

# Design and Simulation of MEMS-based Sensor for Artificial Hand

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**Introduction:** An artificial hand is the one that replaces the hand lost through trauma, disease, or congenital conditions. Sensing of object and lifting or moving to different place can be easily done by measuring the object size and mass (Figure: 1).

**Computational Methods:** When the object gets in contact with the hand, capacitance is calculated with closed form integral expressions. For the capacitance value, size of the object can also be computed.

$$C = \epsilon \epsilon_0 \frac{A}{d} V^2$$

Where, A is the area of the dielectric and d is the distance between the electrodes.

The pressure of the object has been converted in to force experienced on the finger and it is calculated by using the formula give below:

$$p = \frac{F}{A}$$

Where, p is the normal force and A is the area of the surface in contact.

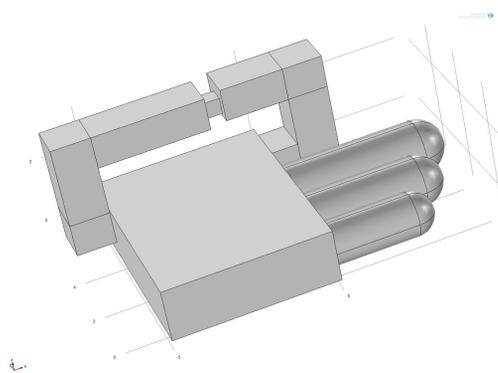


Figure 1. Index and thumb finger holding a box.

**Results:** The ball and box is considered as objects. The change in capacitance for 0.5 x 0.5 inch square box and 2" radius ball is observed as  $1.7988 \times 10^{-12}$  and  $5.8166 \times 10^{-13}$  respectively (Figure:2). The capacitance value for different dimensions of box and ball were observed and tabulated (Table 1).

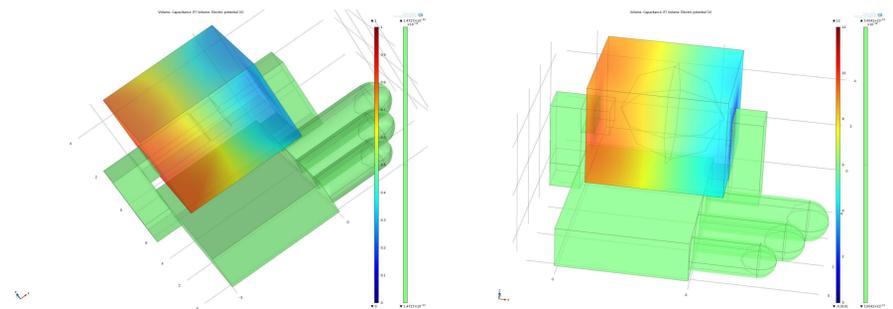
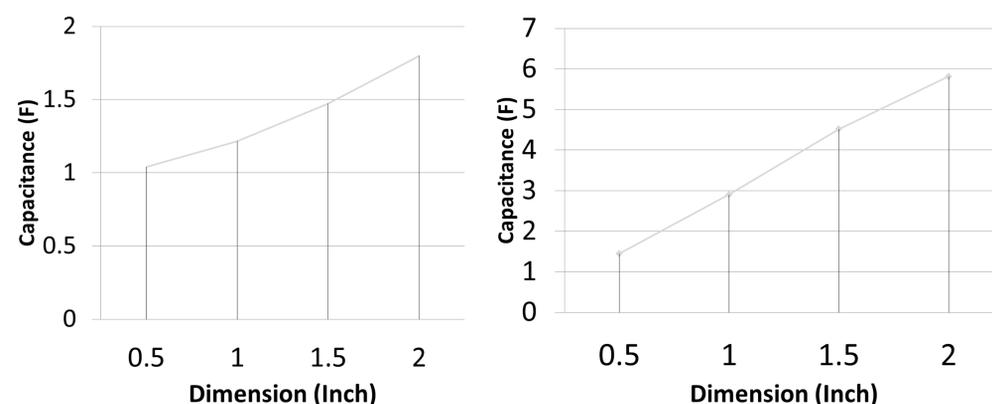


Figure 2. Capacitance for box and ball

S.No	Length of Sq. box/ Radius of the ball (inches)	Capacitance_Box (F)	Capacitance_Ball (F)
1	2	$1.0400 \times 10^{-12}$	$5.8166 \times 10^{-13}$
2	1.5	$1.1855 \times 10^{-12}$	$7.5145 \times 10^{-13}$
3	1	$1.4727 \times 10^{-12}$	$1.0089 \times 10^{-12}$
4	0.5	$1.7988 \times 10^{-12}$	$1.4512 \times 10^{-12}$

Table 1. Capacitance value for box and ball



**Conclusions:** The change in capacitance varies linearly with the increase in the dimensions of the object. As the size of the object increase the change in capacitance decreases, since the dielectric area is varied for box and square. In the same way, objects of different size and shapes can be chosen to study the change in the behavior of the prosthetic hand.

## References:

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