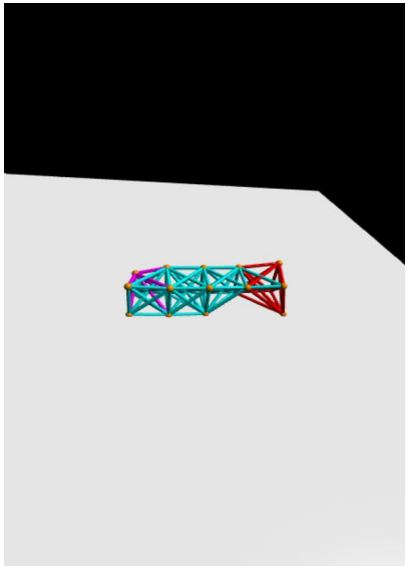
MECS E4510: Evolutionary Computation and Design Algorithms

Term Project: Evolving Soft Robots

Zena-Marie Gonzalez (zg2326)

Fastest Robot: Evolutionary Algorithm

Speed: 0.025719 meters/s



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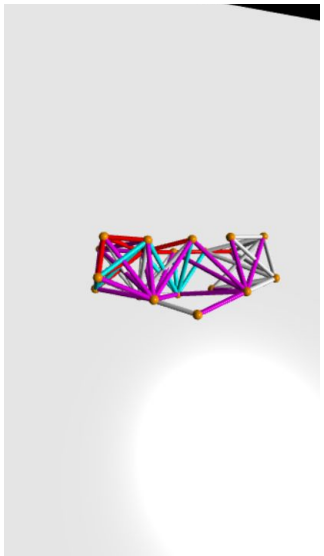
Parallel Hillclimber



Speed: 0.02555 meters/s

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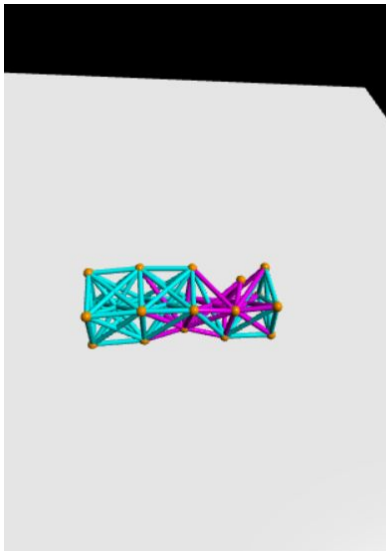
Random Search

