

Evolving Soft Robots with Vibration Based Locomotion

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Abstract

Soft robots offer advantages over normal robots such as increased flexibility, maneuverability, and deformability but they are much harder to design. The difficulty in soft robot design is that there are two intertwined problems: how to shape the robot and how to move it. Since it is unclear how to go about finding a solution, researchers use evolutionary algorithms (EA).

Grammatical Encodings

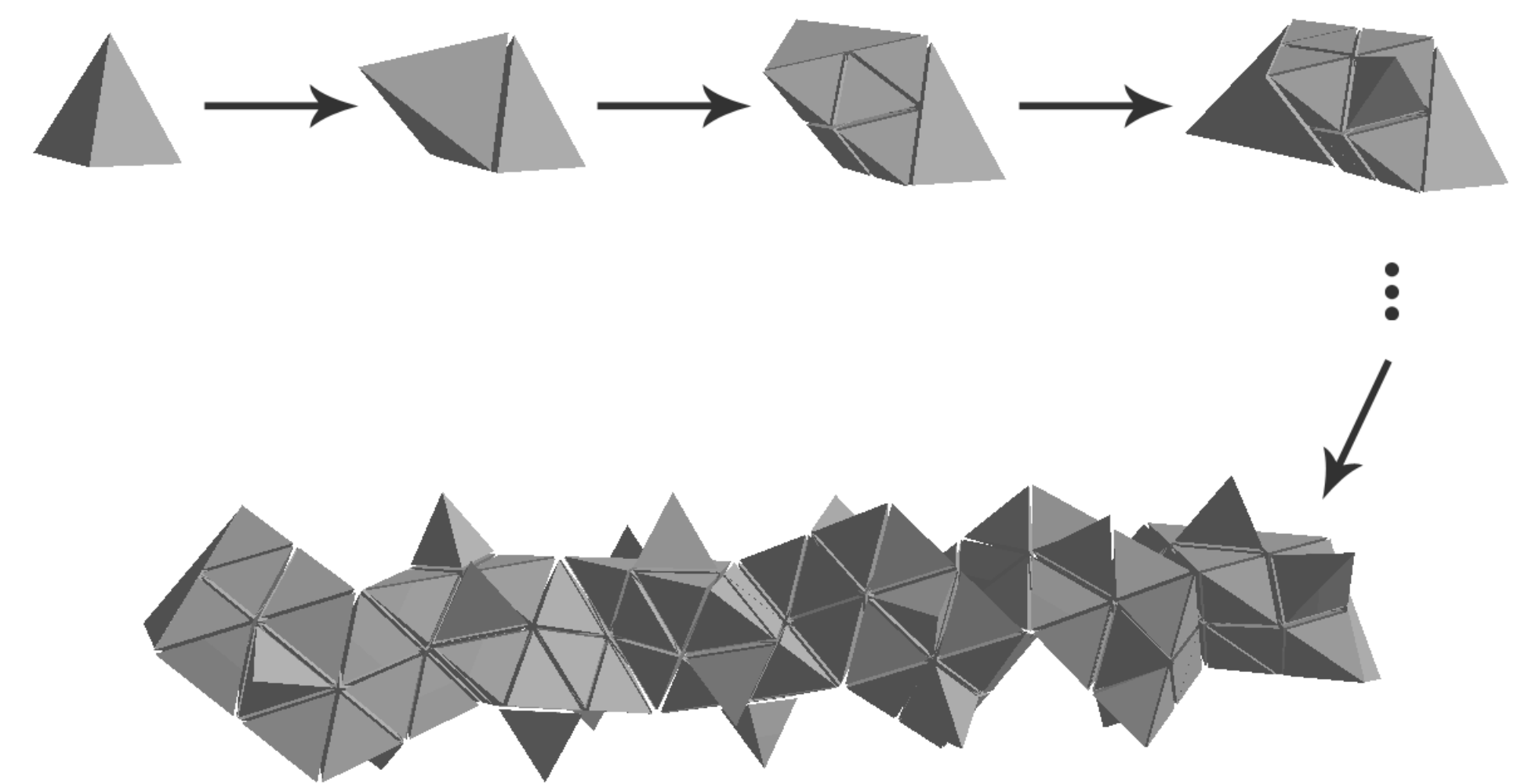
- Method for generating new designs in EA
- Direct vs Generative:
 - Direct: specify the exact design
 - Generative: “grow” design based on rules
- Benefits of Generative Encoding:
 - widespread coordinated change
 - expand on promising designs

