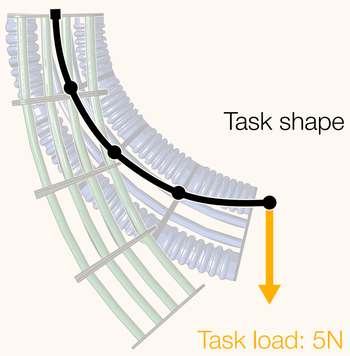
Fast evaluation of continuum arm designs against task requirements

Bill Fan[1], Jacob Roulier[2], Gina Olson[2]
[1]Olin College of Engineering, [2]University of Massachusetts, Amherst

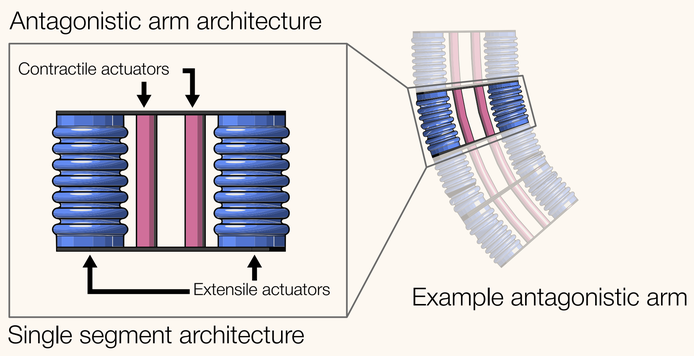
INTRODUCTION

Soft robot arms enable safe human-robot interaction, but are **hard to design for tasks with significant load.**

External loading alters soft arm geometry, meaning a task's feasibility can only determined by attempting it.

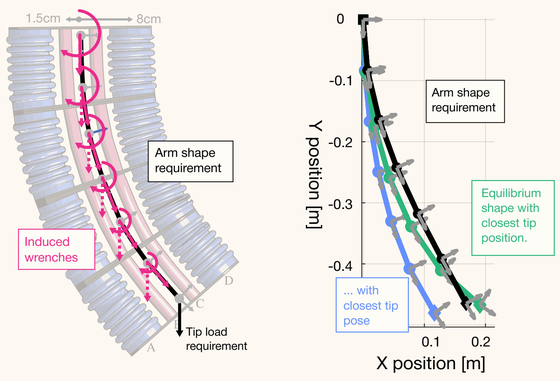


We neeed systematic ways to evaluate new arm-designs for task requirements.



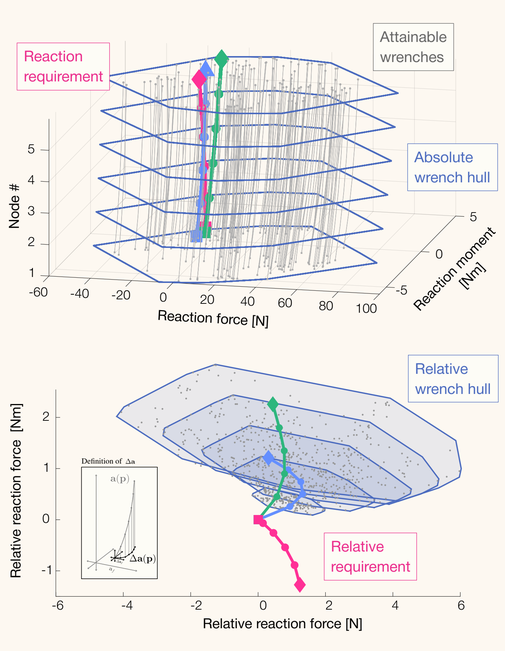
WRENCH HULL ANALYSIS

We present a **model-based method** for evaluating **soft arm task performance.**



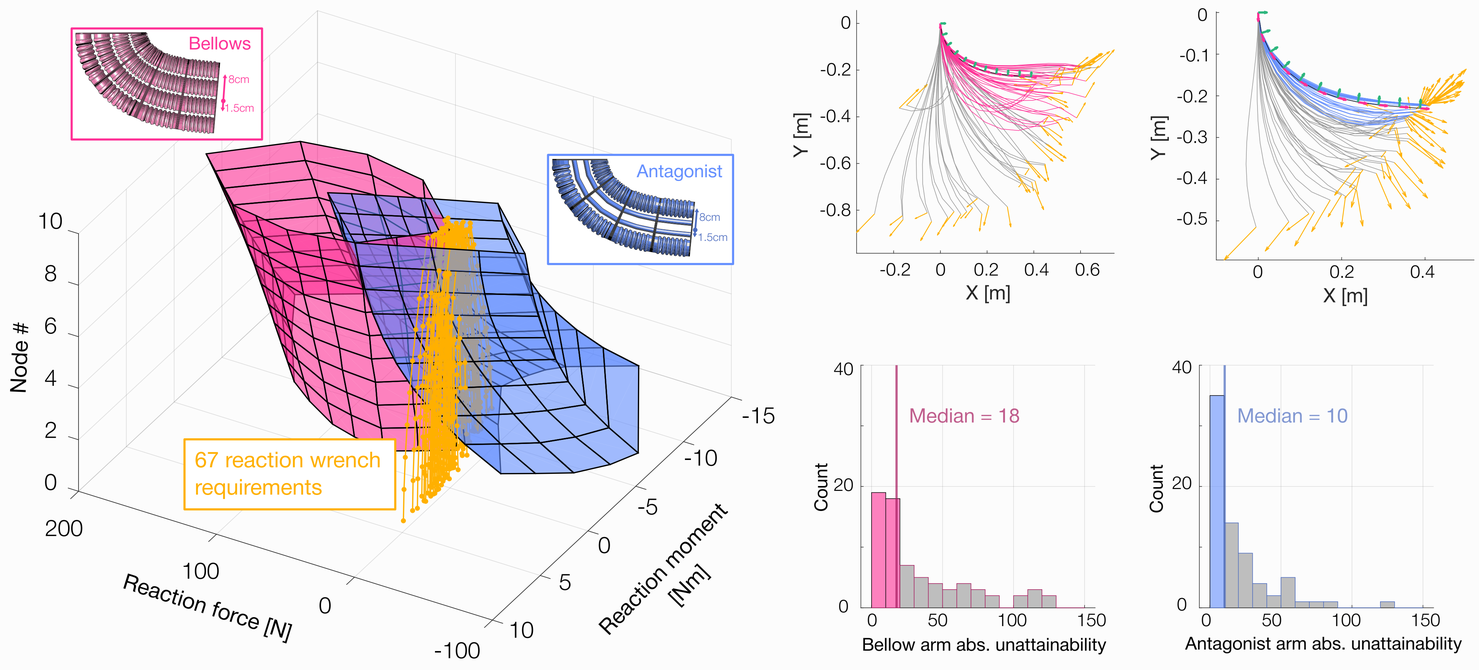
Key idea - we formulate tasks as reaction wrench requirements.

