

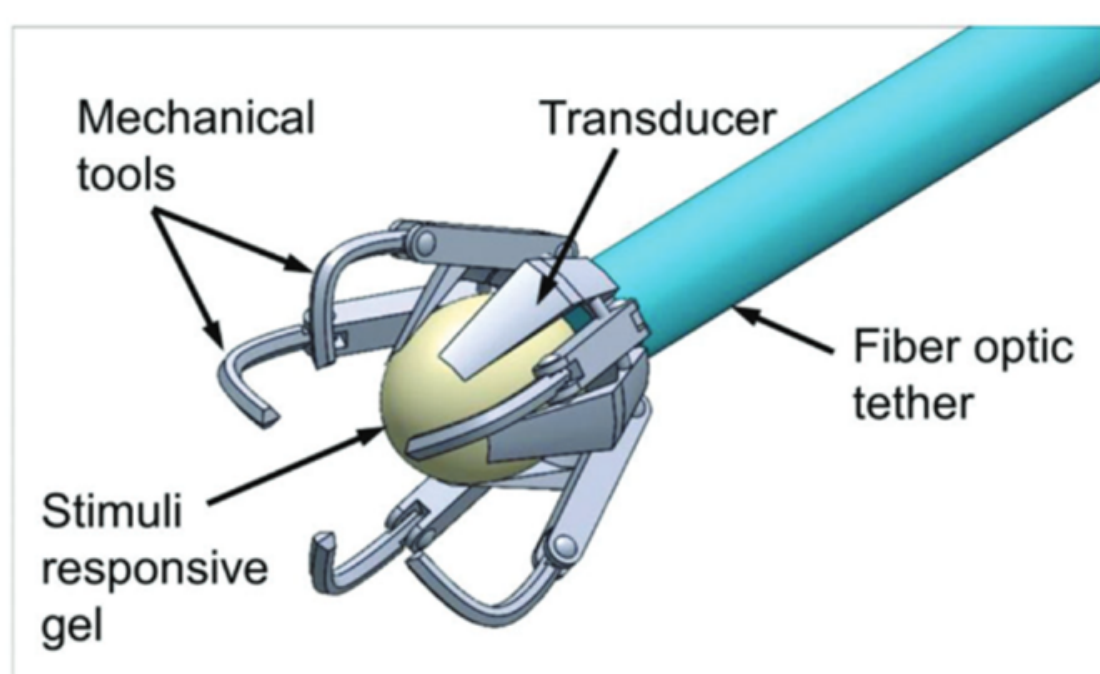
# Topology Optimization for Design of Multi-Material Microtools

