

Using Time to Interactively Evolve Animations

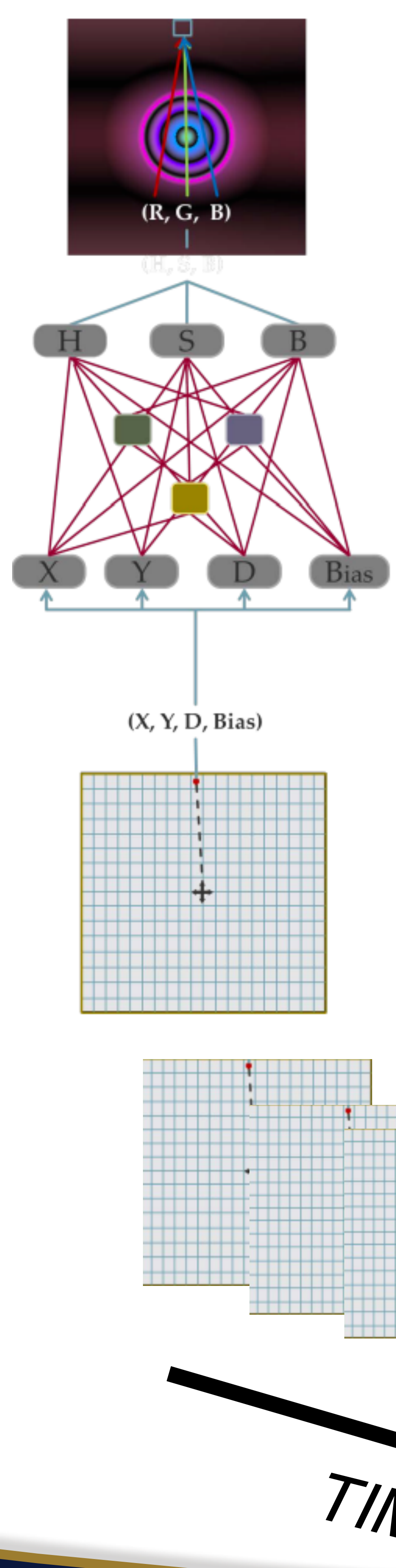
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Abstract

Evolutionary computation is a machine learning method generally applied to optimization problems, but it can also be used in many creative applications. Through the evolution of Compositional Pattern Producing Networks (CPPNs), evolutionary computation has the power to create interesting 2D pictures [1], and 3D shapes [2]. However, this research is the first time that animated images and objects have been generated using CPPNs.

By using an interactive interface, users are able to generate their own repeating 2D and 3D animations, save artifacts that they prefer, and evolve objects over generations in a process that mimics evolution via selective breeding. This program allows users to create interesting animations without any knowledge of graphic design technology or a background in animation.

Compositional Pattern Producing Networks



Evolved 2D and 3D animations are created using Compositional Pattern Producing Networks (CPPNs), a form of neural network that can take advantage of the geometry of an input space and encode spatial intelligence.