Speed: 0.01755 meters/s



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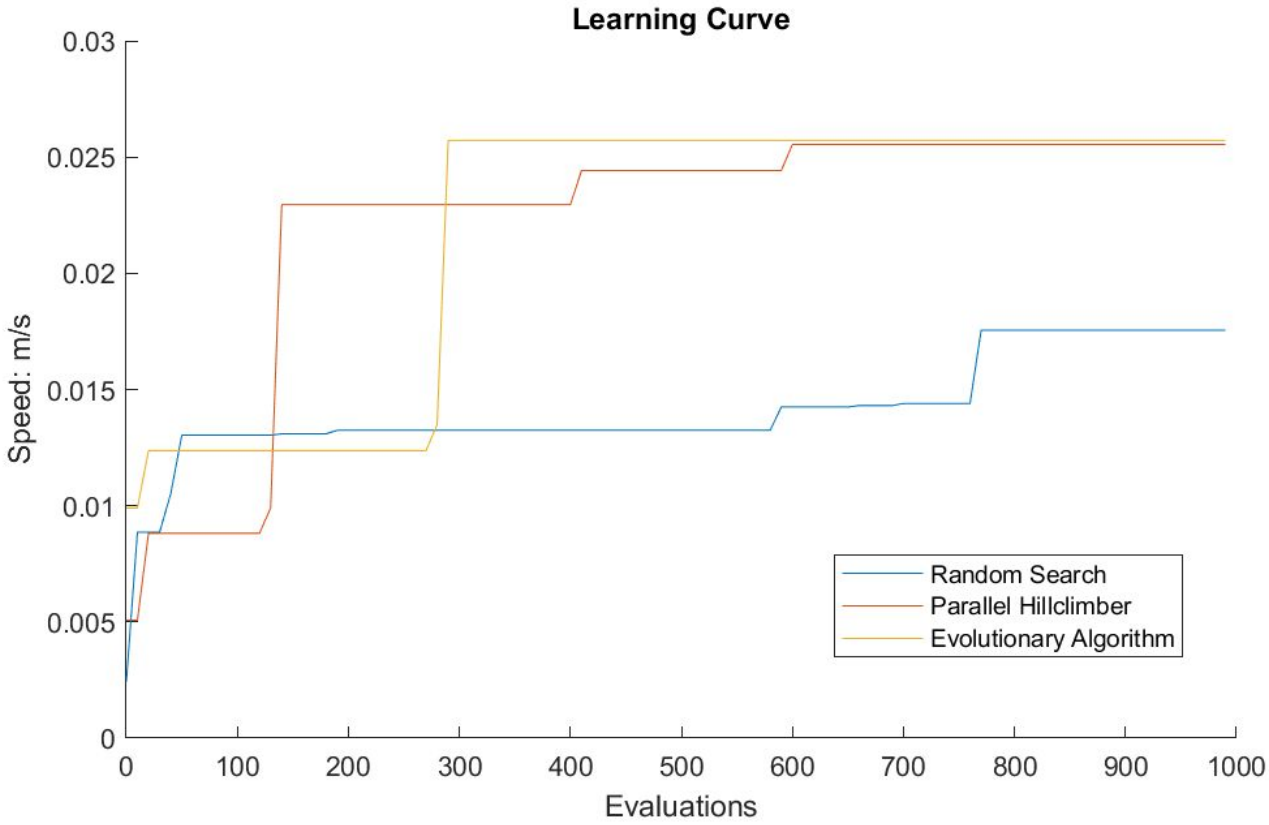

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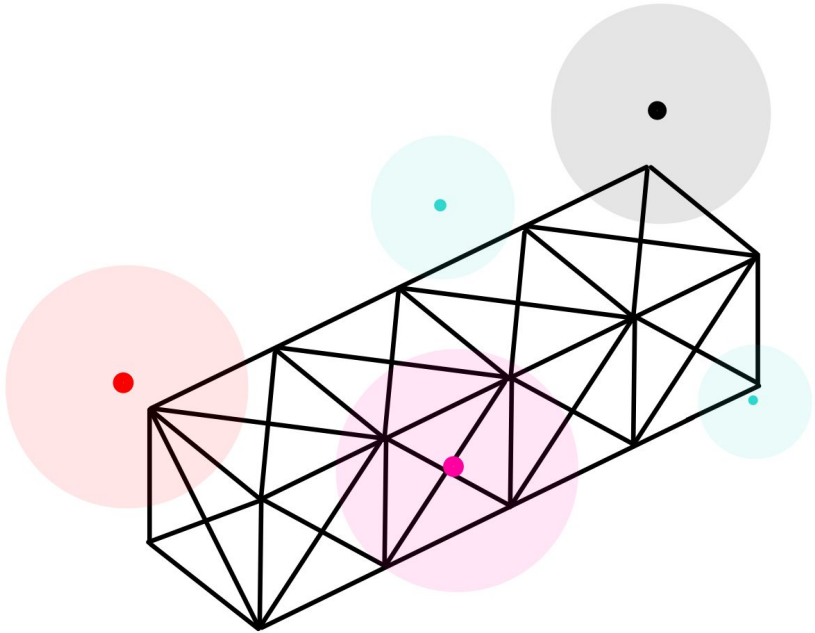
Encoding



