

East West University



Project Report

Course Code: EEE 305

Course Name: Electromagnetic Fields and Wave

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Theory

A capacitive fuel level sensor works by the principle of changing the capacitance due to the change of the height of the fuel in between the electrodes of the capacitor, as it is immersed into the fuel (left figure).

However, if the fuel level changes due to the tilting of the fuel tank (as is the case for an aircraft, where the aircraft leans during cruise or take-off or landing), the level sensor may give incorrect result (right figure).

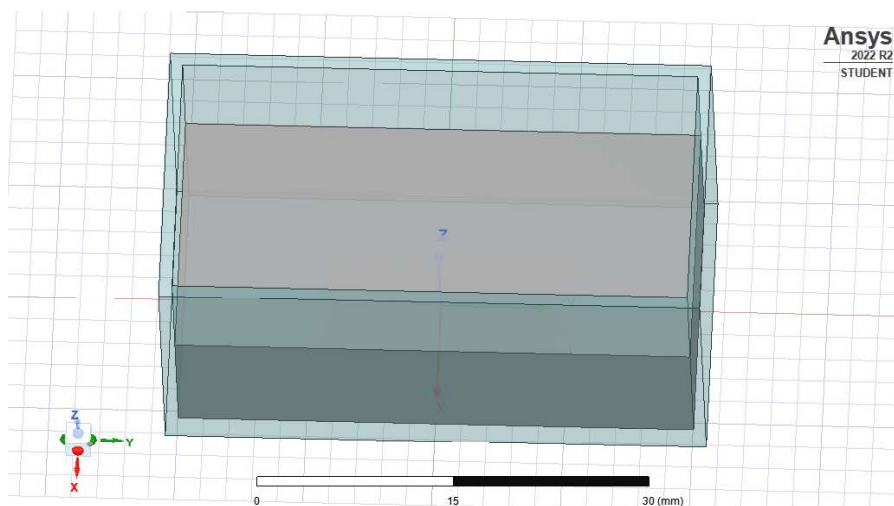


This can be solved by placing multiple capacitors in the fuel tank and measuring the total capacitance (equivalent capacitance of parallel capacitors). In this way, as the aircraft maneuvers, some probes are in more fuel than others, due to the change in fuel height. But the fuel level indication should remain steady, as the total capacitance of all the probes remains the same.

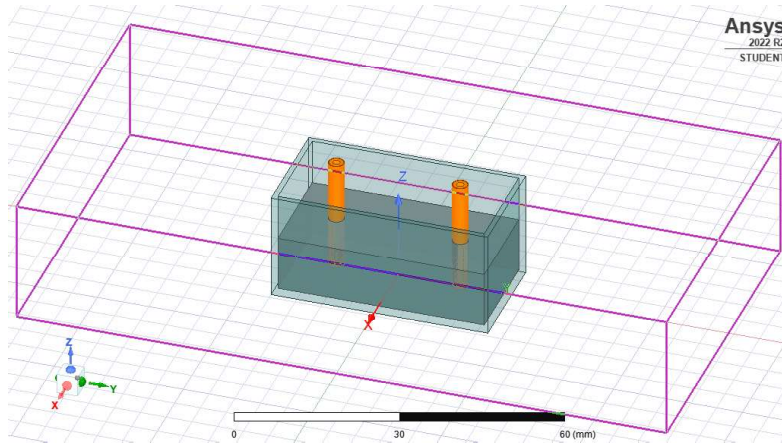
The design parameters are:

1. Inner radius of the cylindrical capacitors, a
2. Outer radius of the cylindrical capacitors, b
3. Distance between the capacitors, d

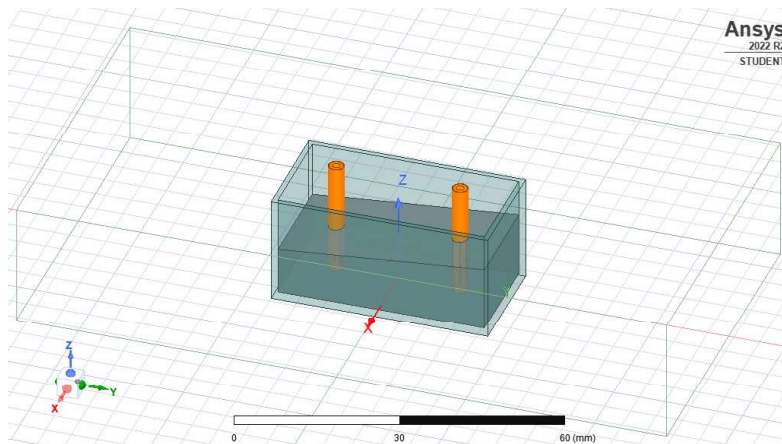
Diagram:



