Underwater Soft Robot Modeling and Control with Differentiable Simulation
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1. Overview & Summary
• We present a holistic framework for modeling and controlling underwater soft robots;
• We show an algorithm that iteratively solves system identification and trajectory optimization;
• We develop a differentiable simulation model and show its power in narrowing the reality gap;
• We demonstrate the efficacy of our method on a real underwater soft robot.

2. Robot Setup & Fabrication

3. Simulation & Optimization
• We simulate a differentiable soft body and hydrodynamic model.
• We use gradient-based optimization in system identification to narrow the reality gap and in trajectory optimization to improve the controller.

4. Experimental Results
• The robot travels 4x faster compared to a handcrafted baseline.
• Convergence occurs after four iterations.
• Control signal shows addition of high-frequency components (See left).

5. Conclusion & Future Work
• Our pipeline allows for significantly improvement in performance and narrowing of the sim-to-real gap.
• The pipeline can be used interchangeably with other simulators (hydrodynamic models) and robot systems.

6. Acknowledgments
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