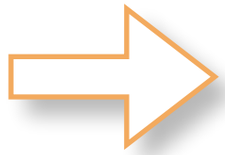
texture synthesis

+

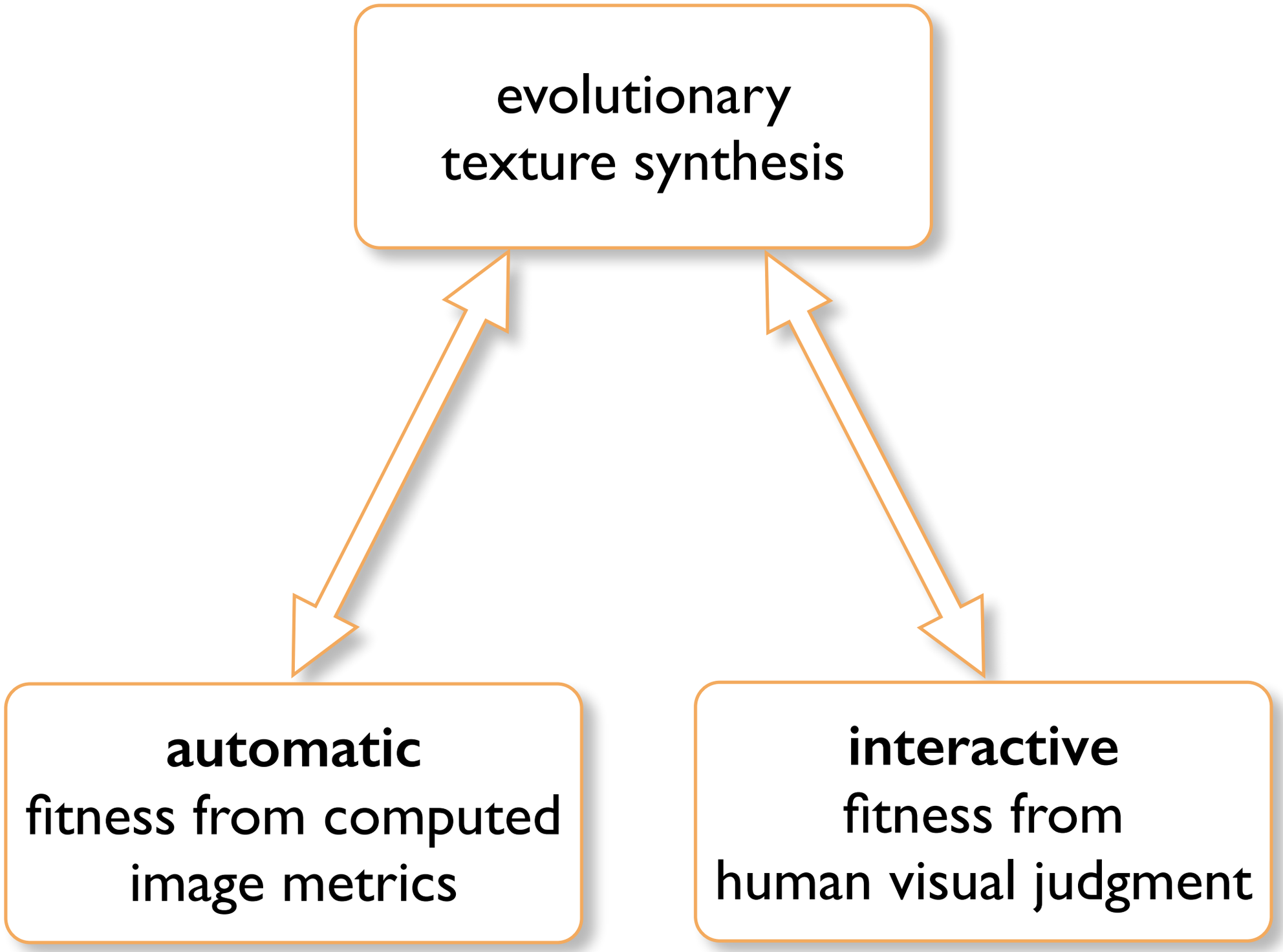
optimization

+

