Using High Density Conductive Polyethylene Black Foam as a restive sensor to build spatial object awareness in robotic grippers

1. Introduction

Magnus Today, the most common robot gripper still looks like the one this picture. Two flat sheets, often made out of metal, press down on any tool that the arm is trying to grab. There is no way to get information on shape, texture or features of the object. In this work, we attempt to create a sensor that could begin to rectify the absence of these features.

2. Conductive foam.

What is Conductive foam (High Density Conductive Polyethylene Black Foam) you might wonder. This is the foam that we use to protect Integrated circuits from static electricity. Amoungst other features, the foam has conductive ability to lead away static charges, which is exactly what enables us to use it in our implementation.

3. How it used.

Daniel First recall that the material is conductive so the material have a given resistance per meter. Now, the structure of the material is full of holes which obviously counduct very poorly. Thus, the electrons that moves through the foam move on thr surface of bubbles inside the material. The final property of the conductive foam that is utilized is that when squeezed, it will return to its original* shape. When the material is squeezed, the bubbles are pressed togather basicaly short circuiting the surfaces that the electrons travel decreasing resistance. It has not been in the scoped of our project to test how durable this material is.

4. What was done

Magnus The approach to measure this is based an grid array of measurement pins inserted in to the bottom of the foam. That grid of measurement pins in the foam could be abstracted down to a resistor map as shown. In the implementation as shown later the pins in this map will be altering from positive to negative. And by the implemented algorithm a image of the features in the pressed down figure could be shown.

5. How the algorithm works

Daniel To generate an matrix from the measurements the following algorithm visualised here are proposed. On the left the abstracted resistor grid representing the foam and on the right an outline of an matrix is shown. In this demo the matrix wont be filled with values. Instead the focus is to show how the values are acquired.

5.1. Measurements

0 The first measurement is done by taking the two highlighted resistors

1 Second measurement

2 Third measurement

3 Last measurement

6. Hardware implementation.

Magnus The hardware that was intended to be implemented in this project have tree parts.

1 On the left an standard Arduino

2 In the middle the board with the multiplexers are shown.

3 This construction is used to so that standard lab cables could be used for measurements.

7. How the measurements was done.

An Arduino was used for this project to measure the foam. In this figure an high abstraction electrical flow chart is presented. Two muxes is used to switch the measurements from pair to pair. Observe that the resitor with the variable resistance in the foam acts as an part of a voltage divider. Read by the **Vread** input to the Arduino.

8. Software design.

The software design used in this project is done in three layers. As stated the first layer are the Arduino, who is programmed tho set the multiplexer and send the data over the serial. The first python program reads the data from the serial and converts it from string to numbers. Then the

meanstoMatrix()

algorithm is used to convert the reading to pixel data and finally that data is sent over to the 3d display program by storing the data in an temporary file.

9. Results.

Daniel Do to project complexity, time and unforeseen problems like the Voltera accuracy smears out the traces and don't support Linux. What we did instead. Proof of concept measurements of the foam resistance drop when exposed to pressure. Result from program with dummy text string as input is shown on the next slide. This corresponds somewhat to Proof of concept measurements. We still intent to complete the project do to personal interest.