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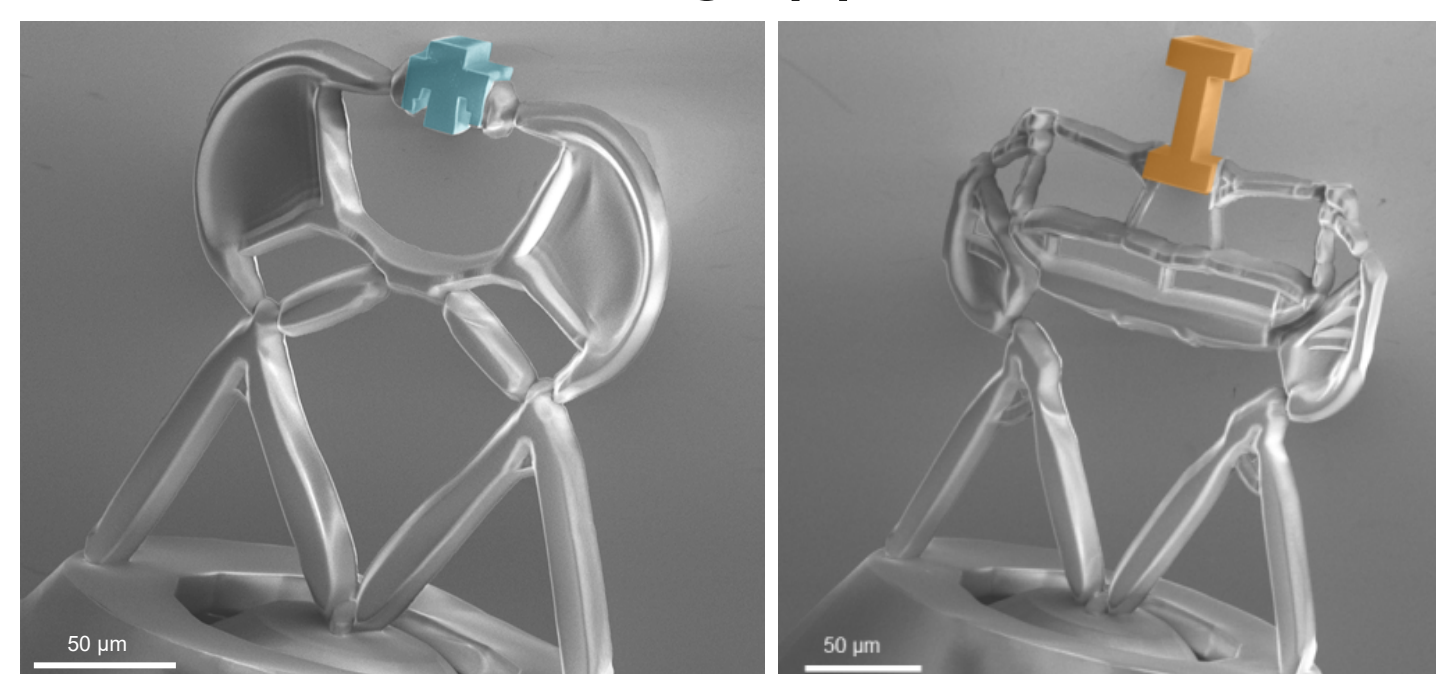


