Evolving Neural Networks with NEAT to Control an X-Drive Robot

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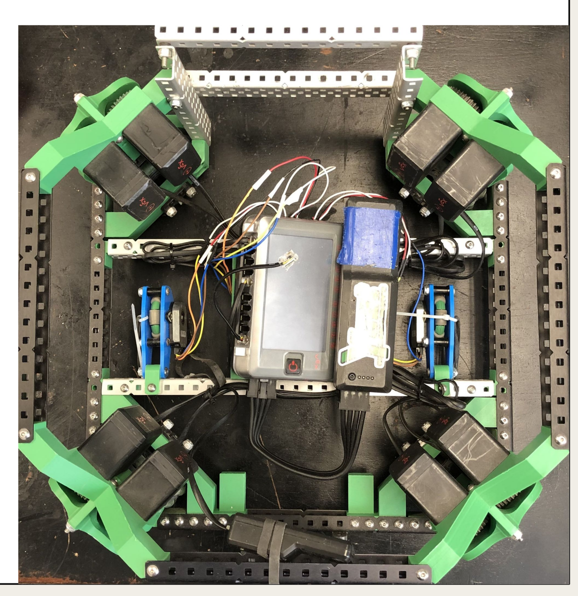
Introduction & Motivation

- Both have a strong background in robotics
- Wanted to explore how a trained model might behave when presented with a driving task using direct motor inputs
- X-drive has a more interesting control scheme with complicated equations involved
- Self-driving technology is on the rise
- **How feasible is evolving a neural network to control an X-drive robot entirely on its own?**

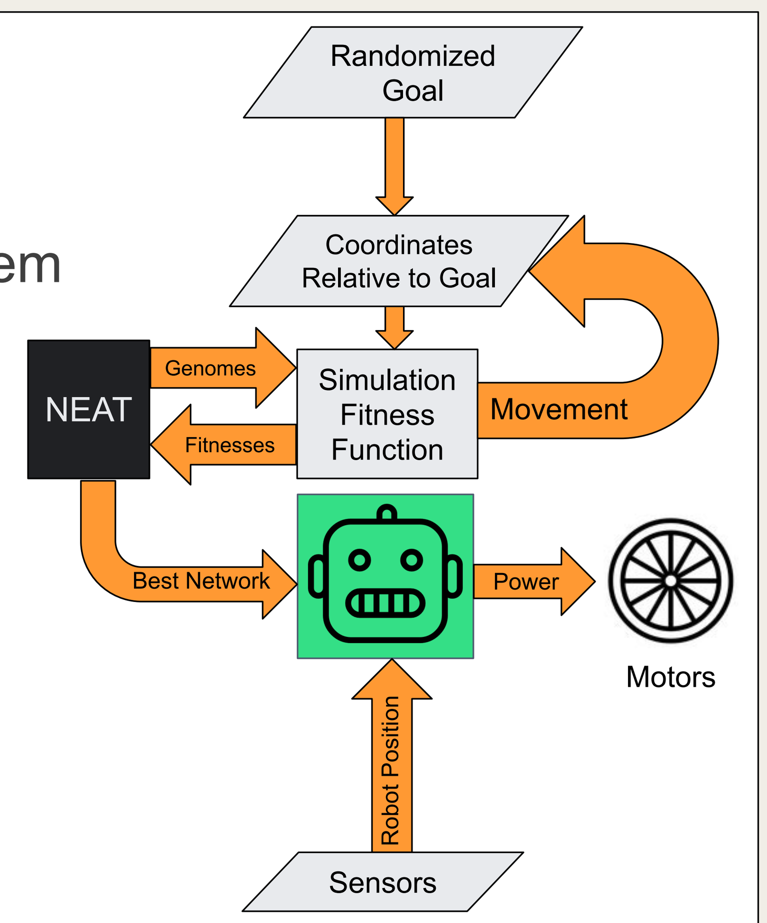
An X-drive chassis:

