During the life cycle of aircraft, external structures are under constant attack from environmental degradation in the form of corrosion. Corrosive defects consist of multiple types of surface and subsurface damage that are often undetectable due to surface coatings or insulation leading to loss in structural integrity. Non-destructive techniques for corrosion detection typically require the removal of paint. Detection of corrosion under insulation (CUI) is highly valuable for cost and time effectiveness. Although techniques have been developed for detection of CUI, not many of these satisfy the criteria for portability and hangar operation. To address this, multiple techniques were investigated yielding Pulsed Eddy Current Thermography (PECT) as a promising technique to pursue a proof of concept. Through multiphysics simulation using COMSOL, case studies were developed to understand and predict the temperature responses of aircraft materials when altering the current, lift off, and defect size and to design the coil for optimal non-destructive detection capabilities. Initial studies were conducted on various samples including coated and uncoated Aluminum, Carbon steel, Zinc-galvanized carbon steel with different types of corrosion. A novel in-house MATLAB® code was developed for post-processing of the corroded samples. Initially, defect localizations through edge heating or from dissipation was captured through IR thermography. To address issues with non-uniformity of heating that decrease the accuracy and precision of this technique, the thermal change with respect to time was analyzed through each frame and decomposed using Fourier transform from the time domain to a frequency domain. Manufactured corroded defects made through salt fog and acid baths, such as pitting voids, were detected under insulation of 125 microns with diameters ranging from 0.5 - 1 mm for all material systems. These results show the high potential of PECT for aerospace on-field applications providing location and shape for defects under insulation.

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The public is welcome to attend.