

Deploying ropes along prescribed patterns



NRI: FND: Physics-based training of robots for manipulation of ropes and clothes

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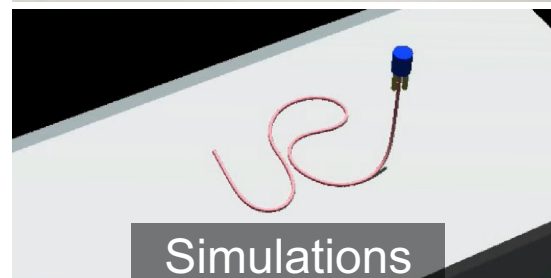
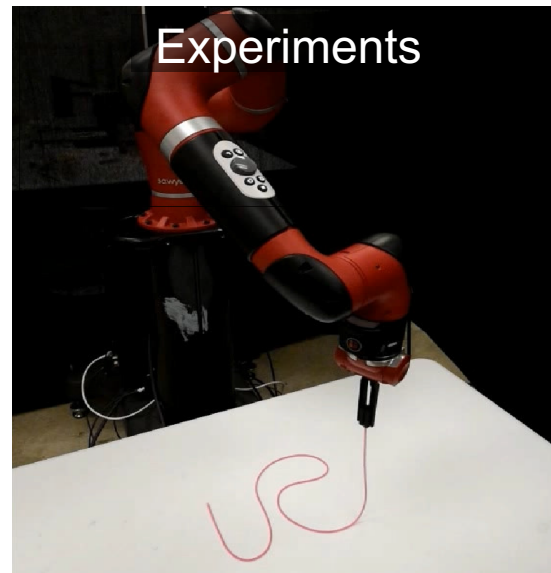
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Challenge

- Slender structures (rods, shells) undergo large deformation during robotic manipulation. A robot should be able to predict the deformation for successful manipulation.

Solution

- Physics-based simulations to train robots for robust policies, in lieu of purely data-driven approach.