- 4 motor groups each controlling an omni-directional wheel angled at 45°
- Can rotate independent of movement



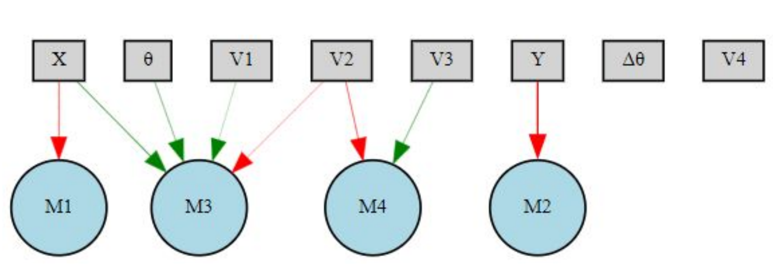
Methods

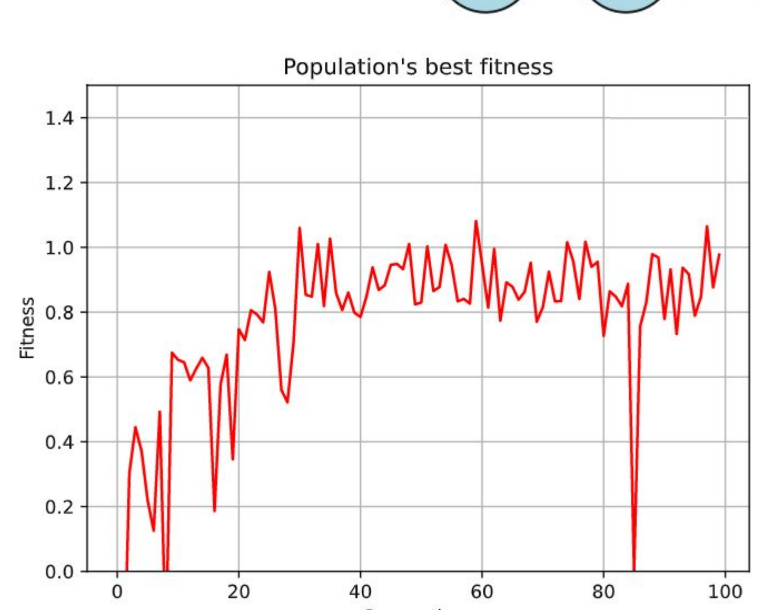
- Developed a robot simulator in Python to be used as the problem space for training
- Used NEAT **[1]** to evolve populations of robots to reach a goal position and angle in our simulation
- Integrated the neural network behavior into the C++ program running on a physical robot

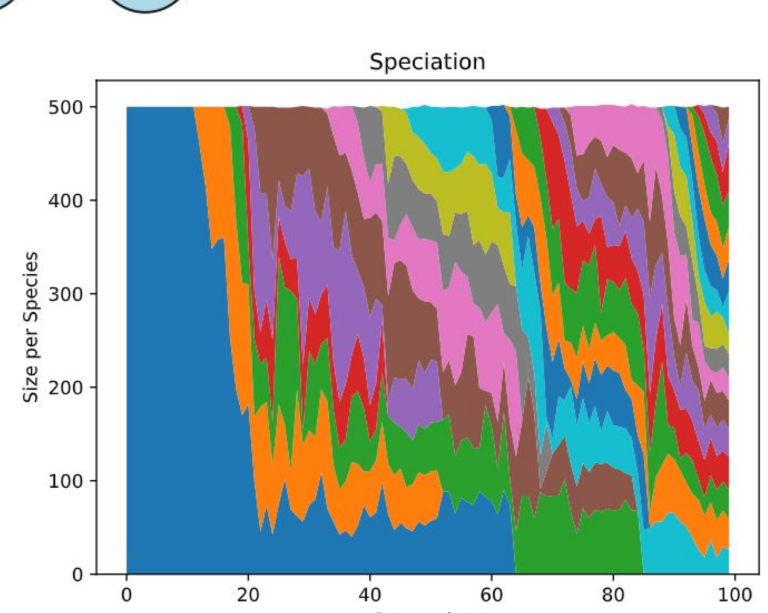


Results

- Trained to drive to random points within 10 arbitrary units away with a desired final angle
  - Fitness measured across 5 trials based on how close to the target position it could get after 100 iterations in each
  - Additional bonuses for getting within a range of the goal and/or reaching the target angle
- Tested best models in 9 driving tasks with different target positions and target angle of π radians with 500 iterations to run for