## Motivation

### Previous Heuristic Microgrippers



### Topology Optimized Microgrippers

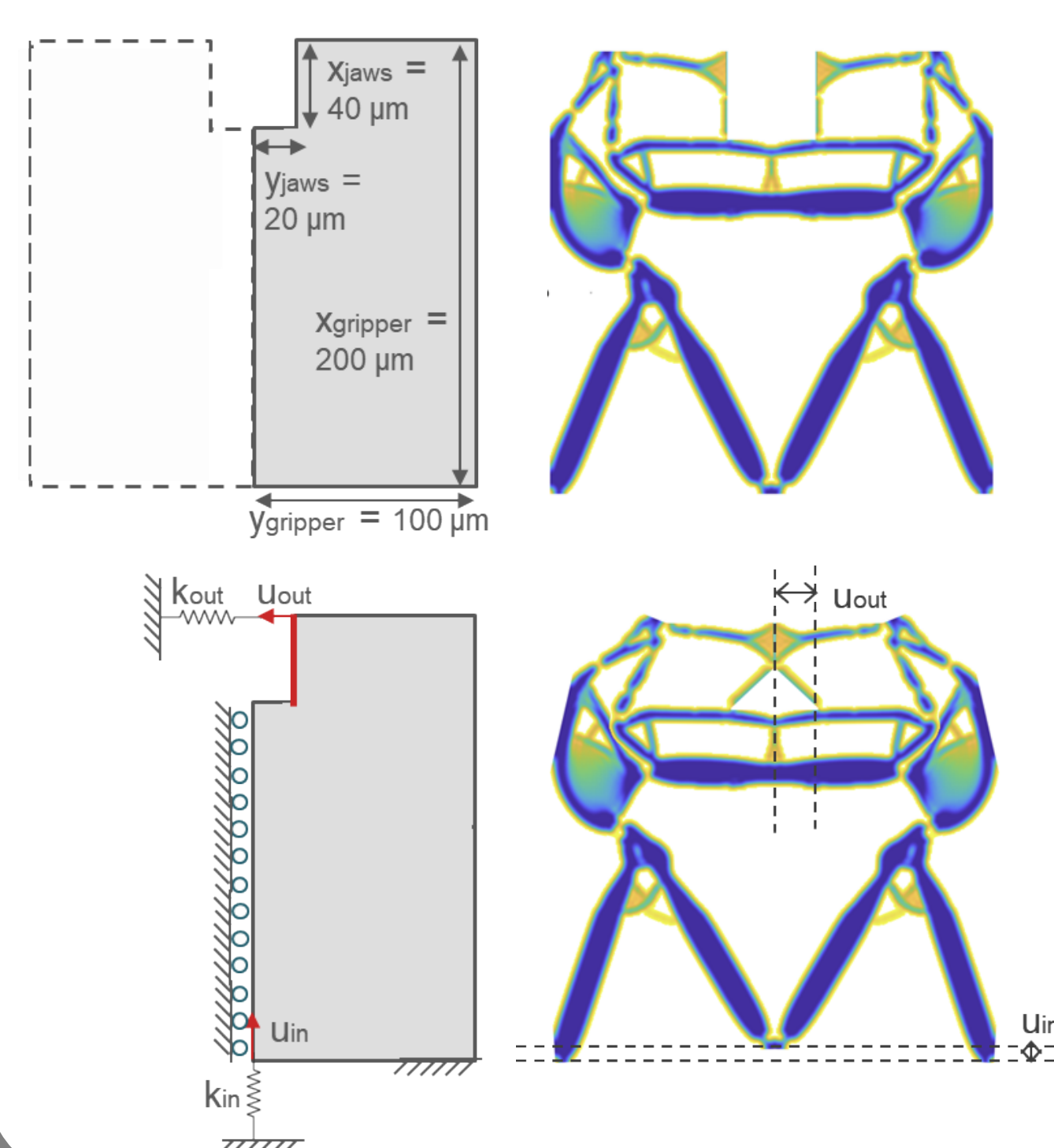


Heuristically designed microgrippers do not have enough output displacement when stimulated by physiologically relevant pH [1].