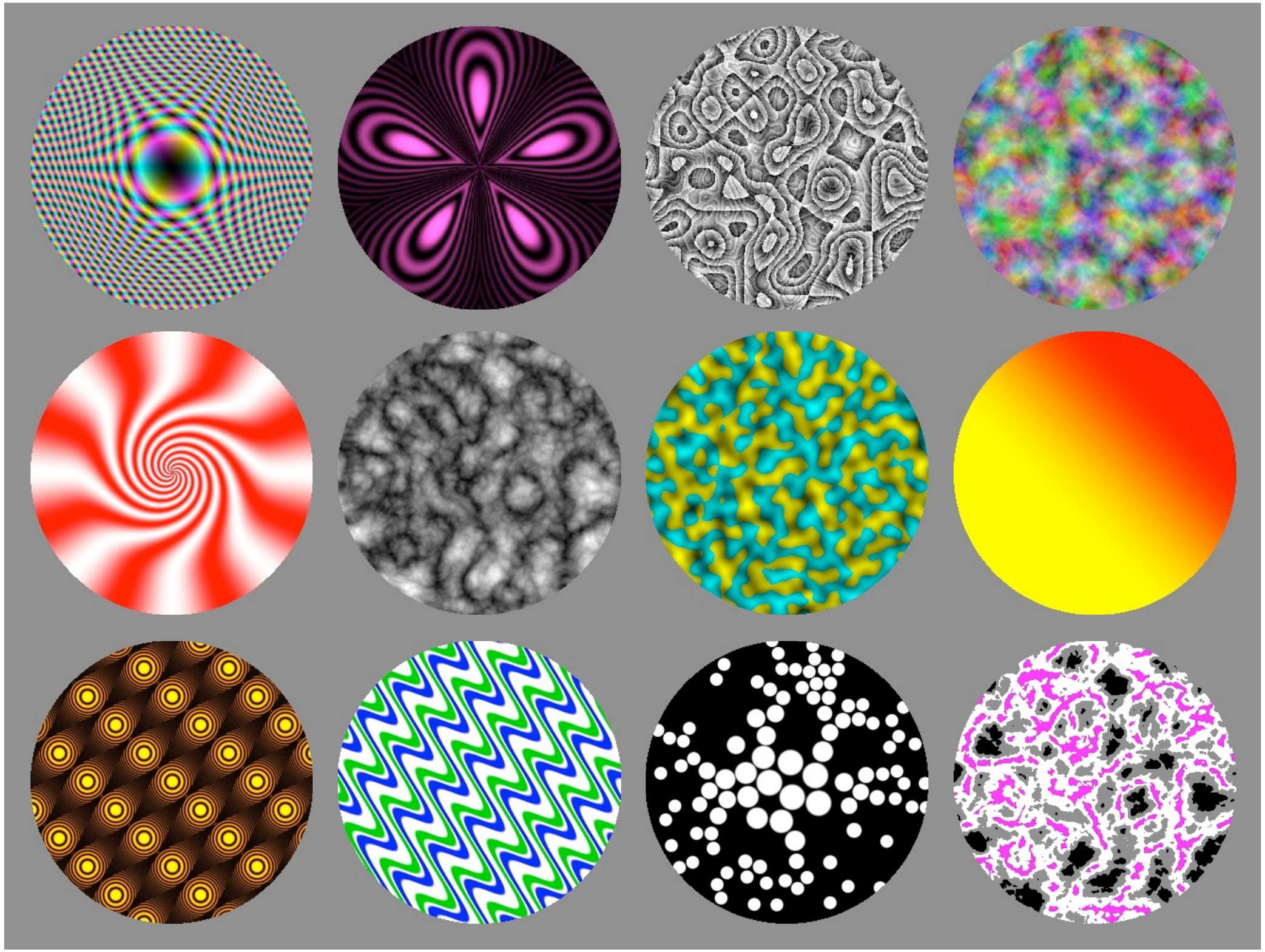
goal



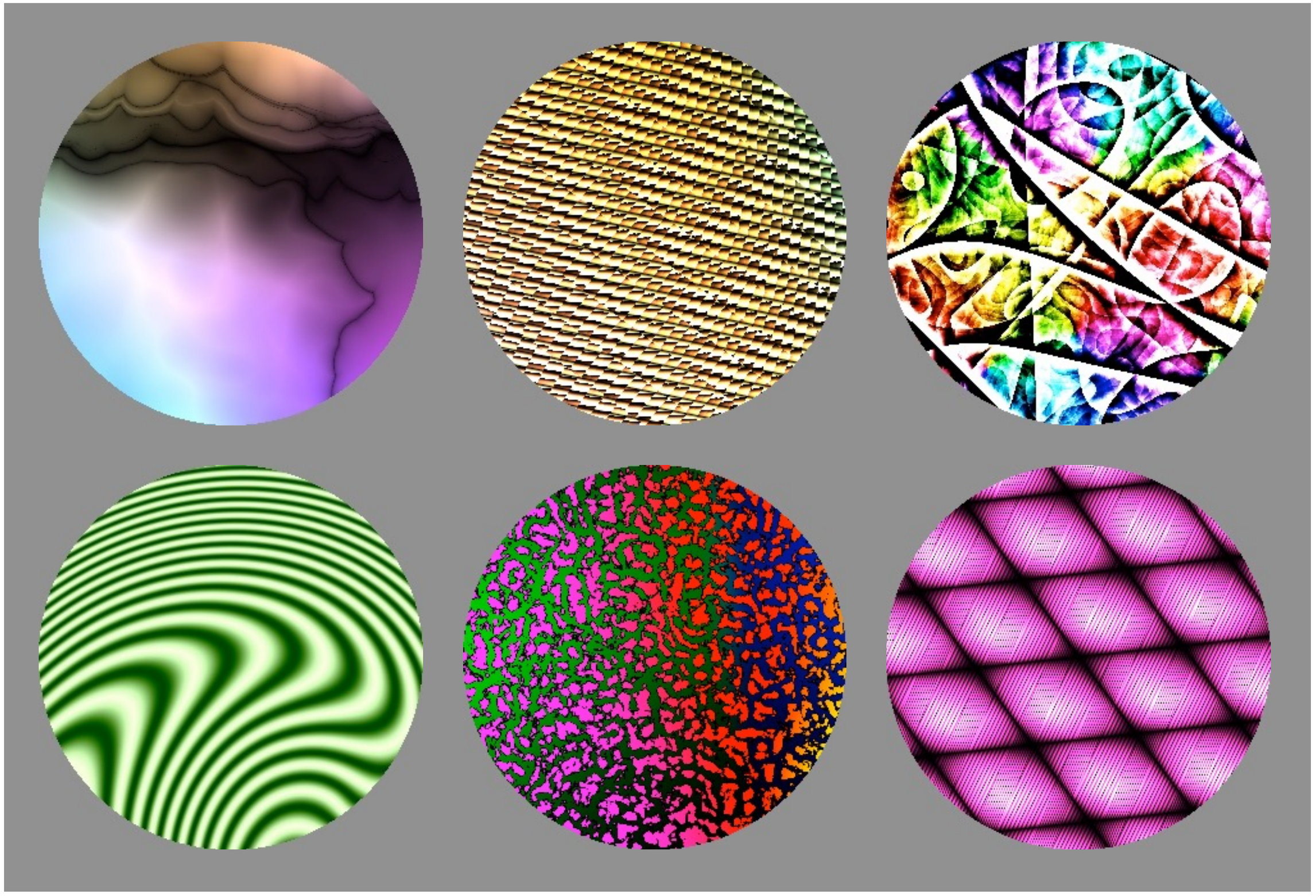
goal-oriented texture synthesis


evolutionary
texture synthesis
automatic
fitness from computed
image metrics
interactive
fitness from
human visual judgment