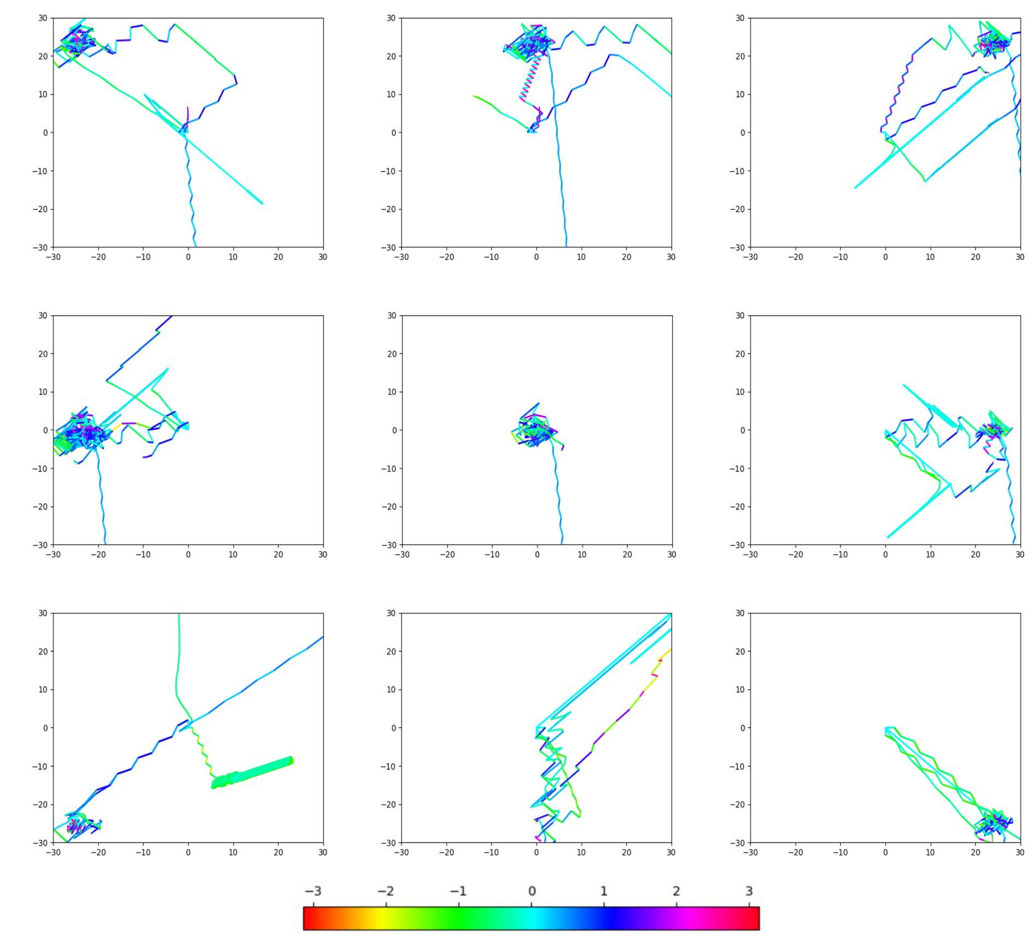