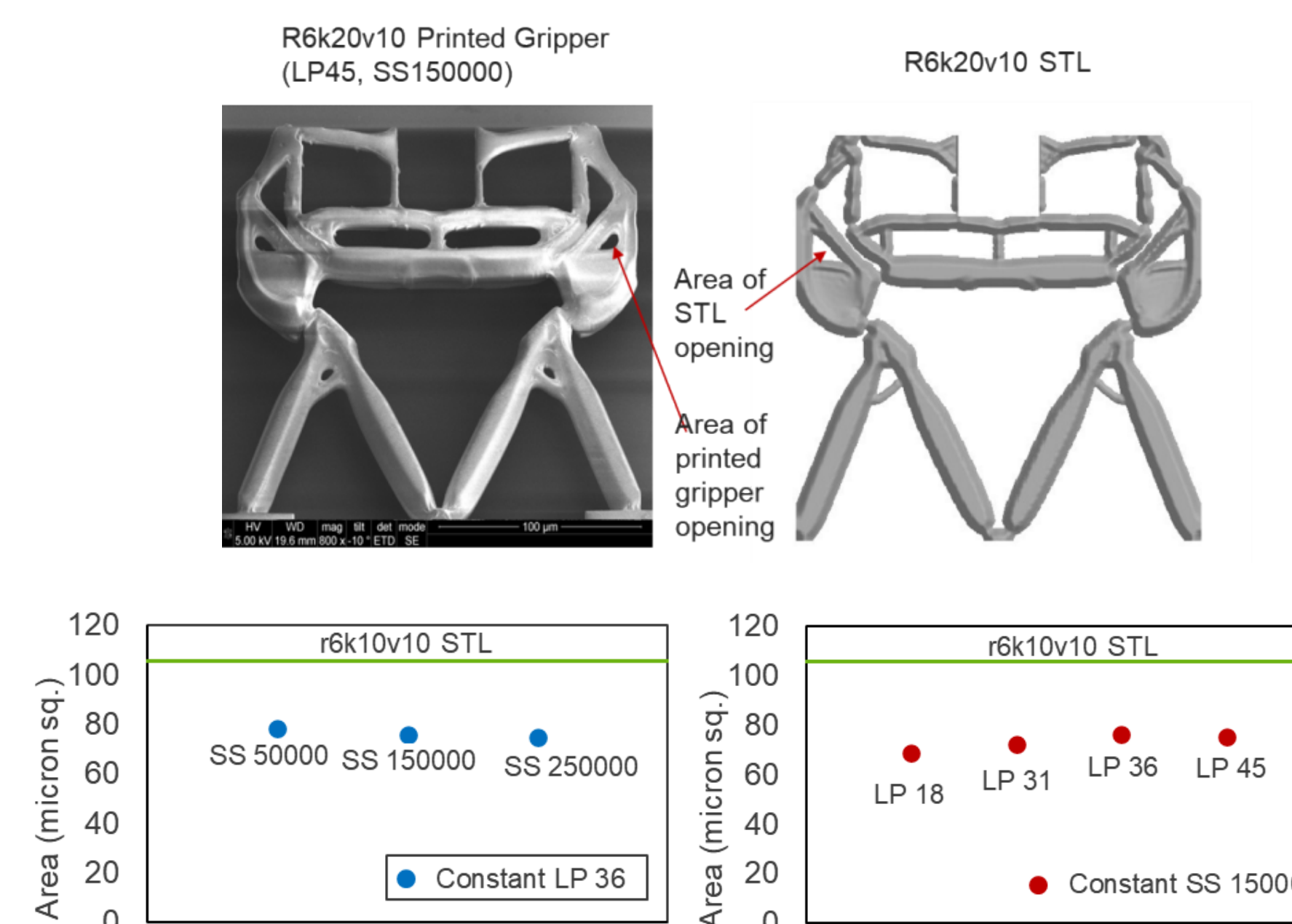
**Aim:** To develop predictable environmentally active microgrippers that can predictably increase output displacement for minimal input displacement in physiologically relevant conditions by using Topology optimization.

