Sensitivity depth analysis for capacitive sensors in CFRP manufacturing

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Capacitive sensing is a method of Electromagnetic Non-Destructive Testing (NDT) that can distribute an electric field in both conducting and insulating materials. Throughout the scanning process, there may be changes in test material electrical permittivity which will impact the electric field distribution and thus the output voltage on the receiving electrode. This method can be used to monitor the Resin Transfer Moulding (RTM) process in the manufacturing of aerospace grade composites.

The experiments carried out in this work substituted water for resin and involved using a co planar capacitive sensor to monitor changes in water levels and the resulting changes in impedance across a frequency range of 10kHz – 1MHz. Two experiments were carried out, one for water only and the other for rising water levels with the addition of triaxial carbon fibre. The sensor in both experiments consists of one driving electrode and one sensing electrode both with dimensions of 25x25mm and a separation distance of 10mm. Finite Element Analysis was carried out in COMSOL to simulate rising water levels, to validate the experimental results and to observe the distribution of electric field as the water level rises. Monitoring the impedance changes, both experimentally and in COMSOL, across a large frequency range helped determine the optimal operating frequency of the sensor and the depth at which the sensors show sensitivity to rising water levels. Preliminary results are presented here, and comparisons made between experimental and COMSOL to determine the validity of this work and its potential moving forward.