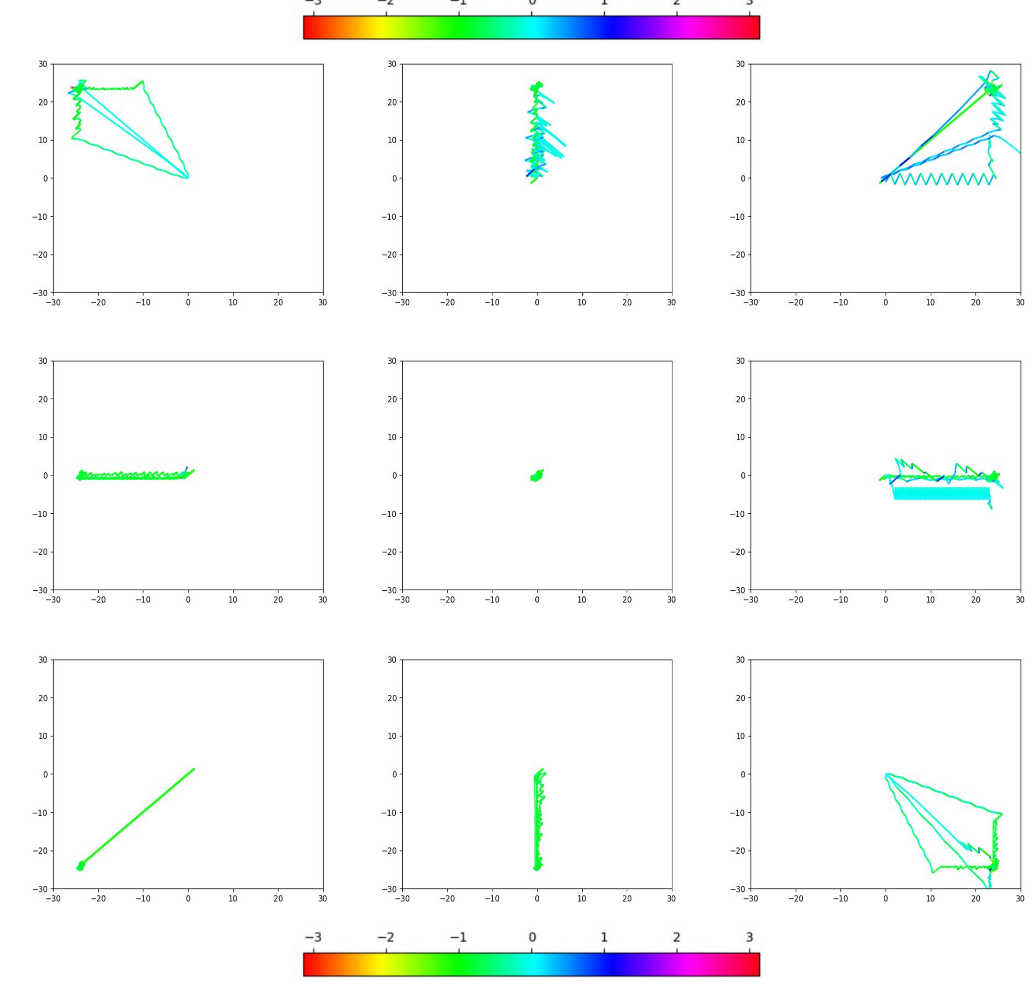


Results (cont.)