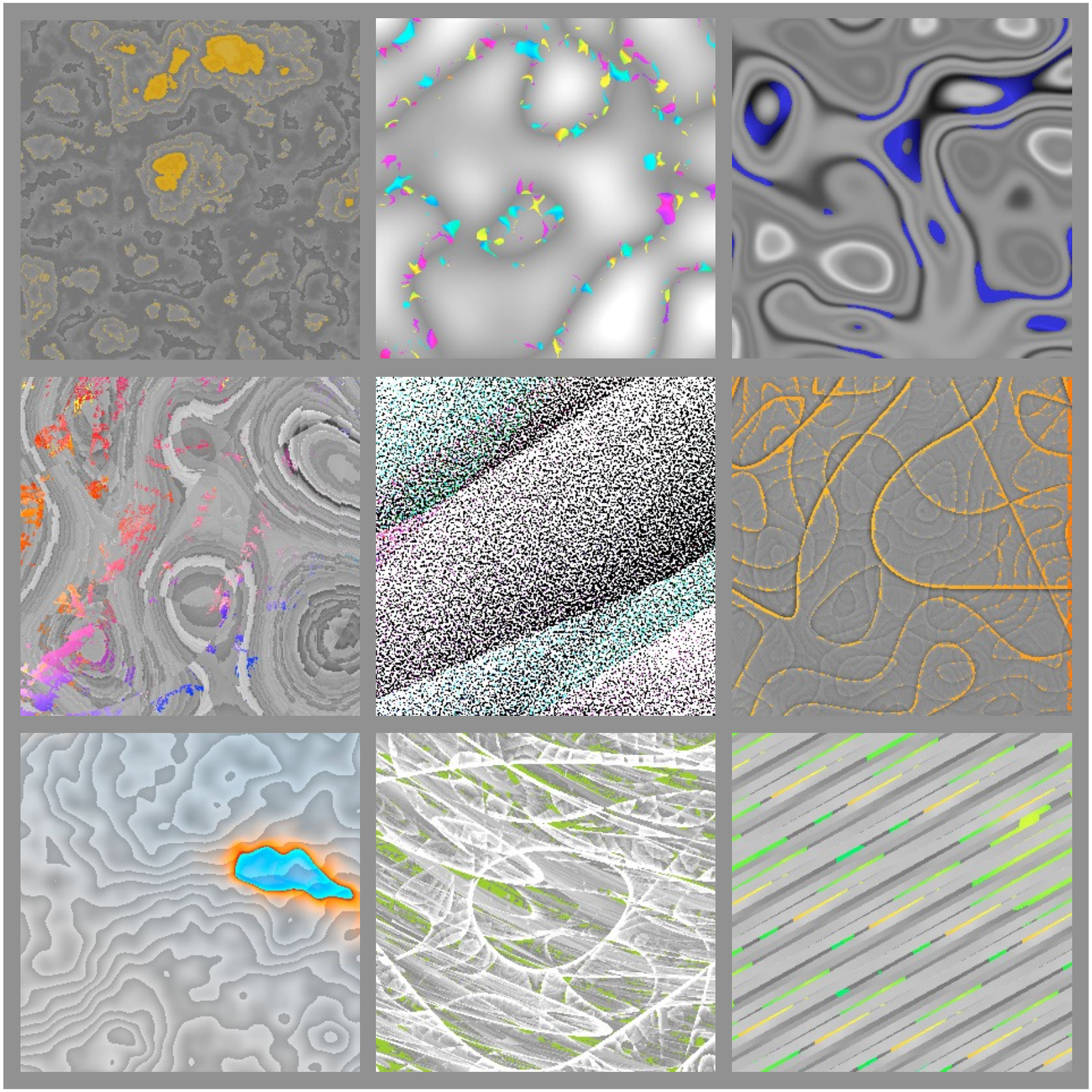
procedural fitness for texture synthesis



simple hand-written combinations of texture synthesis primitives



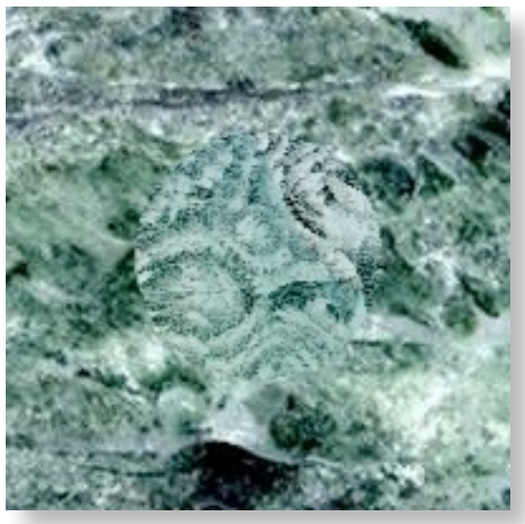
textures evolved with GP — procedural fitness

