EE430 Electromagnetism
Project 3: Capacitive Rain Gauge
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Materials:

For this project, we are to construct a rain gauge in which the level can be measured through capacitance. The materials to construct our rain gauge are two sheets of conductive material and a box to hold water. To optimize the project, the distance between the two plates should be decreased as much as possible and the surface area of the plates should be increased. It is also required that the two plates are not shorted together through the water. The tool used to measure the capacitance is an impedance analyser set to capacitive mode.

Constructed Rain Gauge:
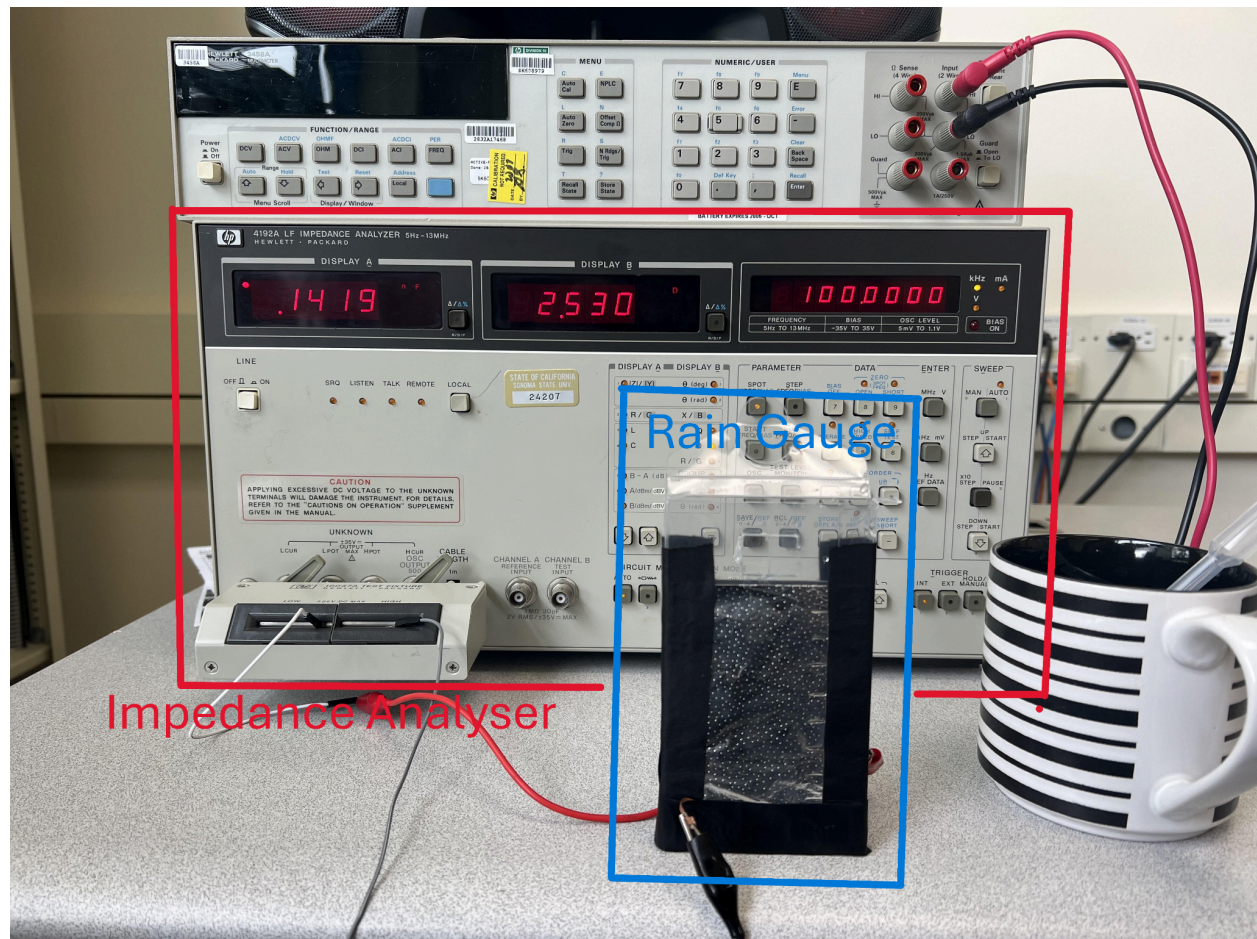
Theoretical calculations:

Width (m)	Height	Distance	Area	Capacitance (ε = 1)	Capacitance (ε = 1)	Waterlevel	Calculated Capacitance (F)
0.067	0.095	0.009	0.006365	6.26E-12	5.01E-10	0	6.26E-12
						0.95	4.95E-09
ε_0	ε_r (air)	ε_r (water				1.9	9.90E-09
8.85E-12	1	80				2.85	1.48E-08
						3.8	1.98E-08
						4.75	2.47E-08
						5.7	2.97E-08
						6.65	3.46E-08
						7.6	3.96E-08
						8.55	4.45E-08
						9.5	4.95E-08

Theoretical waterlevel vs capacitance graph:

Waterlevel vs Capacitance
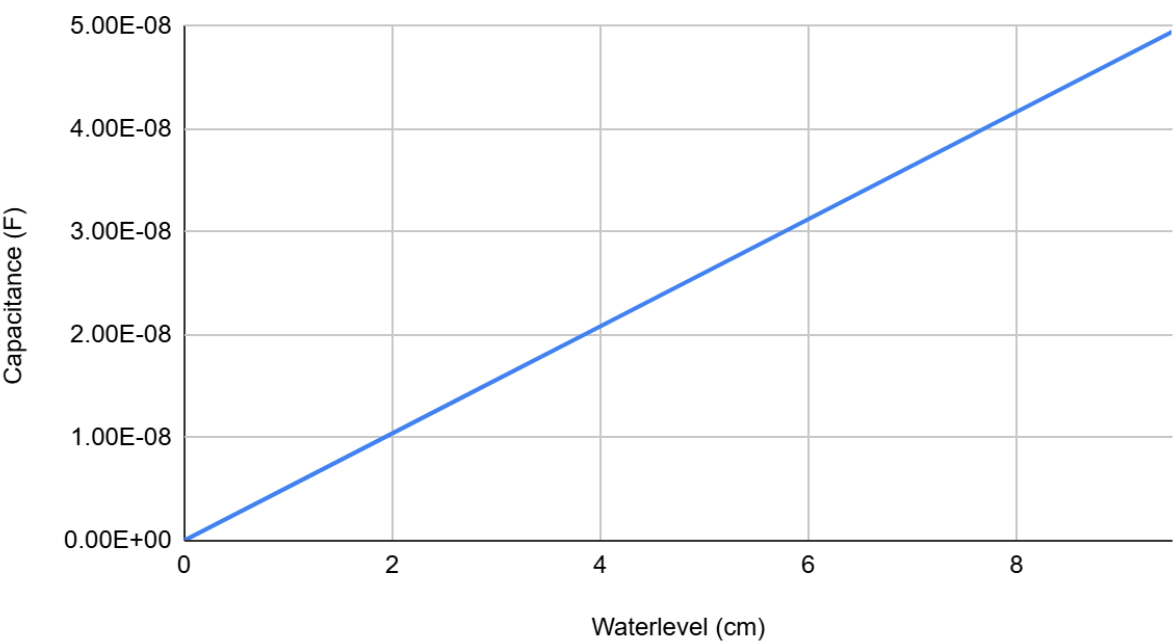
Capacitance measurement methodology:

The capacitance of the rain gauge was measured on the impedance analyser. The connecting wires were made to be as short as possible to not increase parasitic capacitance.

Table of capacitance and waterlevel:

Waterlevel	Calculated Capacitance (F)	Measured Capacitance(F)
0	6.26E-12	3.08E-11
0.95	4.95E-09	4.51E-11
1.9	9.90E-09	5.72E-11
2.85	1.48E-08	6.96E-11
3.8	1.98E-08	7.56E-11
4.75	2.47E-08	8.25E-11
5.7	2.97E-08	8.60E-11
6.65	3.46E-08	9.78E-11
7.6	3.96E-08	1.09E-10
8.55	4.45E-08	1.16E-10
9.5	4.95E-08	1.28E-10

Actual waterlevel vs capacitance graph:

Waterlevel vs Capacitance (real)
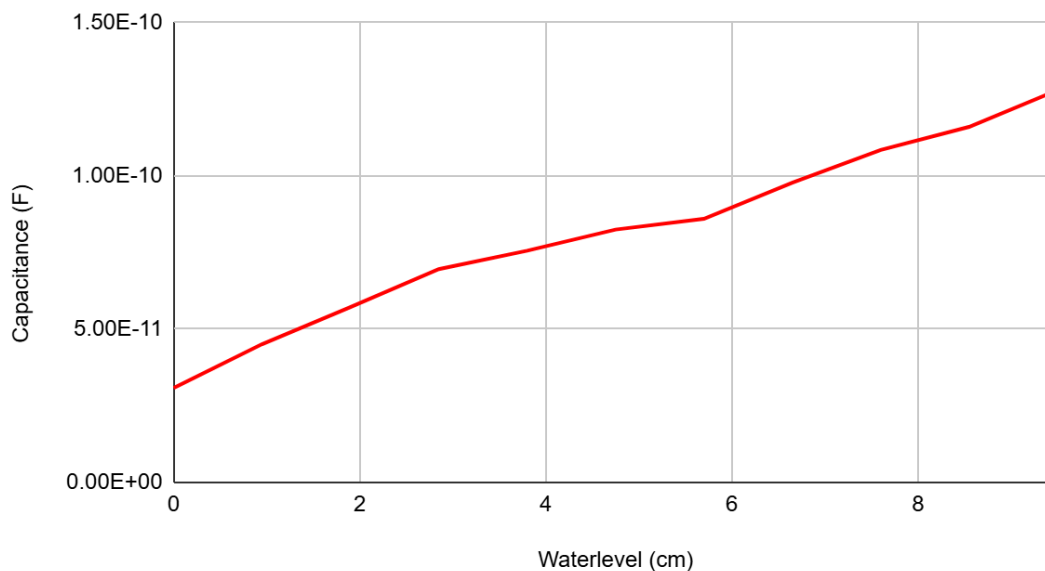
Comparison of theoretical vs calculated results:

       The slope of both graphs are very similar, the graphs differ when it comes to the magnitude of capacitance. I believe the capacitance discrepancy comes from the plates not being perfectly flush with the container's surface, this caused the real world results to be significantly lower than the theoretical results.