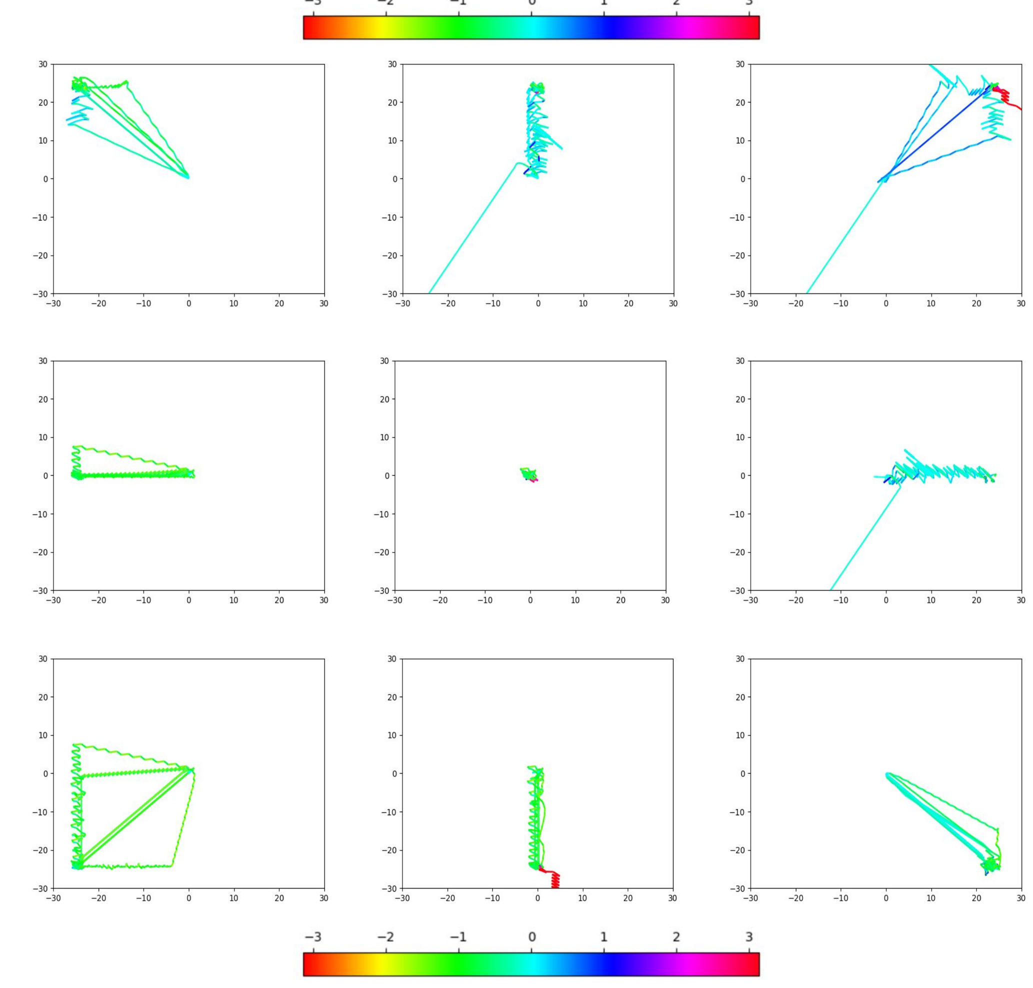
Paths and angles of the top 5 performers from testing with goals in 8 main directions and at the starting position (generation 10)



Paths and angles of the top 5 performers at generation 50

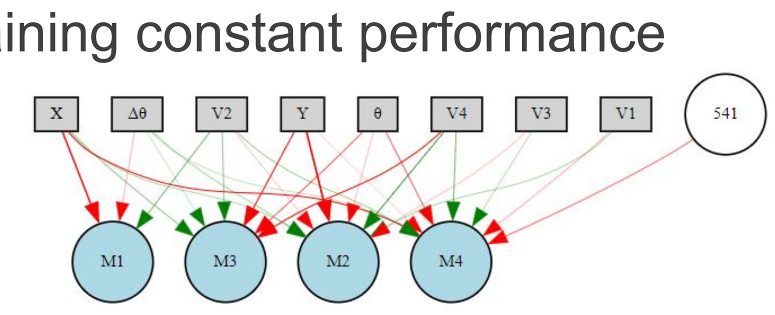


Paths and angles of the top 5 performers at generation 100



Conclusions

- Models were quickly able to discover solutions to the problem
- Models were seen using combinations of previously learned patterns to move in new directions
- Our fitness function could be rewritten to more highly consider the speed at which a model reached the goal
- Later generations focused more on simplifying the network while maintaining constant performance



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[1] https://github.com/CodeReclaimers/neat-python