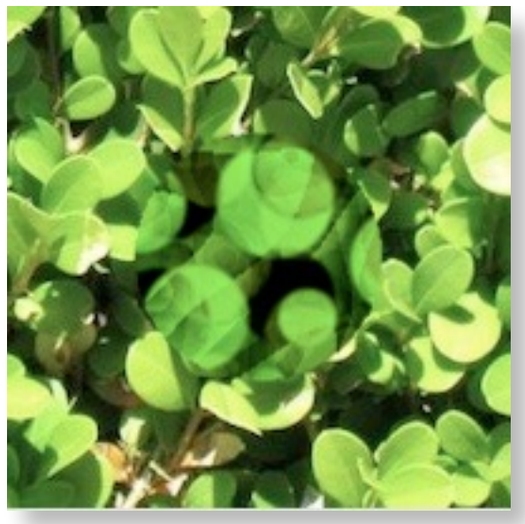


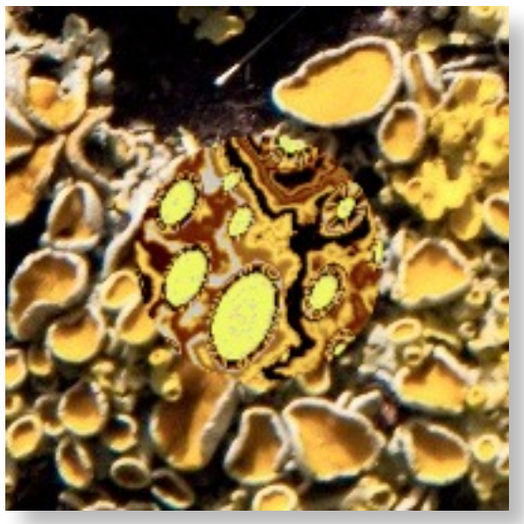
Evolved textures: gray with accent color