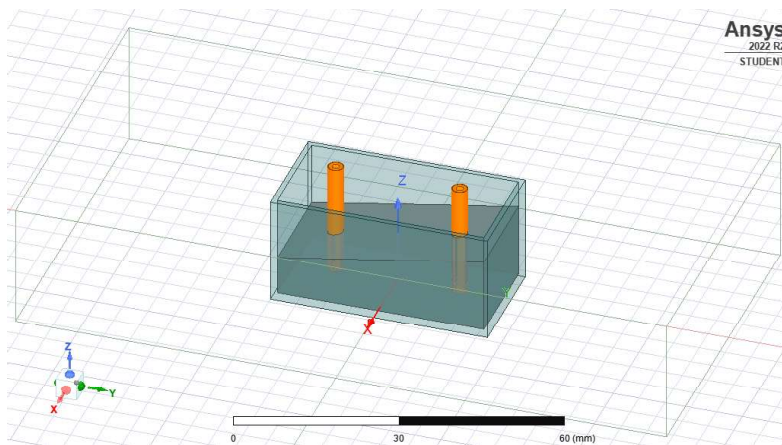
- When inclination angle is 0°



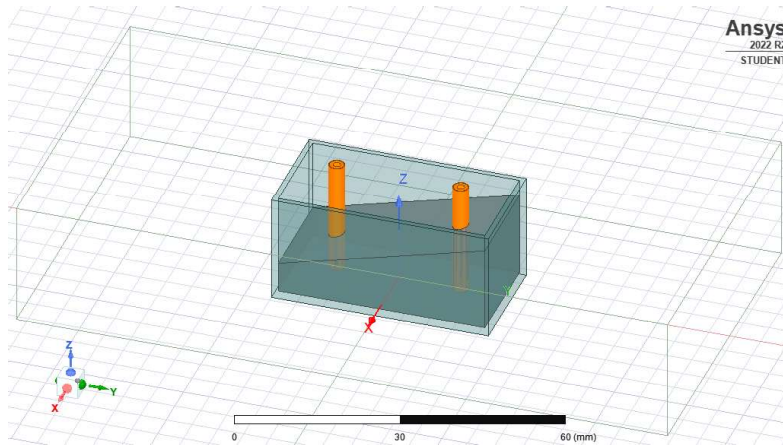
- When inclination angle is 5°



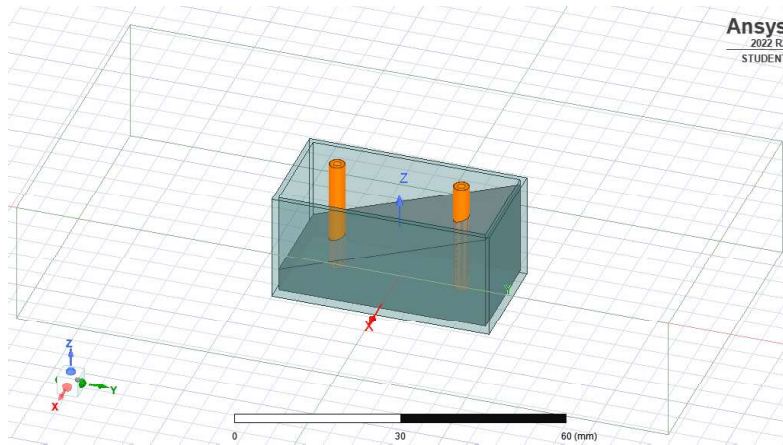
- When inclination angle is 10°



- When inclination angle is 15°

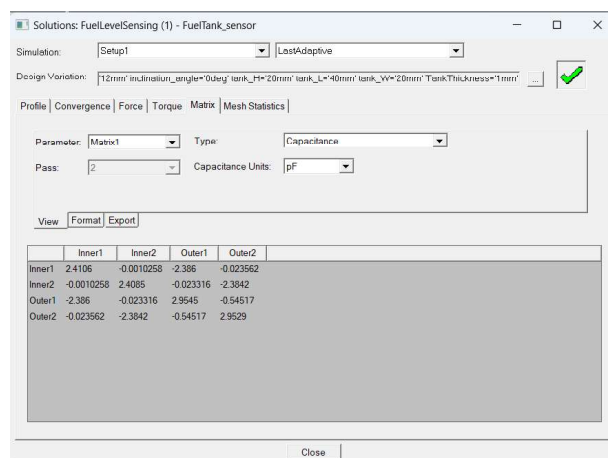


- When inclination angle is 20°



Solution Data

- When inclination angle is 0°



- When inclination angle is 5°

Solutions: FuelLevelSensing (1) - FuelTank_sensor

Simulation: Setup1 LastAdaptive

Design Variation: 12mm' inclination_angle=5deg' tank_H=20mm' tank_L=40mm' tank_W=20mm' TankThickness=1mm'

Profile | Convergence | Force | Torque | Matrix | Mesh Statistics

Parameter: Matrix1 Type: Capacitance

Pass: 2 Capacitance Units: pF

View | Format | Export

	Inner1	Inner2	Outer1	Outer2
Inner1	2.4732	-0.0010339	-2.4491	-0.023079
Inner2	-0.0010339	2.3522	-0.023793	-2.3274
Outer1	-2.4491	-0.023793	3.0135	-0.5406
Outer2	-0.023079	-2.3274	-0.5406	2.891

Close

- When inclination angle is 10°

Solutions: FuelLevelSensing (1) - FuelTank_sensor

Simulation: Setup1 LastAdaptive

Design Variation: 2mm' inclination_angle=10deg' tank_H=20mm' tank_L=40mm' tank_W=20mm' TankThickness=1mm'

Profile | Convergence | Force | Torque | Matrix | Mesh Statistics

Parameter: Matrix1 Type: Capacitance

