Embodied optimization in soft and multimaterial robots
From aerial to ground applications

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AERIAL APPLICATION
Aerial grasping by UAV needs to be able to cope with:

- Inaccuracies in positioning
- Energy constraints
- Perturbations to the UAV
- A variety of objects to be grasped
Design optimization for aerial grasping

Closed structure, normally closed, compliant gripper with multimaterial fingertips

(VIDEO)
RESULT

Design optimization for aerial grasping

Gs: Success rate of grasping

Gc: Success rate of pushing the object to the centre
GROUND APPLICATION
MOTIVATION

Power Efficient Adaptive Behavior in a Shape Changing Robot

In order to adapt its behavior, should a robot rely more on changing its control input or shape?
Power Efficient Adaptive Behavior in a Shape Changing Robot

**APPROACH & RESULT**

Red arrows: “Sliding” behavior
Green arrows: “Hopping” behavior

![Robot Image]

\[ M = \sqrt{(PF_x)^2 + (PF_y)^2}, \quad \gamma = \arctan(PF_x/PF_y) \]

<table>
<thead>
<tr>
<th>Shape</th>
<th>Power to achieve “hopping” (W)</th>
<th>Power to achieve “sliding” (W)</th>
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<tbody>
<tr>
<td>40 DEG</td>
<td></td>
<td></td>
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<tr>
<td>30 DEG</td>
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<tr>
<td>20 DEG</td>
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SUMMARY

The importance of optimizing soft and multimaterial body, demonstrated in different applications.

ACKNOWLEDGEMENT

All members of LIFE - Laboratory for Intelligent and Flexible Machine(s): sgnurzaman.org/people

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THANK YOU
RELATED PUBLICATIONS


Lee LY, Nurzaman SG, Chee Pin T. Design and analysis of a gripper with interchangeable soft fingers for ungrounded mobile robots. IEEE Int. Conf. on Cybernetics and Intelligent Systems (CIS) and IEEE Conference on Robotics, Automation and Mechatronics (RAM), 2019. (link)

Katiyar SA, Iida F, Nurzaman SG. Energy harvesting in soft robot locomotion with complex dynamics. IEEE Int. Conf. on Cybernetics and Intelligent Systems (CIS) and IEEE Conference on Robotics, Automation and Mechatronics (RAM), 2019. (link)


OTHER PUBLICATIONS OF LIFE

sgnurzaman.org/publications