## Approach

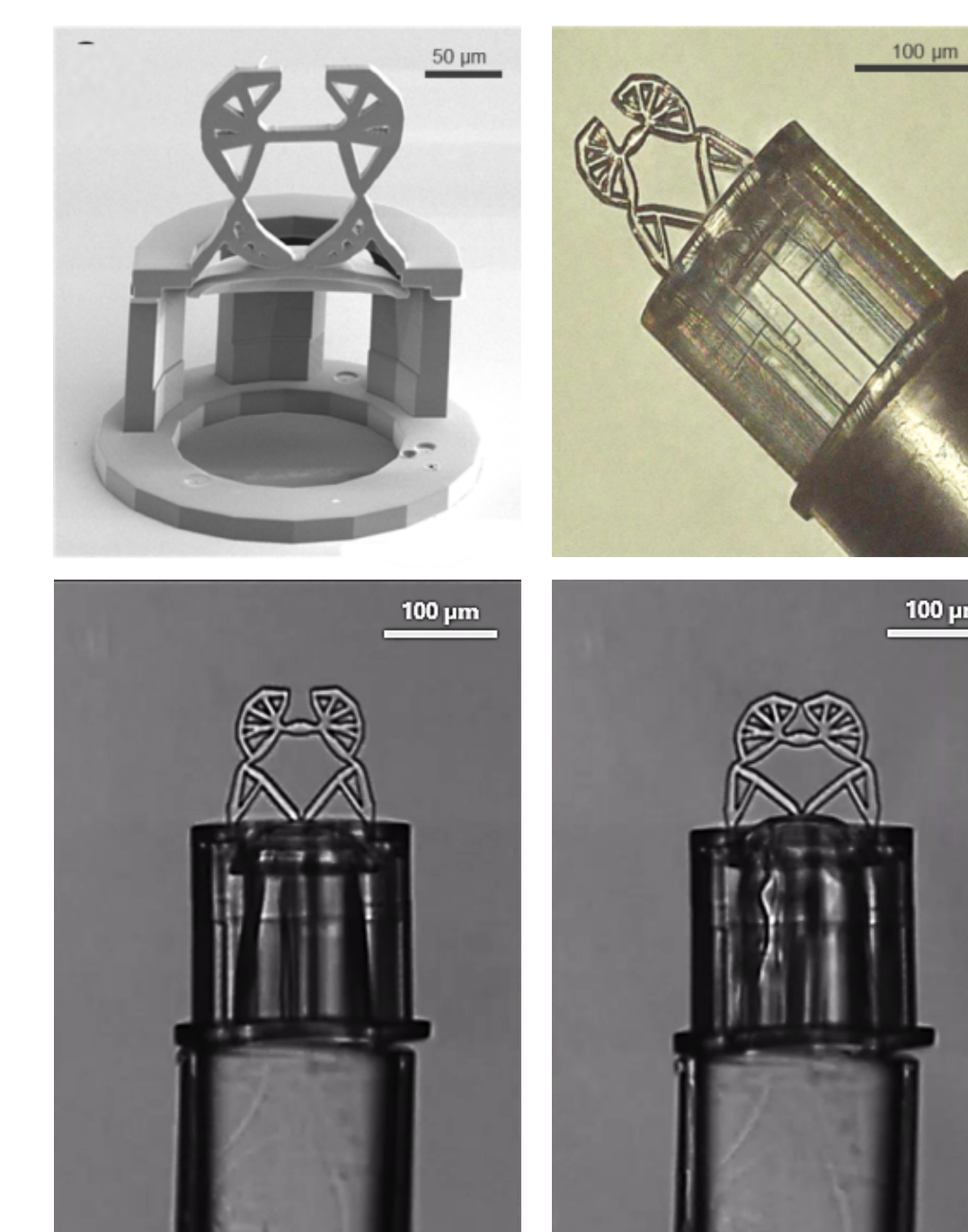
### Topology Optimization Design Domain [2]