Pass: 2 Capacitance Units: pF

View | Format | Export

	Inner1	Inner2	Outer1	Outer2
Inner1	2.5363	-0.0010378	-2.5126	-0.022723
Inner2	-0.0010378	2.2993	-0.024115	-2.2741
Outer1	-2.5126	-0.024115	3.0743	-0.53761
Outer2	-0.022723	-2.2741	-0.53761	2.8345

Close

- When inclination angle is 15°

Solutions: FuelLevelSensing (1) - FuelTank_sensor

Simulation: Setup1 LastAdaptive

Design Variation: 2mm' inclination_angle=15deg' tank_H=20mm' tank_L=40mm' tank_W=20mm' TankThickness=1mm'

Profile | Convergence | Force | Torque | Matrix | Mesh Statistics

Parameter: Matrix1 Type: Capacitance

Pass: 2 Capacitance Units: pF

View | Format | Export

	Inner1	Inner2	Outer1	Outer2
Inner1	2.6084	-0.00103	-2.5855	-0.021885
Inner2	-0.00103	2.2497	-0.025076	-2.2236
Outer1	-2.5855	-0.025076	3.1531	-0.5425
Outer2	-0.021885	-2.2236	-0.5425	2.788

Close

- When inclination angle is 20°

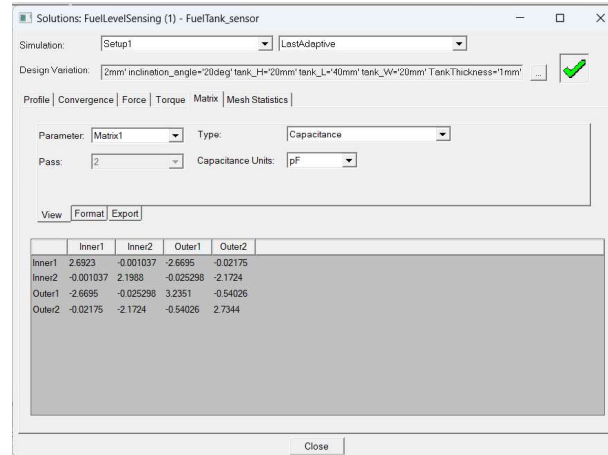


Table:

Table 01:

Parameter	Value (mm)
Inner radius, a	0.7
Outer radius, b	1.4
Distance, d	12

Table 02:

Inclination angle	Capacitance of the first capacitor, C1 (pF)	Capacitance of the second capacitor, C2 (pF)	C1 + C2 (pF)
0°	2.386	-2.3842	0.0018
5°	2.4491	-2.3274	0.1217
10°	2.5126	-2.2741	0.2385
15°	2.5855	-2.2236	0.3619
20°	2.6695	-2.1724	0.4971