interactive fitness for texture synthesis

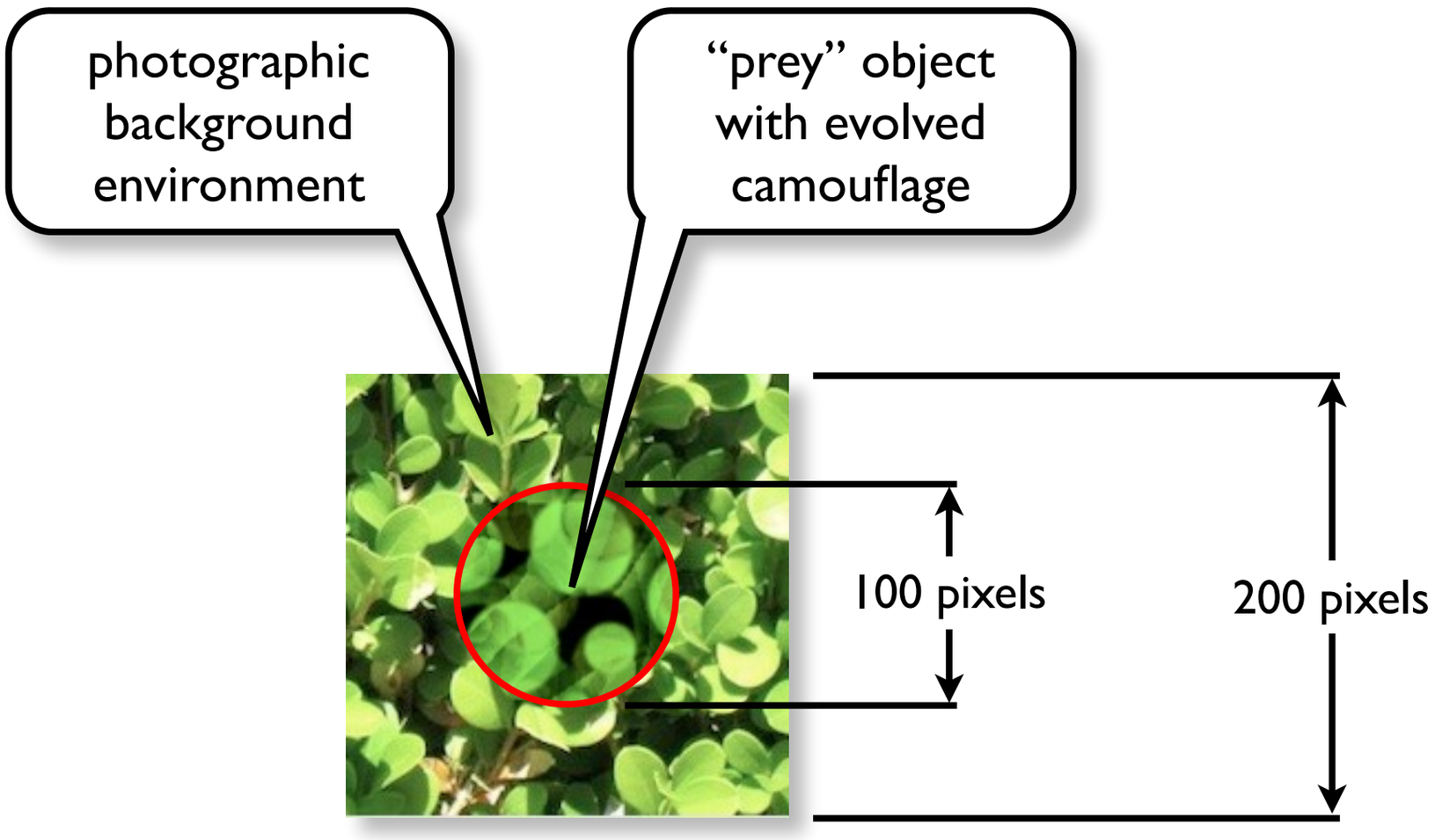
Evolved camouflage



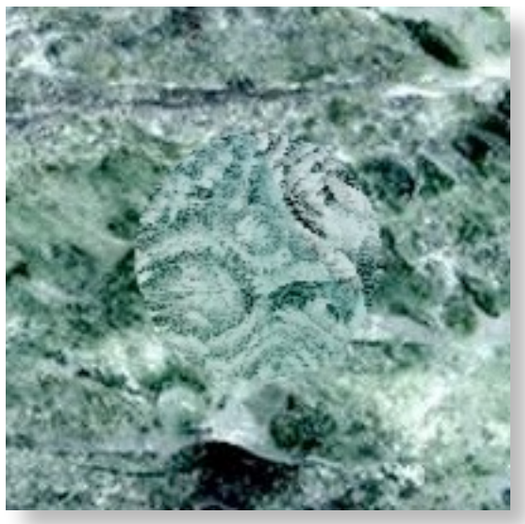