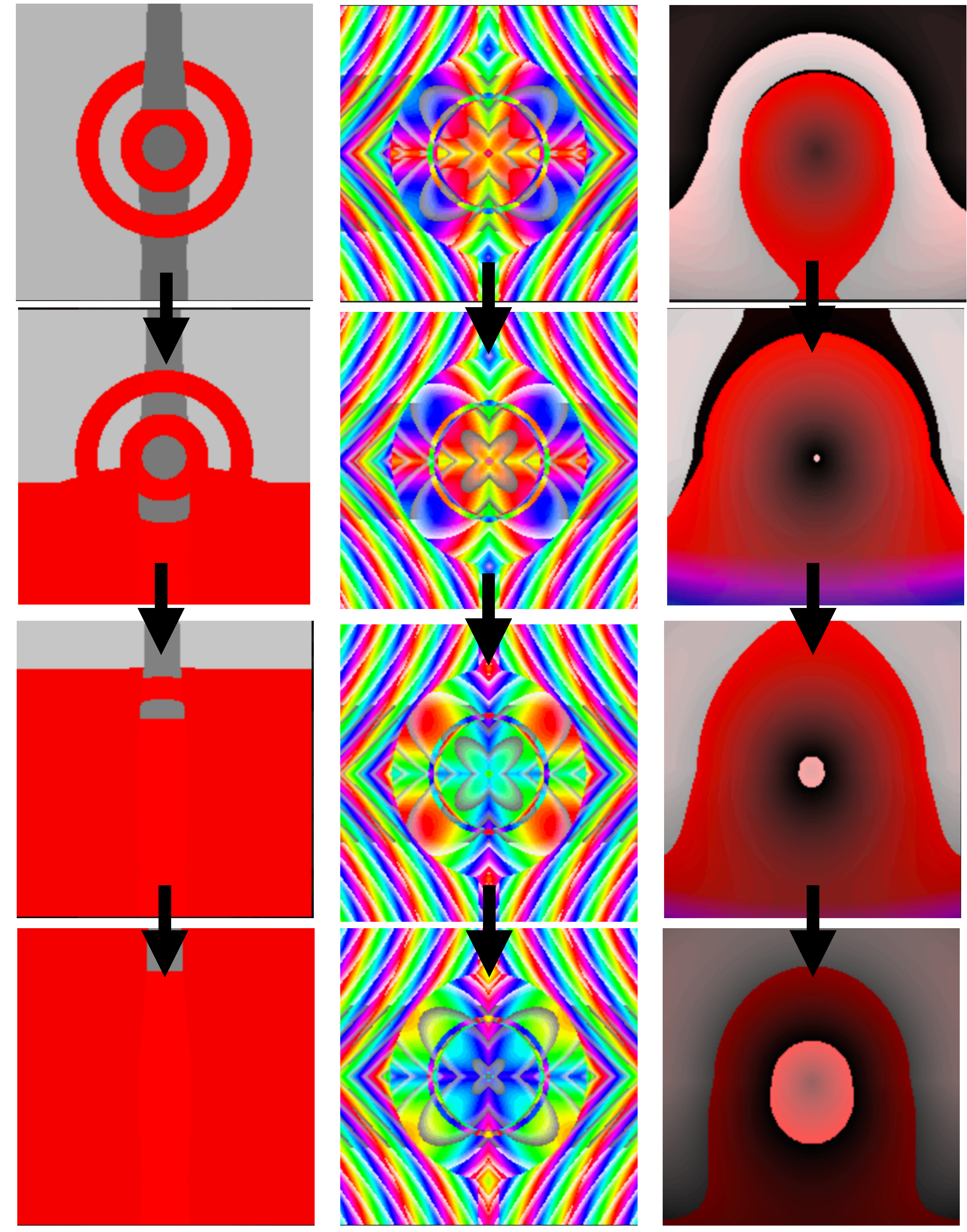
To generate images, for each pixel the CPPN uses the current x/y coordinates, the distance from the center, and a constant bias of 1.0 as inputs. These values propagate through the CPPN to generate hue, saturation, and brightness values used to define the color of that pixel.

To generate animations, a time input is added to the CPPN, and the whole process is repeated at the desired frame rate to generate a sequence of images that animate in order.

To generate 3D shapes, an input for the z coordinate of each voxel (individual cube) is added, and an output determining whether a given voxel is present is also added. For 3D animations, a time input is added, as with the 2D animations, and each 3D object that is created is added to the sequence of objects that is then animated.

