An Automatic Design Tool for Fluid Elastic Actuators

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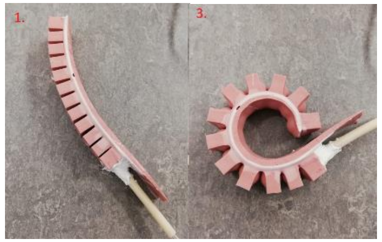
Introduction

Soft robotics is an emerging field within the robotics community. Their bio-inspired nature allows them to use them for a wide variety of scenarios. Their design and fabrication is a laborious process, especially with little knowledge of CAD and 3D printing.

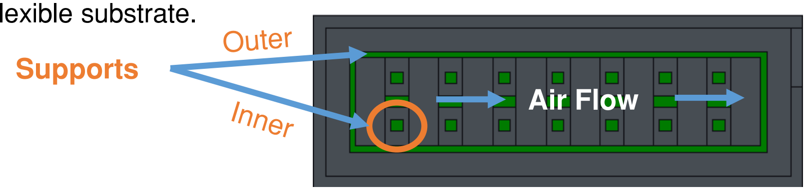
The tool aims to

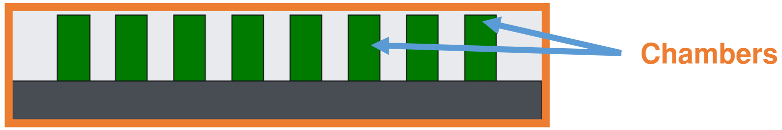
- Be user friendly/accessible
- Simplify the design process
- Reduce human error
- Reduce time
- Provide solution for more accurate and repeatable experimentation



Core Components

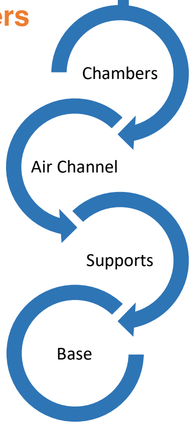
A Common design for soft actuators are Fluid Elastomer Actuators (**FEA**). They are composed of a series of inflatable chambers on a flexible substrate.





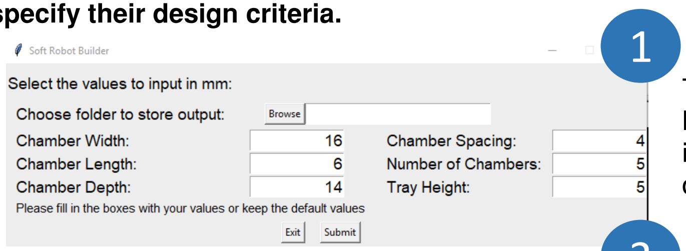
To create a functional actuator there are **Four Core Components** that the design tool needs to create

1. The **chambers** cause the actuation movement.
2. The **air channel** allows air to pass through into each chamber.
3. The **supports** are there to aid in the manufacturing process to ensure air passage to each chamber is not impeded
4. The **base** encloses the actuator

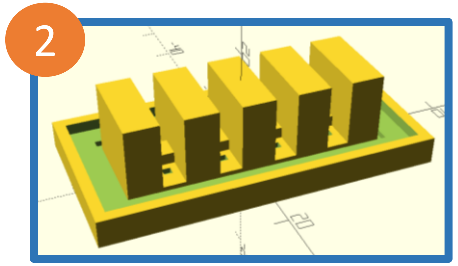


Process

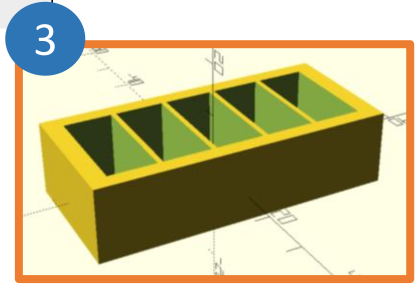
The design tool incorporates all the **Core Components** but it allows the user to **specify their design criteria.**



The user can enter a location to store their files inside. Then define dimensions of chambers



The total dimensions are calculated from the users specification. **Part A** is then produced (above).



The locations of chambers and height of the air chamber are used to produce **Part B** and the tray, **Part C.**

There will be **6 Output Files,** containing the 3 parts ABC

- **3 x STL Files**
- **3 x Scad Files**

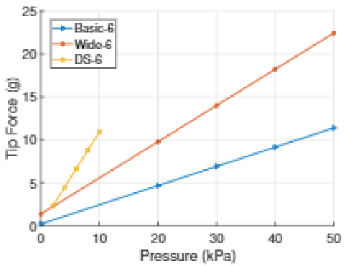
The files can be directly 3D printed or opened as a 3D model

The moulds can then be assembled and the silicone moulding process can begin

Tool can be found at http://www.liv.ac.uk/paoletti/public/softdesigntool.zip

Initial Validation

Initial testing of actuators with differing widths was conducted and the tip force was measured at a range of pressures.



The experiment showed;

- By increasing the width of chamber by 5mm doubled the output tip force
- Materials with lower Young's moduli allows larger variations of tip forces for limited changes in input pressures.

Future Work

Analytical results will be linked with the tool to add an input for the desired tip force range of the actuator. The code will include features

- Input for desired tip force range
- Generation of Optimal internal geometry for tip force
- Option for desired geometry e.g. short of long as the tip force can be achieved with multiple designs (see Results)
- Additional quadrilateral designs

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