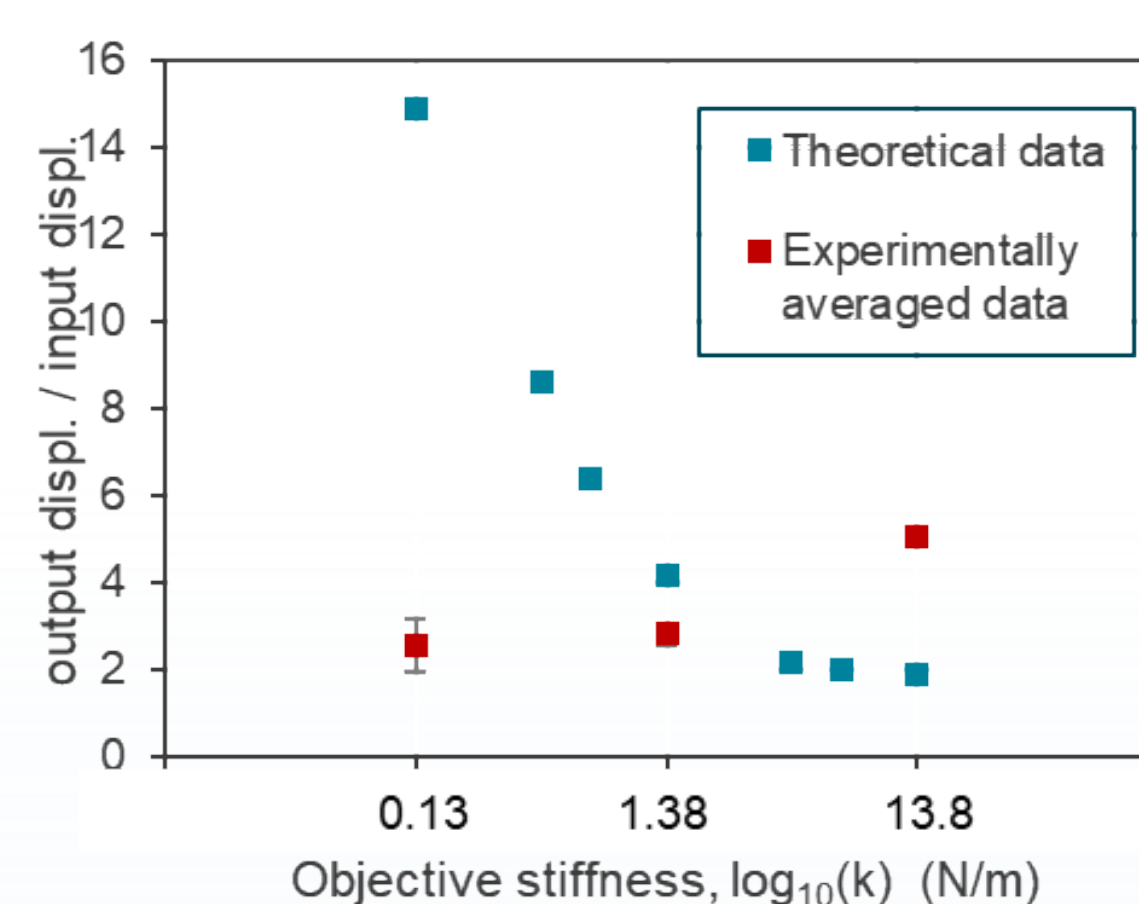
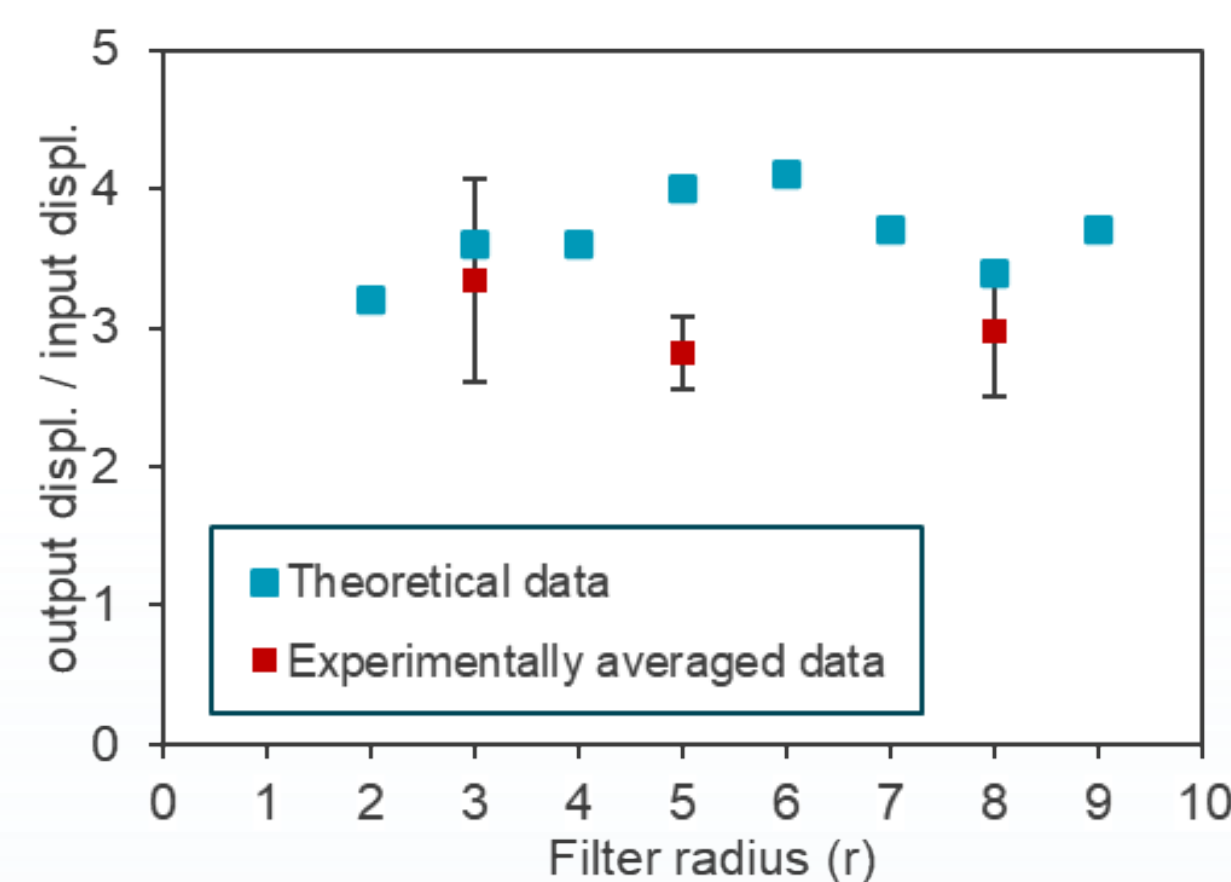