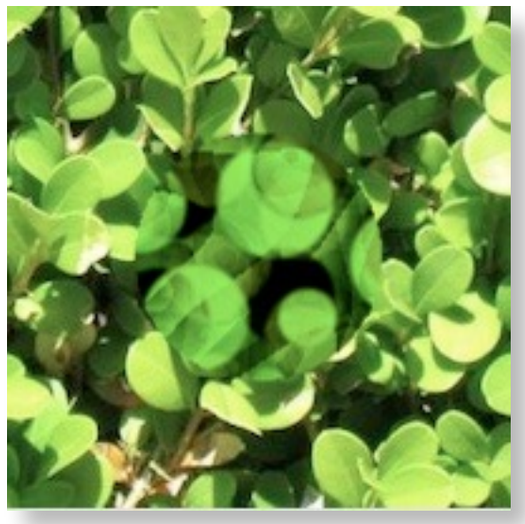


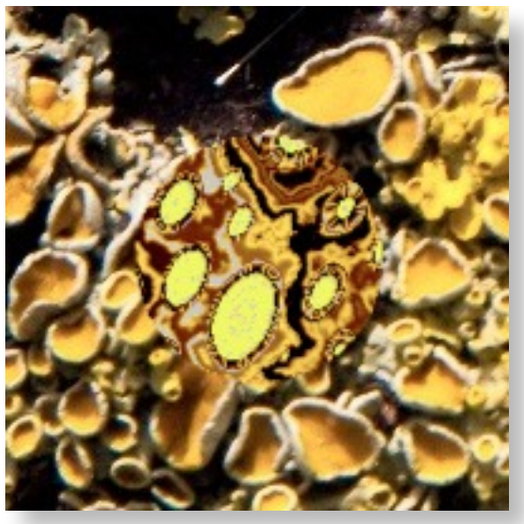
Structure of *thumbnail* images



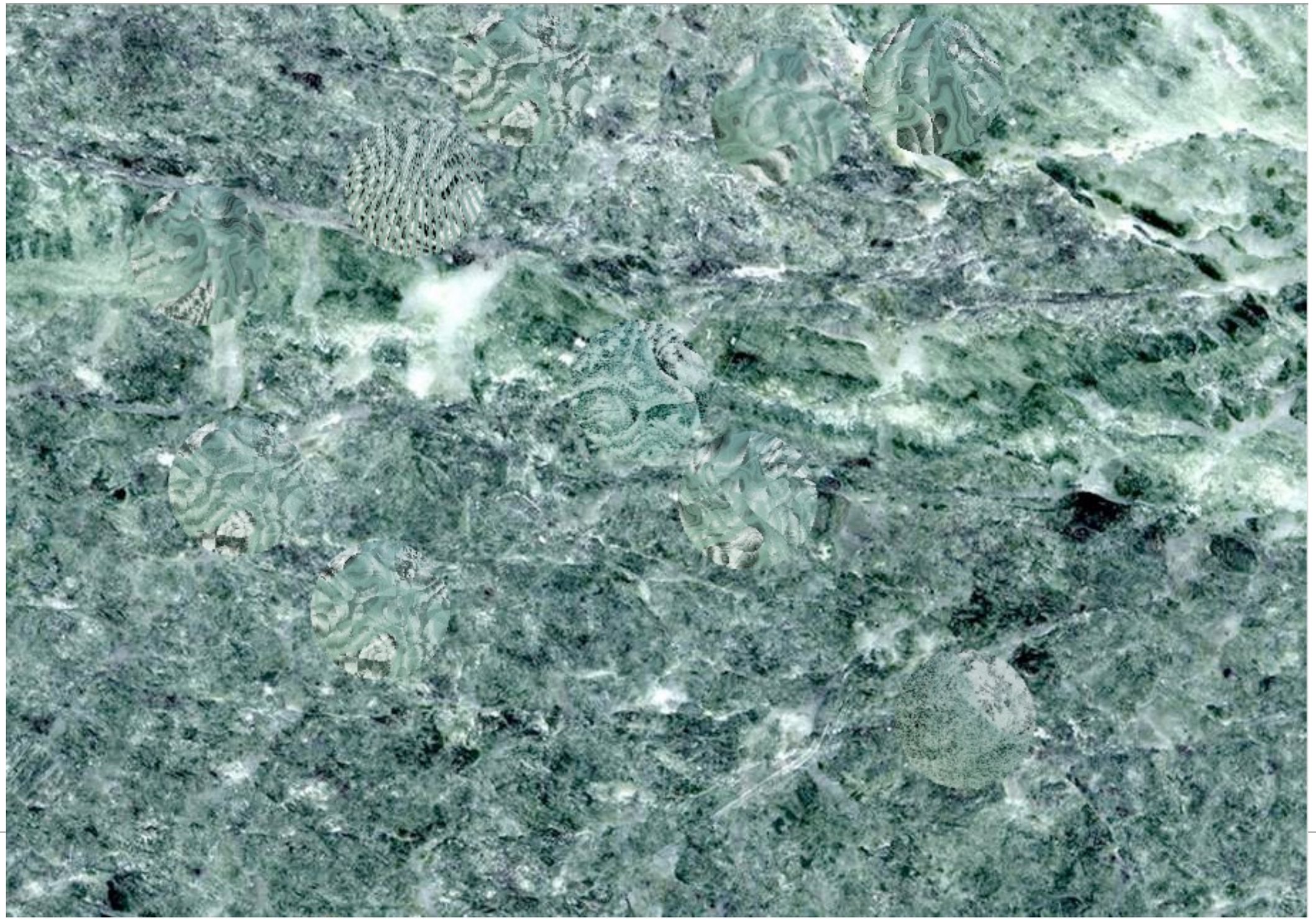
Evolved camouflage