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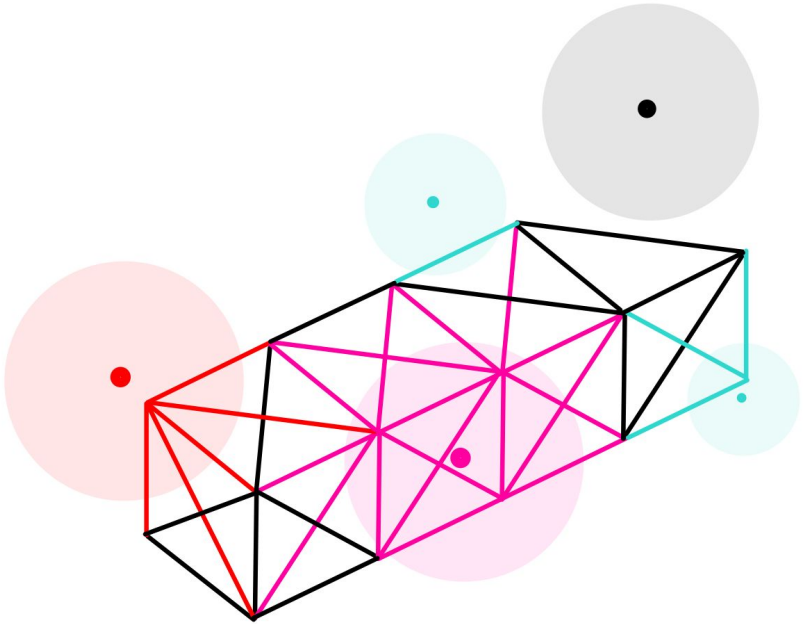
Encoding



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Encoding - Materials

1. **"Tissue"** (cyan): k=1,000, b=c=0

    - soft, connects masses without generating force

2. **"Bone"** (white): k=20,000, b=c=0

    - stiff, rigidly connects masses and does not bend or change length

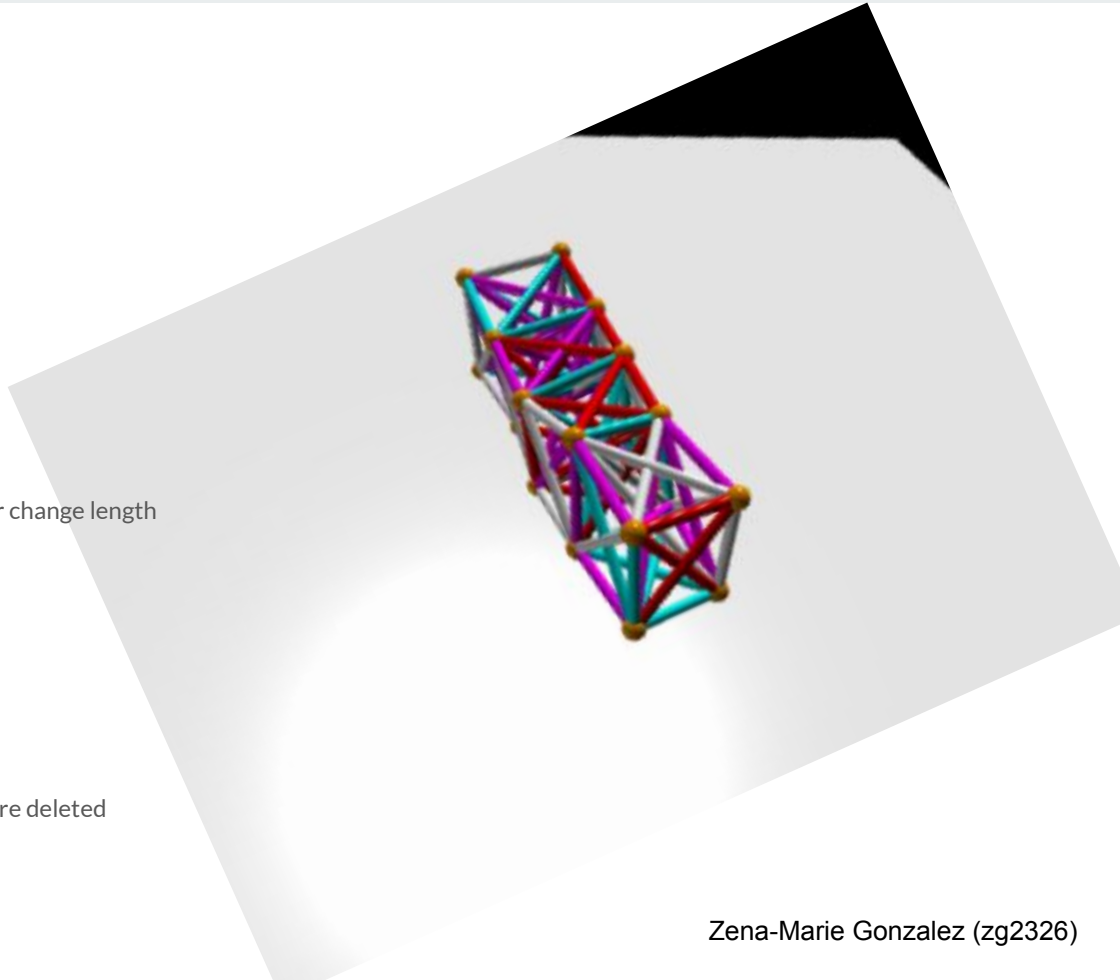
3. **"Muscle " 1** (red): k=5,000, b=0.02 c=0

