EXPLOITING TACTILE INFORMATION THROUGH TEMPORAL FEEDBACK OF A SKIN-INSPIRED SENSOR

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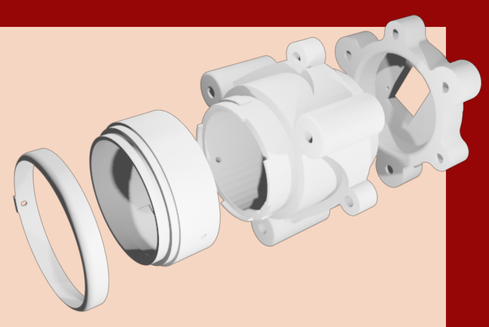
Introduction

Adaptive behaviour relies on environmental information. This project uses tactile skin-inspired sensors for such tasks.
In order to extract useful information we have devised a number of pre-processing techniques to gather movement and pressure.
We demonstrated this with a robotic arm that would move away from obstacles.

TacTip sensor



TacTips are skin-inspired sensors developed by BRL that use cameras facing a flexible mesh to detect tactile movement that can be interpreted as tactile information.

Noise reduction

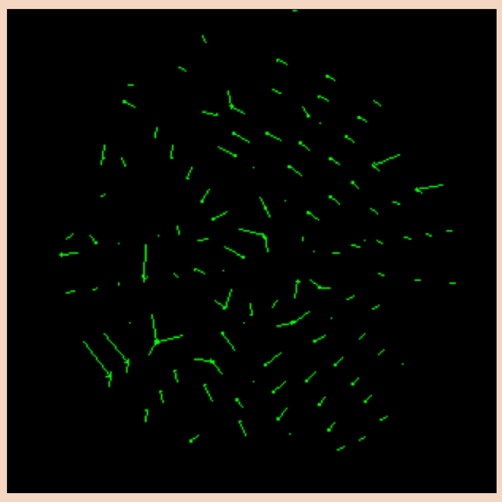
The TacTip sensor uses a ring of LEDs to make the white dots visible.
Glare can be seen on the lens and gel layer, making binary thresholding challenging.
We used an adaptive threshold with blob removal

Movement detection

After noise reduction we calculate the centroids of each point.
We find the nearest points in a matrix C at time step t. Each coordinate is stored in index i.

$$C_{t,i} = \sqrt{(C_{t,i} - C_{t+1})^2}$$

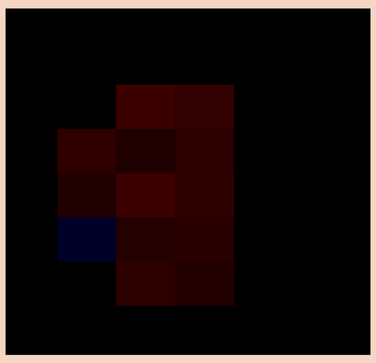
We calculate the Euclidean distance of each coordinates and all coordinates in the next layer. The shortest distances allows detection of where the dots have moved. From this we can plot movement.



Touch detection

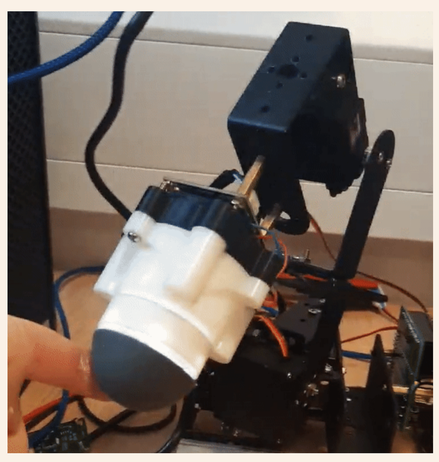
We can calculate pressure in positions by averaging the pixel intensity from the absolute difference in grid squares and reducing by a global average.
Using F a matrix containing pixel values and grid size div.

$$\sum_{x=i}^{div_y+i} \sum_{x=j}^{div_x+j} (F_{i,j}) \times \frac{1}{255 * (div_y) * (div_x)} - \bar{x}$$



Results

The tactile information can be used to recognize information in the environment. We found that the robot arm could sense the touch and direction of the stimuli, so it would move in the opposite way.
Future work hopes to explore larger surface areas of skin with different soft-body morphologies.



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