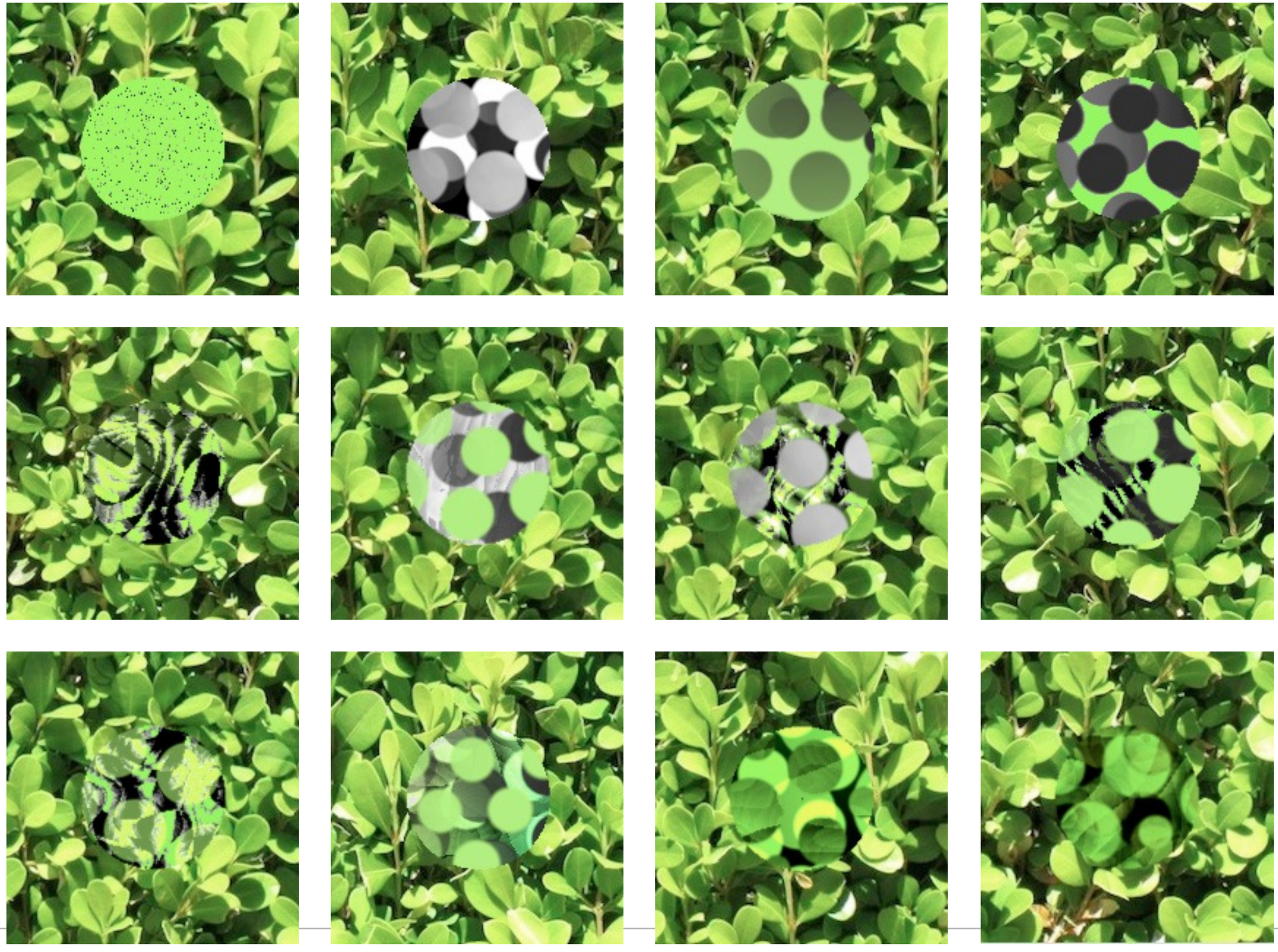






Cohort on environment





(shadows?!)

Thank you!

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http://www.red3d.com/cwr/