    - expands, then contracts in a cycle

4. **"Muscle " 2** (magenta): k=5,000, b=0.02, c=π

    - contracts, then expands in a cycle

5. **"Air"** (no image): empty space. Springs with this material are deleted



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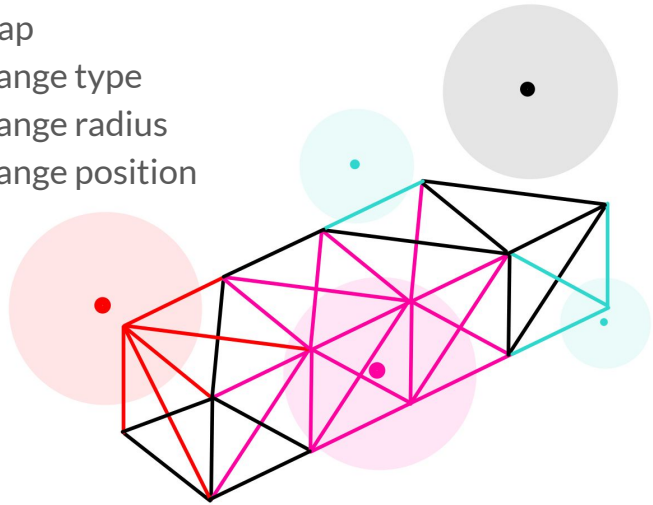
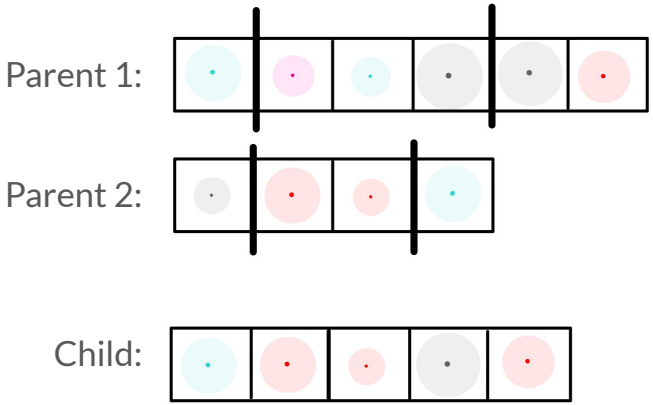
Mutation

