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# The Bio Inspired Tactile Sensor

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## Abstract

In recent years, studies on robotics have been needed, to utilise the tactile sensors for artificial skin. Researchers have been working on tactile transduction technologies which lead to many sensor prototypes and devices for robotic applications in their effort to solve the tactile sensing problems in robotics and medical industries, but they remain unsatisfactory. This project addresses the Finite Element Analysis (FEA) design and characterisation of a bioinspired tactile sensor, mimicking the type of responses produced by the human's mechanoreceptors. Responses generated by mechanoreceptors demonstrate the static and dynamic features, therefore strain gauge and polyvinyllidene fluoride (PVDF) were used in the model to replicate the responses respectively. The FEA study was conducted using COMSOL Multiphysics 5.1 software. Non linear structural materials module together with Shell Multiphysics interface was used in modeling the artificial skin and the strain gauges, modelled as hyperelastic material presented by a neo hookean material model. Piezoelectric Devices Multiphysics interface on the other hand was used in modeling the PVDF thin film. The base of the PVDF film was also grounded as the selected boundary was zero charge (V=0).The unit sensor was subjected to stationary boundary loads applied on the ridge, in both normal and horizontal directions as well as ramp indentation boundary load. The model base was fixed throughout the experiments, together with the PARDISO type of solver system. The proposed bio-inspired tactile sensor consists of two strain gauges and a PVDF thin film placed directly underneath a semi-circular ridge. The strain gauges were placed on a shell element of 800 µm width x 500 µm length, located at 400 µm below skin surface., while the PVDF film was placed deeper underneath (900 µm below the skin surface). A relationship to predict the direction of applied load was developed from the static load components. The output of the PVDF film model, are able to demonstrate the ability to detect transient load given to the unit sensor. The proposed unit of the bioinspired tactile sensor can be used as an analogue of the slowly adapting type 1 (SA1) and fast adapting type 2 (FA 2) for the artificial skin, which is useful for robotic fingertip's skin applications. Overall, the project was successfully done in obtaining a bio-inspired tactile sensor model mimicking the response produced by the human mechanoreceptors in the glabrous skin.

## Reference

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2.Yamada, D., Yamada, Y., & Maeno, T. (2001). Design of Artificial Finger Skin Having Ridges and Distributed Tactile Sensors Proceedings of the 32nd ISR (International Symposium on Robotics) (Vol. 19, pp. 21).

## Figures used in the abstract

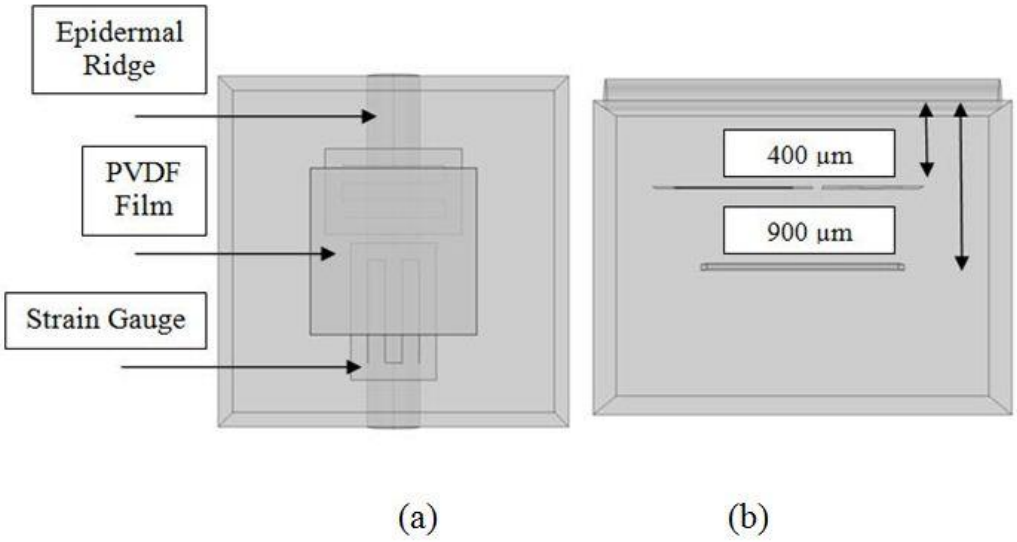


**Figure 1:** The Proposed Bio-inspired Tactile Sensor : (a) Top View (b) Side View