Scientific Impact

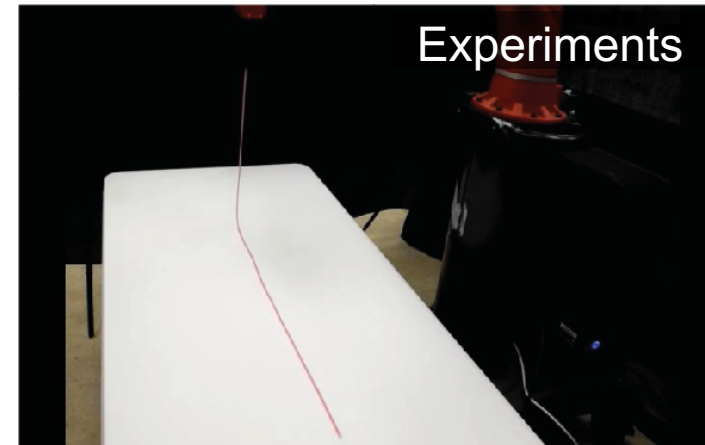
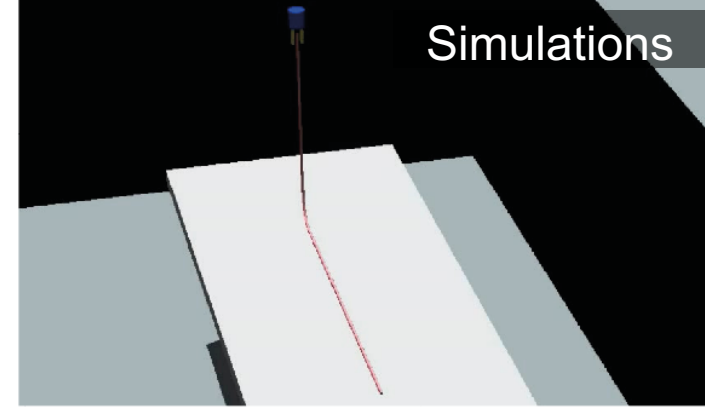
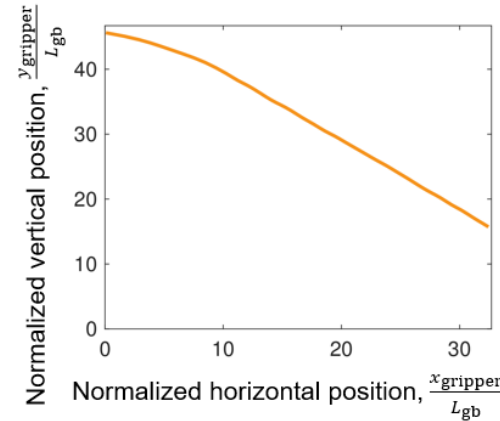
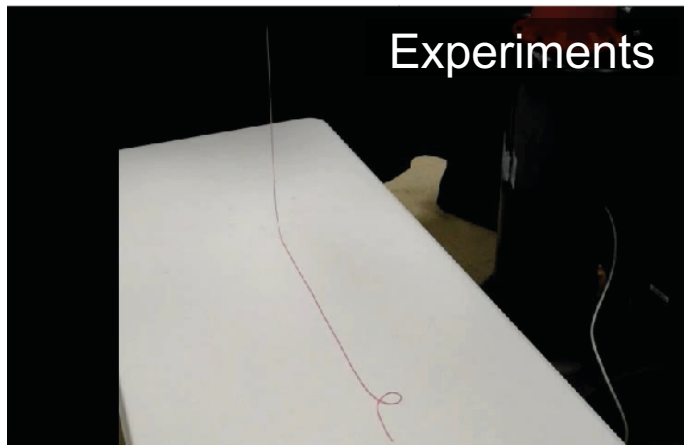
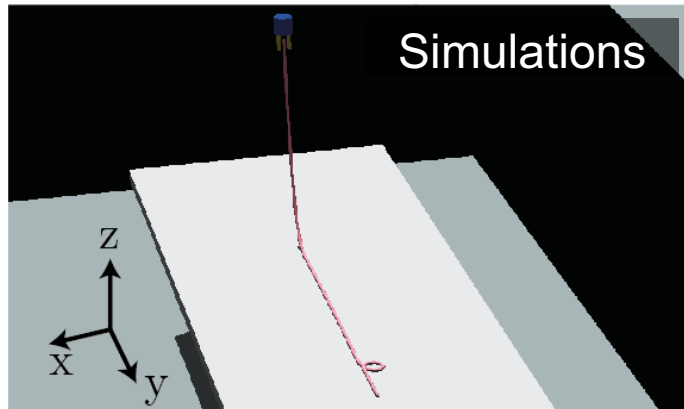
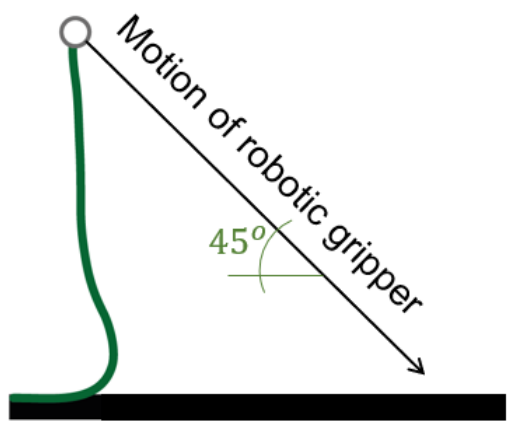
- Built-in robustness due to physics-based policies
- Transfer of simulations to reality.

Broader Impact

- *Apps* (similar to smartphones) that can be download onto the robot for manipulation tasks
- Learning from physics, instead of learning from human demonstration
- New course on mechanics and robotics

<https://structures.computer/education>

Laying down a rope along a straight line



We do not get a straight line. Experiments with elastomeric rod of 1 meter length show that a loop can form if the nonlinearity of the mechanics is neglected.

Physics-based simulations are used to minimize sliding on the substrate. This results in a straight line.

Our intuition can fail

Physics-based policy can be directly employed on a robot to achieve a straight line