- Add
- Delete
- Swap
- Change type
- Change radius
- Change position



Crossover



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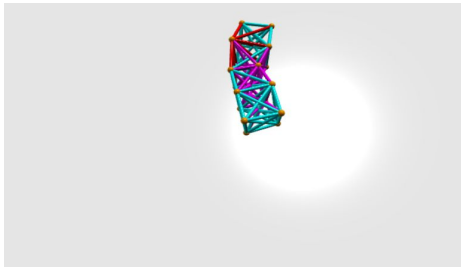
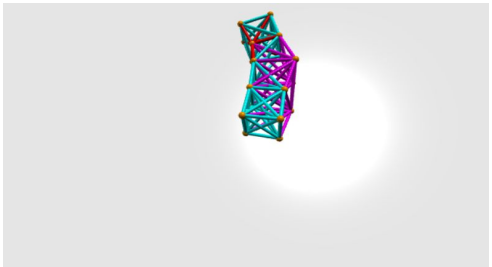
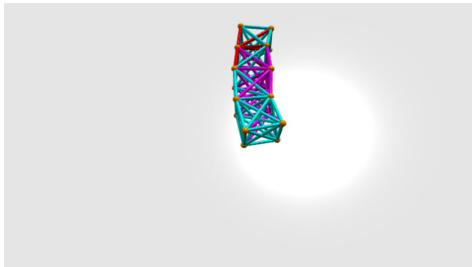
Insights

Biological Approximation: Snake-like movement







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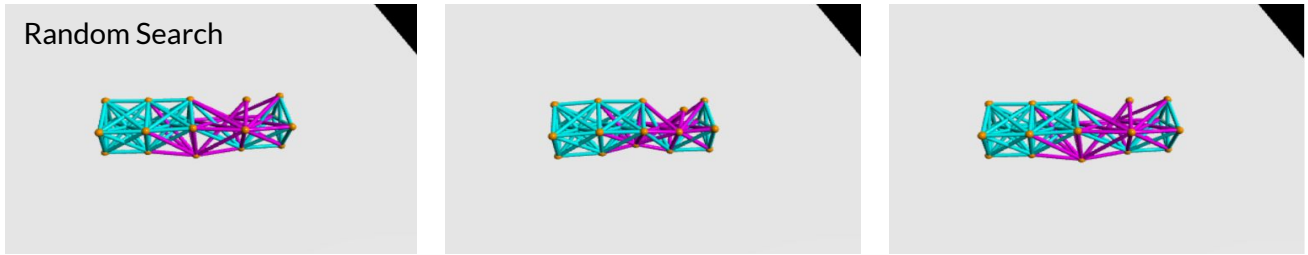
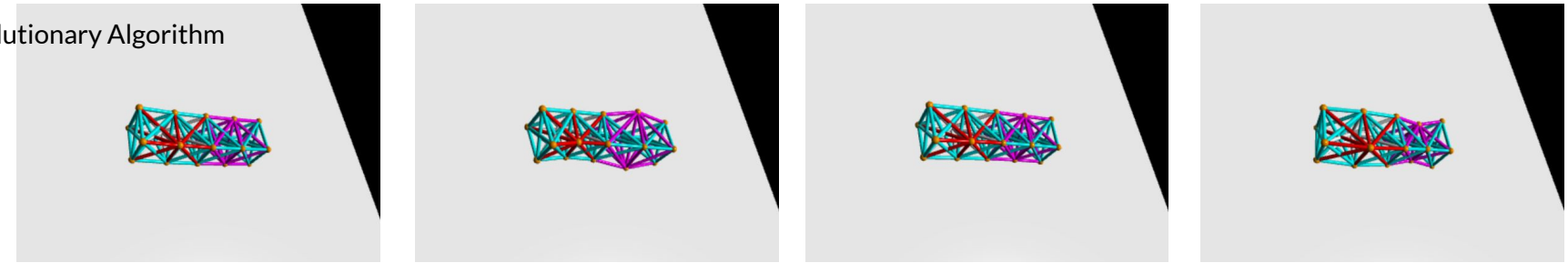
Biological Approximation: Worm-like movement