Two-Dimensional Animations

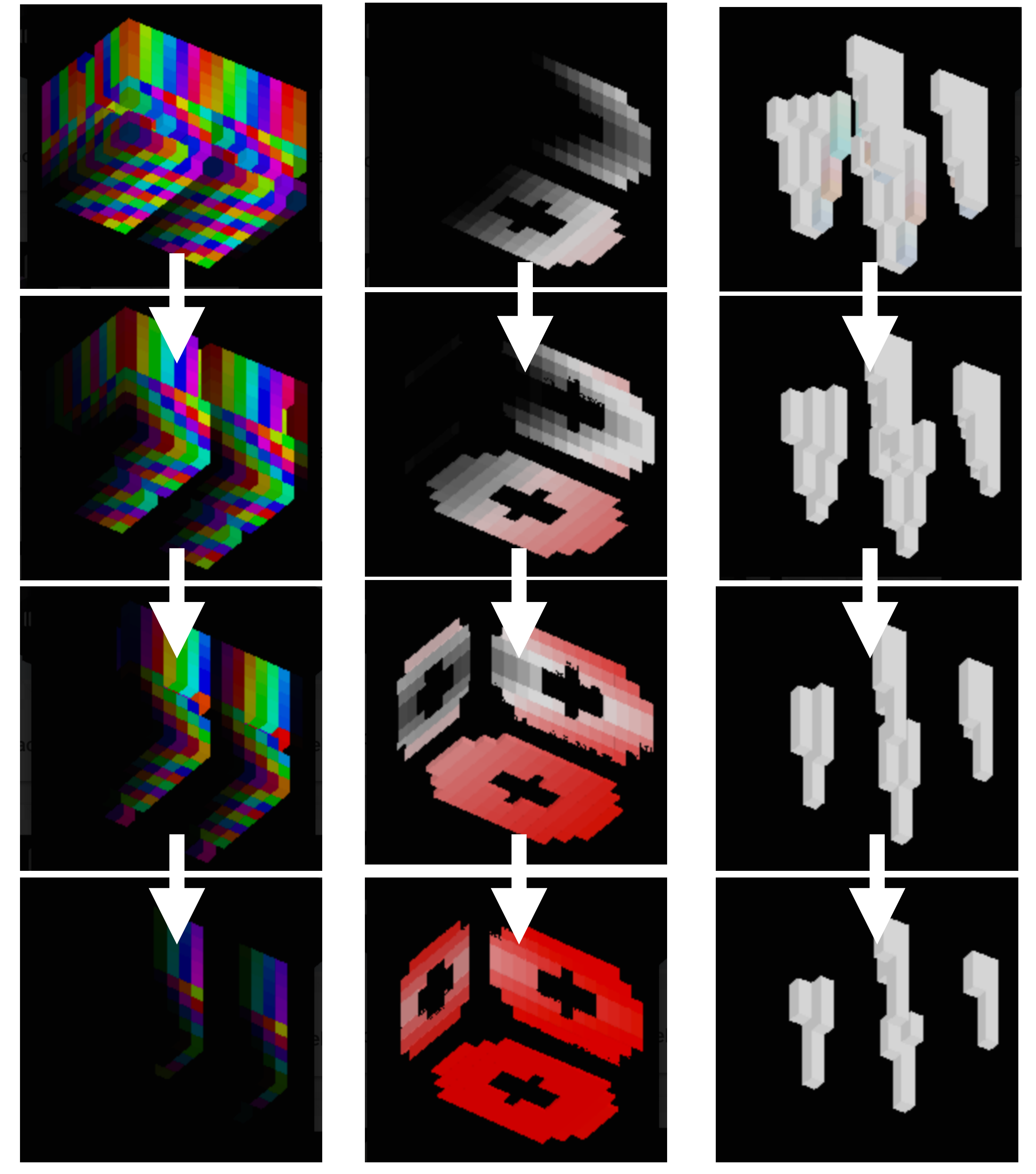
Selected Frames of Sample Animations:



Flooding Target *Rainbow Flower* *Martian Girl*

Three-Dimensional Animations

Selected Frames of Sample Animations:



Rainbow Block *Wobbling Chest* *Melting Icicles*

References

[1] Jimmy Secretan, Nicholas Beato, David B. D'Ambrosio, Adelein Rodriguez, Adam Campbell, Jeremiah T. Folsom-Kovarik and Kenneth O. Stanley. Picbreeder: A Case Study in Collaborative Evolutionary Exploration of Design Space. *Evolutionary Computation* 19, 3 (2011), 373?403. DOI: http://dx.doi.org/10.1162/evco_a_00030

[2] Jeff Clune and Hod Lipson. 2011. Evolving 3D objects with a generative encoding inspired by developmental biology. *Proceedings of the European Conference on Artificial Life*. 144-148. URL: <http://www.evolvingai.org/files/2011-CluneLipson-Evolving3DObjectsWithCPPNs-ECAL.pdf>