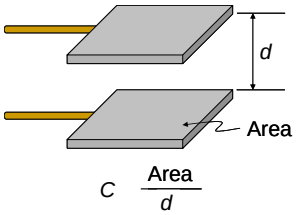
Capacitive Tactile Sensors – A Technology Primer

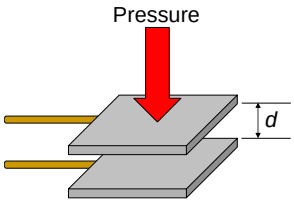
Capacitance

The basic electrical property of **capacitance** – a measure of an object's ability to store electrical charge –has been demonstrated in countless physics classes with the classic example of two electrodes with area *A* separated by an air gap *d* as shown. If the air gap decreases, the capacitance *C* goes up.

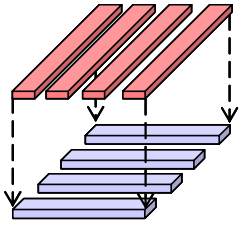


Tactile Sensors

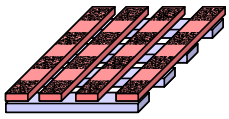
Pressure Profile Systems uses this property to build its tactile pads and arrays by separating the electrodes using a proprietary compressible dielectric matrix, which acts like a spring. Precision manufacturing techniques allow excellent repeatability and sensitivity, while advanced conductive materials allow for conformable, stretchable, industrial, and other hybrid sensor designs. The simplicity of the capacitive sensor design gives PPS a large degree of flexibility when creating custom sensor solutions.



Array Sensors

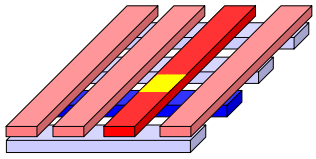


Overlapping Electrodes



Capacitors Formed at Overlap Points

To build tactile array sensors, PPS arranges the electrodes as orthogonal, overlapping strips. A distinct capacitor is formed at each point where the electrodes overlap. By selectively scanning a single row and column, the capacitance at that location, and thus the local pressure, is measured. PPS's proprietary drive and conditioning electronics can scan through an array at high speed while optimizing settings to achieve the maximum sensor response from each sensing element.



Select Row and Column to Measure Single Pressure

Sensor Technology Comparison

Unlike with some other tactile sensor designs, capacitive-based sensors do not have significant internal wear and tear under load. Since the scale of the deflections is so small, there is little chance for "set" in the material, thus reducing the frequency with which capacitive sensors must be calibrated. The following table shows a comparison of capacitive sensors versus the two other most common approaches, resistive and piezoelectric tactile sensors.

Property	Capacitive	Resistive	Piezoelectric
Maximum Range	Good	Good	Good
Sensitivity	✓ Excellent	Poor	Good
Minimum Element Size	Good	Excellent	Poor
Repeatability	✓ Excellent	Poor	Good
Temperature Stability	Excellent	Excellent	Poor
Design Flexibility	Excellent	Excellent	Good

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