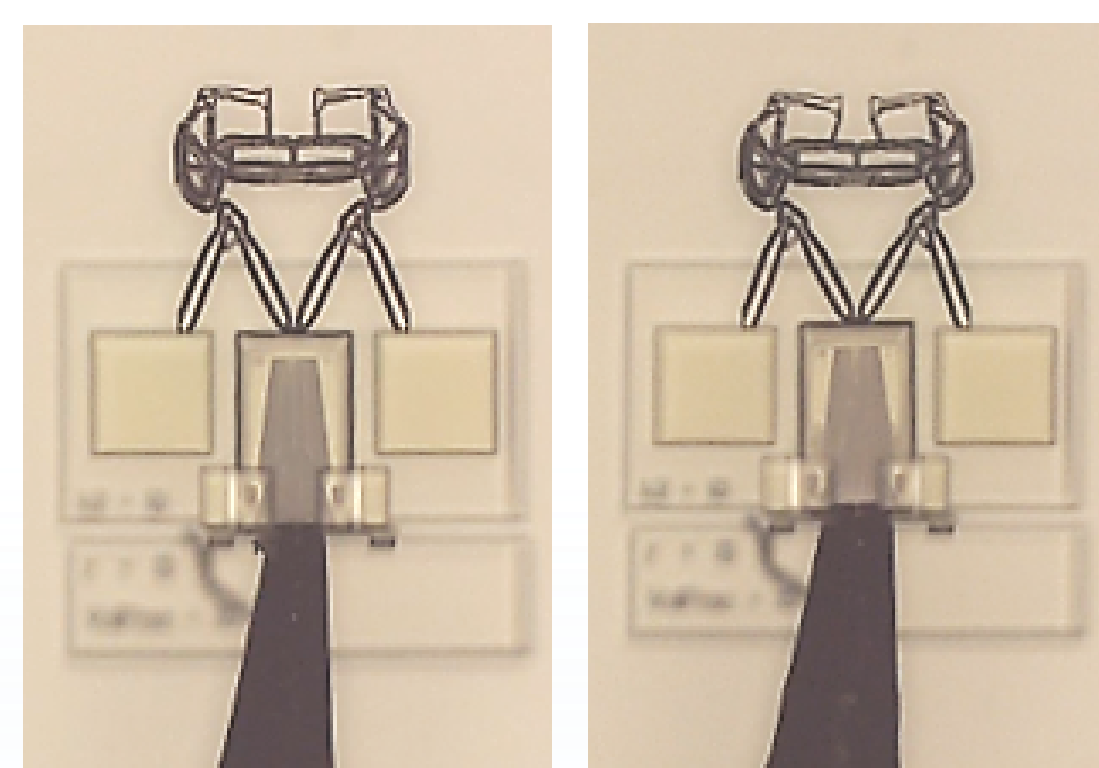
### Print Parameter tests



