Inverse Kinematics of Soft Robots using Neural Networks

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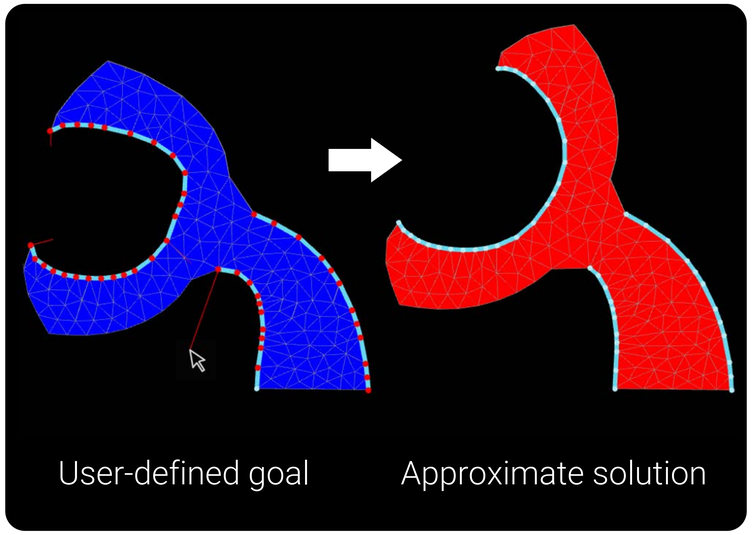
Soft Robots are hard to control

Soft robots are: **flexible, safe, and versatile**, but we **need better control methods** [1][2].

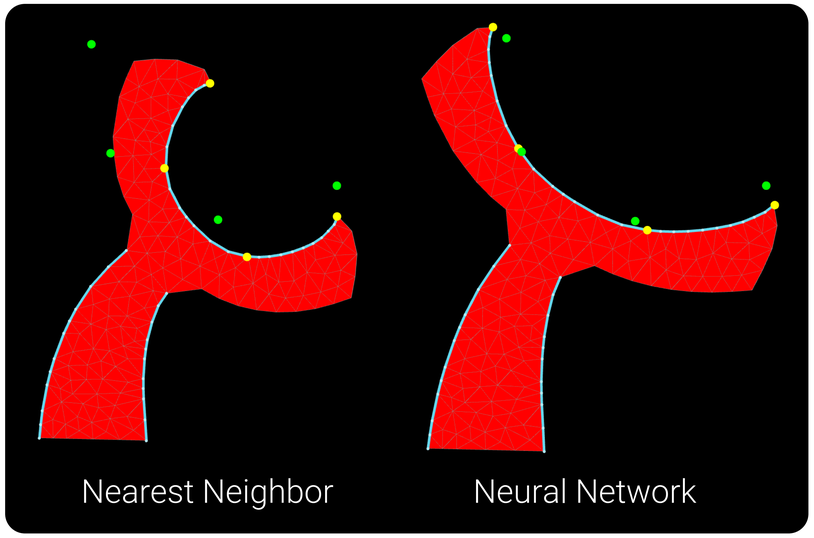
Controlling a soft robot is “like controlling a marionette with rubber bands rather than with strings” [1].



The blue mesh is the desired shape; modified by the user. The red mesh is the solution; controlled with tendons.

The Neural Network is accurate

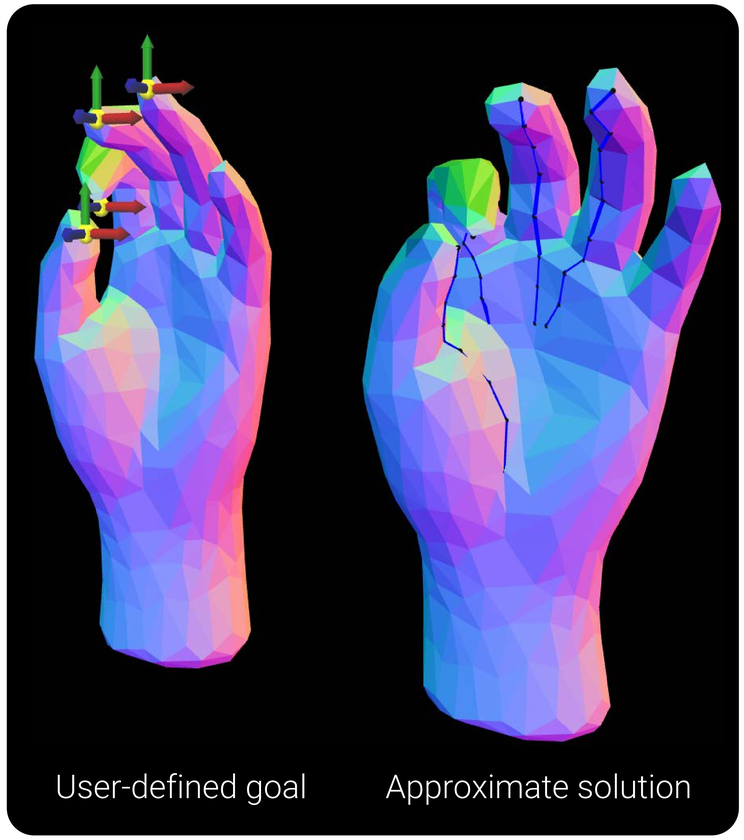
We compare a neural network solution against a baseline nearest neighbor solution. **The neural network performs more accurately than the nearest neighbor.**



The neural network controls the right mesh’s tendons to move the yellow current points to the green points. A baseline nearest neighbor solution controls the left mesh.

Applications show promise

High accuracy, reasonable speed, and versatile user control of the desired goal shows promise.



The hand on the left is in a desired shape. The feature points are extracted into the neural network, which contracts the blue tendons on the hand on the right.

Solution: Neural Network

1) Training

We map desired locations to tendon activations by iterating through every combination **of tendon activations** and recording the location of the **feature points.**

2) Predicting

We extract **feature point locations** from the desired pose, and input them into the **neural network.** We activate tendons based on the output of the network

The solution is generalizable

The neural network can control any soft robot, any placement of tendons, and any feature points. This shows promise to be used on a myriad of **complex and versatile applications.**

The solution is model free

If we train a neural network with a physically realized tendon-activated soft robot, we may be able to compensate real for world variables such as **clumping, friction, and imperfectly flexible materials that traditional models has difficulty simulating.**

Acknowledgments

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References

[1] H. Lipson, “Challenges and opportunities for design, simulation, and fabrication of soft robots,” Soft Robotics, vol. 1, no. 1, pp. 21–27, 2014.
[2] J. Rossiter and H. Hauser, “Soft roboticsthe next industrial revolution,” IEEE Robot. Autom. Mag, vol. 23, pp. 17–20, 2016.

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