Implementation

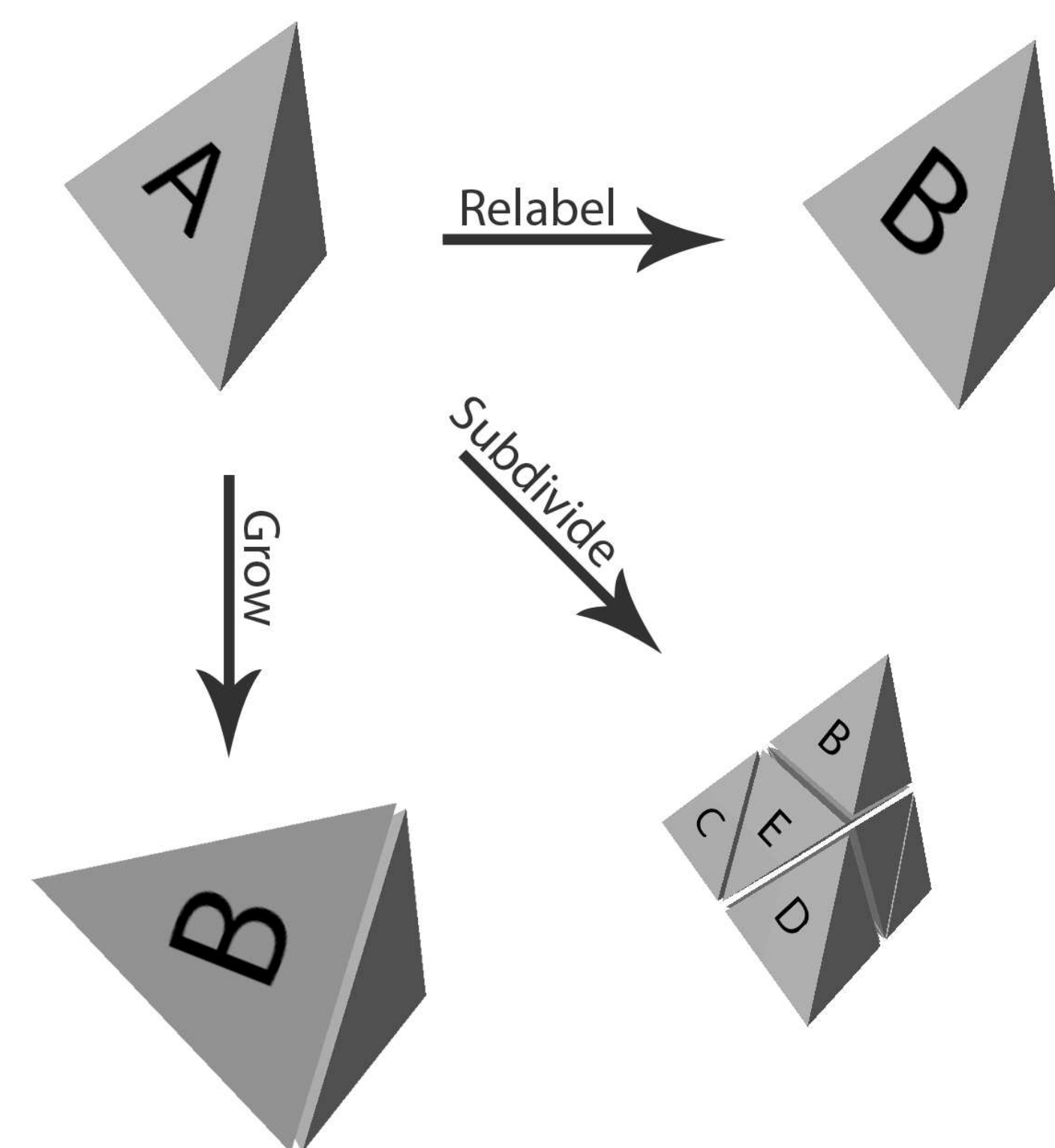
- Bullet Physics Engine – simulate designs
- Tetrahedral Face Encoding Grammar
- Vibration movement mechanism
 - Simulated to resemble real vibration motor
- EA Fitness Function
 - Apply vibration for certain period of time
 - Fitness = the distance the robot traveled

