Pulsed eddy current detection of cracks in CF-188 inner wing spar through insulating wing skin using modified Principal Components Analysis

Thomas W KRAUSE*, Peter HORAN, Ross UNDERHILL
*Physics, Royal Military College of Canada, Kingston, Canada
e-mail: Thomas.Krause@rmc.ca, phone: 613 541 6000 x6415, fax: 613 541 6040

Abstract
Aluminum inner wing spars of CF-188 Hornet aircraft may undergo stress corrosion cracking (SCC) between fasteners that secure carbon-fiber/epoxy composite skin to the wing. The spars are covered by wing skin, which varies in thickness from 8 to 20 mm and acts as an electrically insulating layer. Pulsed eddy currents (PEC) that are generated by a probe centered over either the Titanium or ferrous fasteners demonstrates capability of detecting cracks within the spars with the wing skin present. Comparison of signals from separate pick-up coils, mounted to either side of an excitation coil, are used to detect differences in induced eddy current fields, which arise in the presence of cracks. The dependence of PEC signal response on variations in skin thickness, fastener material and size and centering over fasteners is overcome using a modified Principal Components Analysis (PCA) applied to a large calibration data set. A Discriminant Analysis reduces the resulting multi-dimensional PCA scores to one dimension (1D) and permits real time analysis under inspection conditions. Field trial results obtained from PEC inspection for real cracks in inner wing spars will be presented.