Random Search



Morphological component

Evolutionary Algorithm



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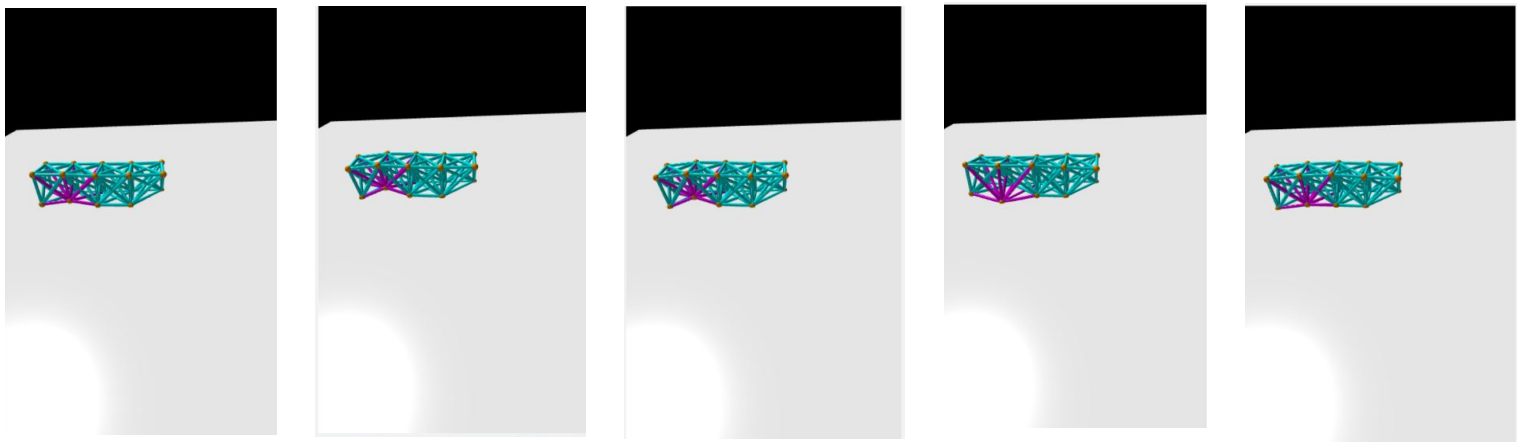
Biological Approximation: Caterpillar-like movement



Evolutionary Algorithm, 0.02492 m/s

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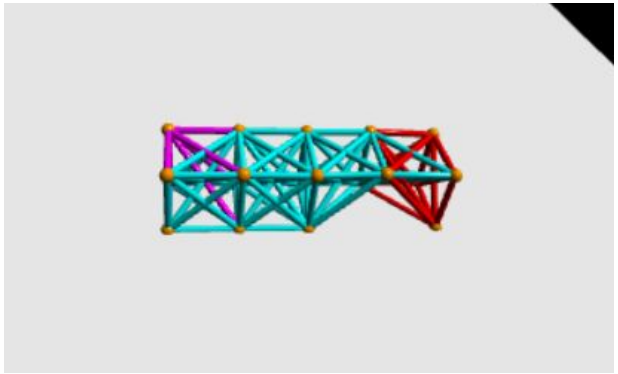
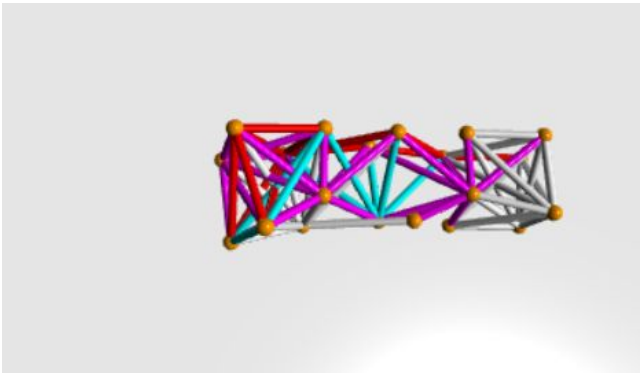
Complexity: Evolutionary Algorithm vs. Hillclimber



Speed: 0.025719 meters/s

Encoding length: 6



Speed: 0.02555 meters/s

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Thank you!