MEMS BASED TACTILE SENSOR FOR ROBOTIC SURGERY

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Introduction: In this work, a piezoelectric tactile sensor was designed in order to assess the pressure exerted on the human body while the robotic surgery is performed. To perform the minimally invasive surgery (MIS) more effectively, the surgeon should be able to feel the tissue, sensing the pressure of blood vessels and ducts during the procedure. This ability is very important during manipulation tasks such as the grasping of the internal organs, gentle load transfer during lifting, suturing and removing tissues. This sensor can be integrated with the commercial graspers that are used in MIS and also in robotic surgery.

Computational Methods: The sensor design consists of a rigid cylinder surrounding by a compliant cylinder which are made up of the Silicone. A 0.01 µm circular PDMS film with radius of 0.5 µm is sandwiched between the rigid cylinder and base plate which measures the force applied to the rigid cylinder. In this model, the rigid cylindrical part is considered as rigid support. Only the compliant cylinder part and tissue are considered flexible and can deflect under very small external load. The compliance of the sensed object (tissue) has been calculated by measuring the force distribution on the rigid and compliant parts.

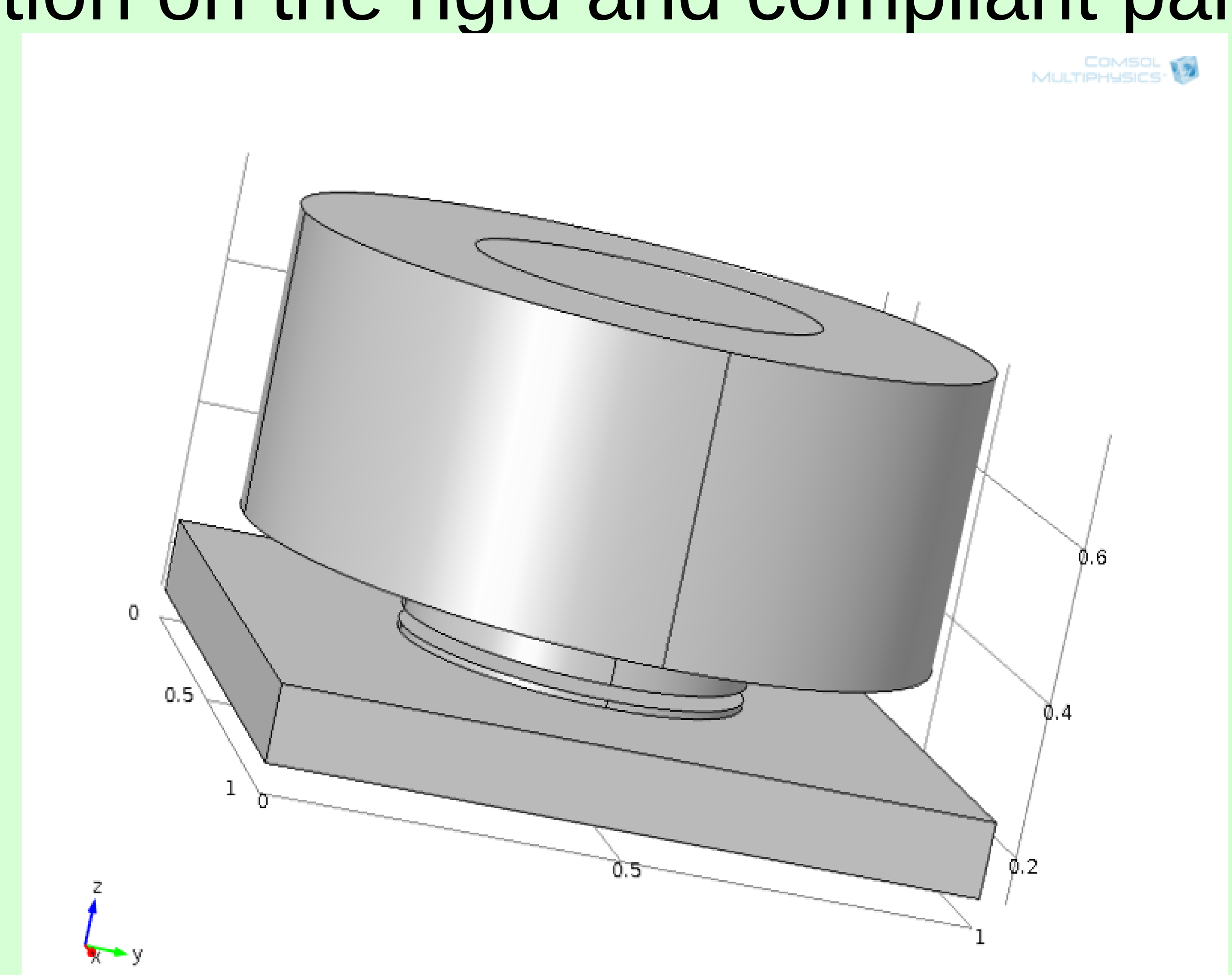

Figure 1. 3D model of Tactile sensor

Results: Different pressures were applied on the surface of the designed sensor. Figure 2 shows the displacement obtained in the sensor when a pressure of 109.8kPa was applied. Table 1. shows the displacements obtained by the sensor for the pressures applies over it.

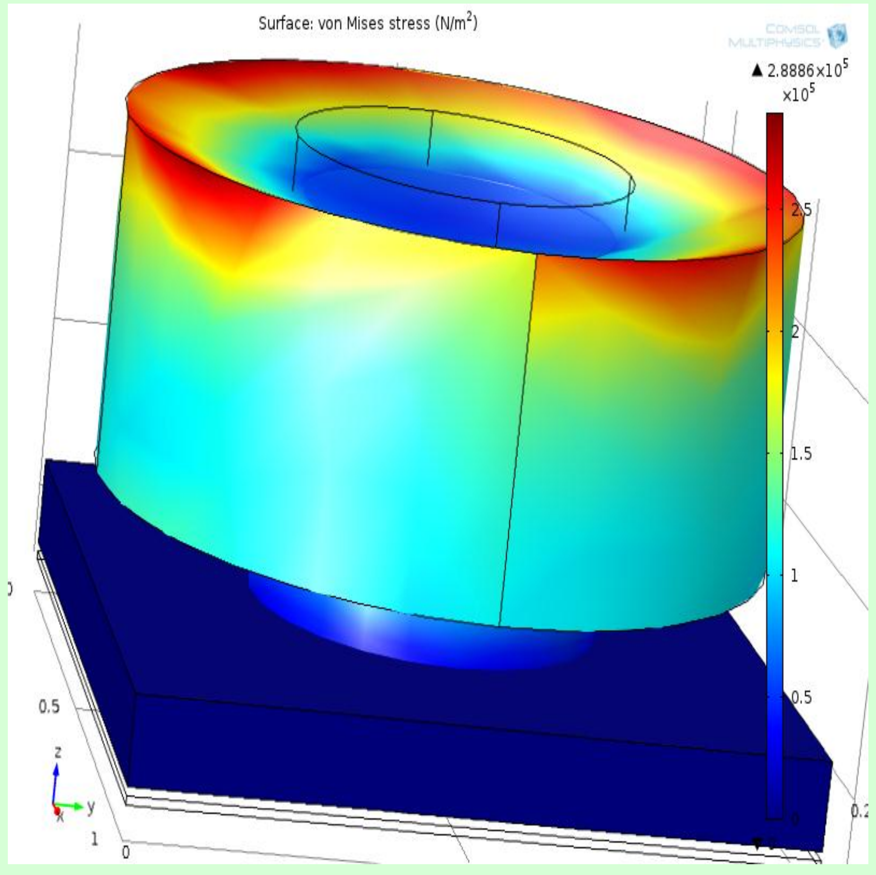

Figure 2. Total Displacement

Pressure (kPa)	Total Displacement (N/m^2)
102.59	2.6989*10^5
109.80	2.8886*10^5
111.68	2.9381*10^5
114.50	3.0123*10^5
122.89	3.2303*10^5
128.57	3.3908*10^5
132.54	3.4870*10^5

Table 1.SimulationResults

Conclusions: A piezoelectric tactile sensor was designed and different displacements were obtained by applying varying pressures from 102.59kPa to 132.54kPa. This sensor can be integrated with the commercial graspers that are used in MIS and also in robotic surgery.

References:

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