Reaction enclosed in both plots = task is attainable



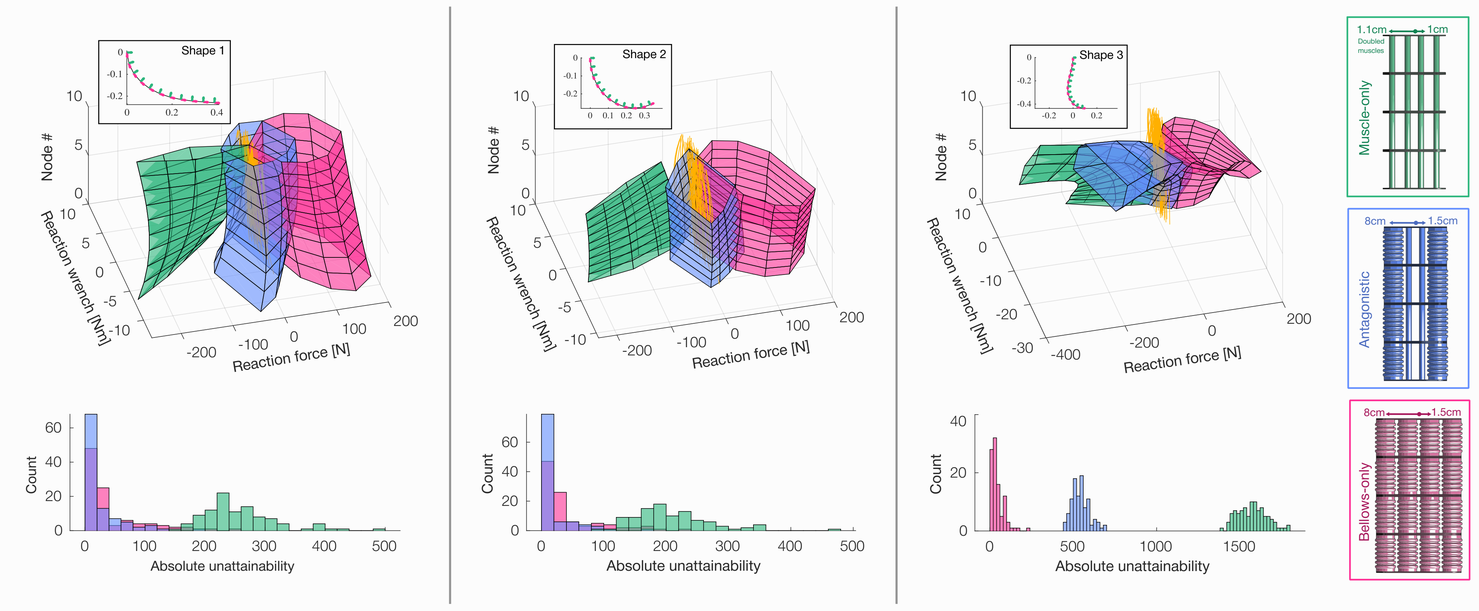
RESULTS

1 Wrench hulls compare arm performance across tasks **accurately and visually, 85x faster than naive methods**



We validate our method by comparing 2 arm designs' abililty to match a task shape while subject to 67 loads. Our method predicts the antagonistic arm can attain more tasks, and needed 108 seconds. Naive searching confirms the antagonistic arm can attain the tip position under a wider range of loads, but needed 8766 seconds

2 Wrench hulls **systematically demonstrate** the advantages of **antagonistic arm designs**



We compare 3 arm designs on their ability to match 3 task shapes when subject to 67 loads. The antagonistic arm performed best across the board, and we see it is because it can produce both negative and positive reaction forces. Evaluating all 607 scenarios took 325 seconds.

DISCUSSION

This is just a first step towards requirements-driven design of soft robot arms. Future work is needed to develop a complete model-based design pipeline, using our method.

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