Future Work

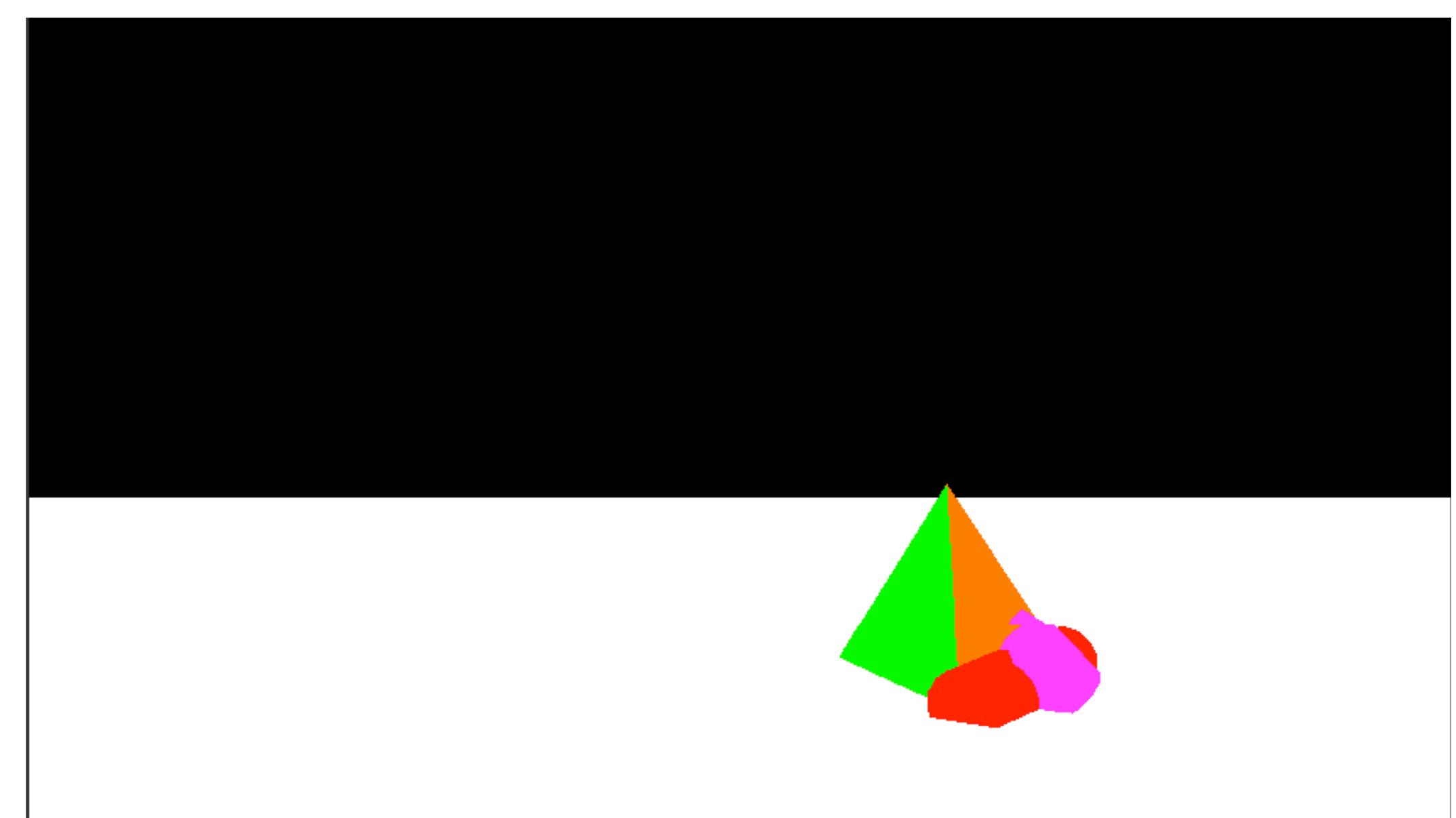
- Stopping Problem of generative encoding
- Static vs Scaled Developmental Timings
- Explore the advantages of each approach
- Leverage the Union College Cluster
- Generate designs and 3D print soft robots



Sample generative encoding growing a design..
Rieffel and Smith, 2012.



Description of a Tetrahedral face encoding grammar.
Rieffel and Smith, 2012.



The simulation of a design in progress.
Vibration motor anchored to an edge of the initial tetrahedron.



(Left) The evolved design in simulation and
(Right) the corresponding 3D printed shape.