**NOVEMBER PROPOSAL: TO INVESIGATE IF ADDING LAYERS OF VELOSTAT IMPROVES THE TACTILE RECONSTRUCTION USING EIT PRINPLE.**

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**Aims:**

To determine whether layered velostat plies enhance the accuracy, resolution, and robustness of cylindrical EIT Tactile sensors.

1. Reconstruction accuracy: *Does a double layer reduce position error and image artefacts compared with a single layer? I*
2. Detectability & Resolution: *Does layering improve the detectability and spatial resolution of small contacts?*
3. Robustness: *Is a double-layer configuration less sensitive to contact impedance and electrode misplacement?*

**Methods:**

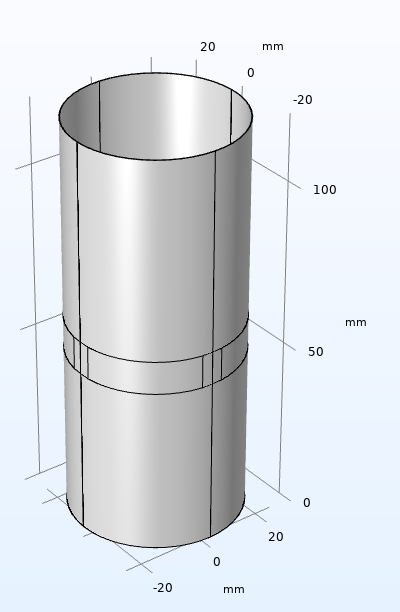
1. COMSOL Model: 1 vs 2 layers
2. Image Reconstruction algorithms

# COMSOL Model

## Parametric Sweep Study 1: 1 layer of Velostat

First, all the parameters, were set to be used later without having to alter the geometry. Then, a cylinder was built to be then used as the Velostat layer (Figure 1a). A belt was added as well, which was then be portioned in 16 structures to be used as electrodes (Figure 1b) .

a.

A curved line drawing of a ladder

AI-generated content may be incorrect.

b.

Figure 1: a) layer of Velostat before adding the electrodes, b) belt partitioned to add electrodes

Then, selections (k) were made to create 16 different boundaries. Brown colour was used to aid with the visualisation, Figure 2. Later on, those selections were assigned current injection. Each electrode would be selected according to the EIT principle, were current is injected through one electrode (src\_idx), and sinked through another (snk\_idx). Two adjacent electrodes are used to measure the voltage difference. Therefore, 12 electrodes remain “unassigned”. The formula that was given to each selection was:

I = Iinj\*((k==src\_idx)-(k==snk\_idx))

A ground point was selected to prevent errors when running the study later on, Figure 3.

A drawing of a cylinder

AI-generated content may be incorrect.

Figure 2: Boundary explicit division for 16 electrodes

A drawing of a cylinder

AI-generated content may be incorrect.

Figure 3: ground point (circled in red) for current put in blue

Before assigning the materials, a point was created on the upper belt to simulate touch, Figure 4.

A drawing of a cylinder

AI-generated content may be incorrect. A drawing of a cylinder

AI-generated content may be incorrect.

Figure 4: touch point

Velostat was then assigned to the upper and lower part of the belt, Figure 5, as well as the belt, as the electrodes had already been assigned with current. Velostat pressed, with different conductivity to the other velostat, was assigned to the “touch point”, Figure 6.

A screenshot of a computer program

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Figure 5: velostat material assigned

A screenshot of a computer

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Figure 6: velostat pressed

Parametric sweep using k assigned. K corresponded to each electrode, so that the study would follow the electrode selection according to the EIT principle.

# Appendix A: Parameters used for COMSOL simulation

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Expression** | **Unit** | **Description** |
| **Geometry** |  |  |  |
| R\_core | 20 | mm | Cylinder core radius |
| H\_core | 100 | mm | Cylinder core height |
| t\_velo | 0.2 | mm | Velostat layer thickness |
| R\_outer | R\_core + t\_velo | mm | Outer radius (with Velostat) |
| ring\_z | 50 | mm | Axial position of electrode ring |
| h\_el | 10 | mm | Electrode height (axial) |
| Ne\_ring | 16 | 1 | Number of electrodes in the ring |
| **Touch Point** |  |  |  |
| touch\_r | 3 | mm | Radius of circular pressed area |
| touch\_p | 10000 | Pa | Applied pressure at touch point |
| **Material (Velostat)** |  |  |  |
| sigma0 | 1e-4 | S/m | Baseline electrical conductivity (unpressed) |
| alpha | 2 | 1 | Sensitivity factor for pressure dependence |
| p0 | 1000 | Pa | Reference pressure |
| eps\_velo | 3 | 1 | Relative permittivity of Velostat |
| **Electrical** |  |  |  |
| Iinj | 1e-3 | A | Current injected between electrode pairs |
| freq | 10e3 | Hz | AC frequency for frequency-domain EIT study |
| **Simulation Control** |  |  |  |
| k | 1 | 1 | Drive index (swept from 1 to Ne\_ring) |
| src\_idx | 1 + mod(k-1, Ne\_ring) | 1 | Source electrode index |
| snk\_idx | 1 + mod(k, Ne\_ring) | 1 | Sink electrode index |