### Gel Actuation



## Results



Objective Function = Output displacement / input displacement

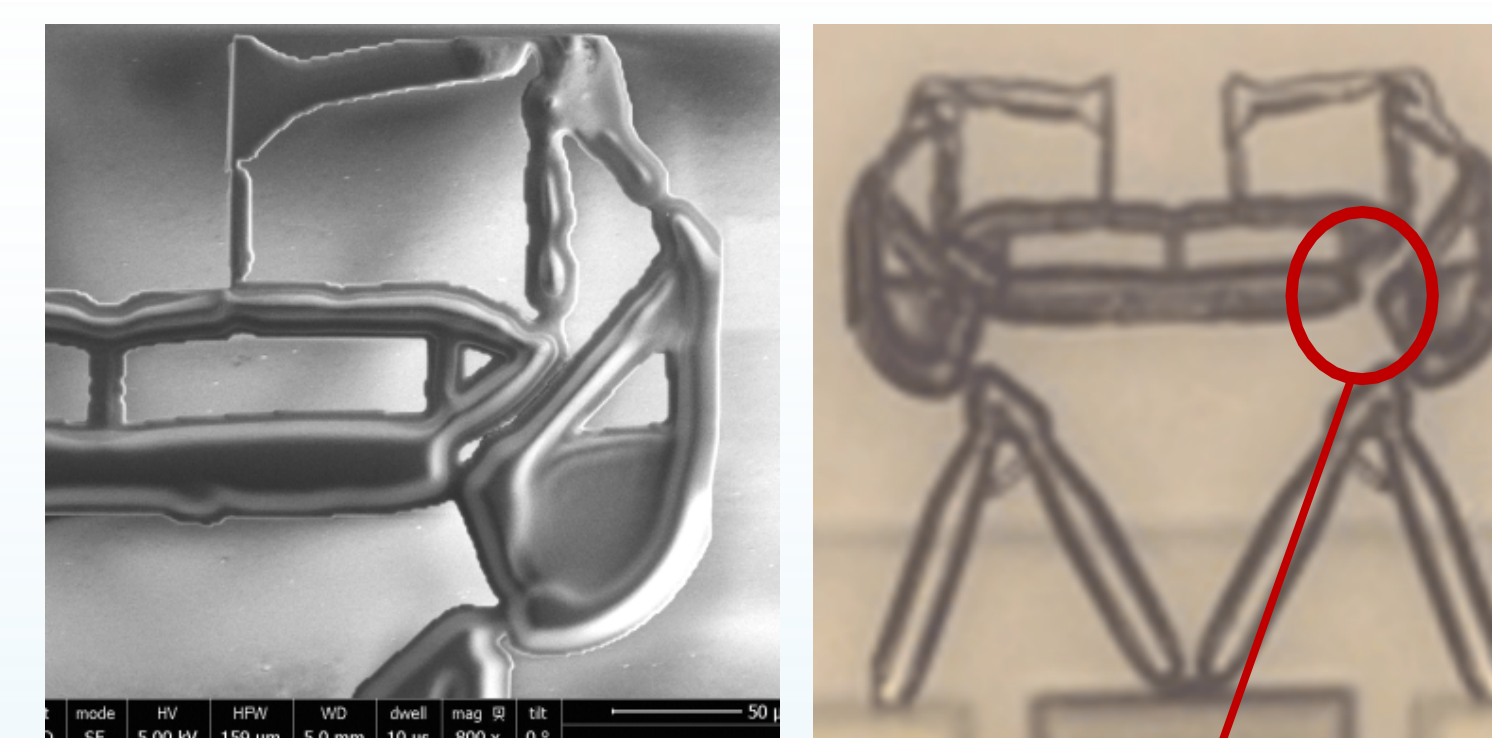
Experimental data is generally predictable by theoretical data except when:  
1.  $r=6$  due to self contact.  
2. Gripping objects of low stiffness due to thin strut elements that could fail during experimentation.

[1] Kaufman et. al, 2023, 10.1002/admt.202202034  
[2] Talischi et. al, 2012, 10.1007/s00158-011-0696-x

## Challenges

Self contact issue of truss elements in the  $r = 5$  gripper causes unpredictability

Laser printing proximity effects



Failure due to proximity effects and self contact

## Future Work

Incorporate proximity effects and self contact issue into the topology design.

New designs: Gripper is now designed to have a small output displacement to grip an object close to the gripper jaw size.

Customize gripper jaw function.

