NDE at its Extreme – Applications for Space Explorations

The Aerospace Corporation is a Federally Funded Research and Development Center FFRDC supporting the U. S. Space Force. A variety of challenges come to the labs in support of the different space programs. At times, these challenges require solutions that can only be brought forth through a multidisciplinary team of innovative Nondestructive Evaluation scientists and engineers. Three examples will be provided in this presentation. In the first example, an eddy current technique is developed to detect dimpling in carbon fiber facesheet/honeycomb sandwich structure. The area of concern traversed a transitional section between two honeycomb thicknesses and covered with cork. The eddy current technique is calibrated to measure liftoff from the conductive fiber layer at the two thicknesses and extrapolated for the transitional region. Accuracy of the measurement is 0.005", largely due to the roughness of the composite surface. In the second example, an ultrasonic technique is developed for detecting kissing unbonds between the Orion heatshield blocks and composite substrate. The heatshield material is highly attenuating and inhomogenous making the ultrasonic technique nearly impossible. The technique requires the use of high damping low frequency transducers, coupling of water and alcohol, normalization of signals to eliminate inhomogeneity of the heatshield material, phase analysis, SAFT and other signal processing tools. All are built into a custom software, which displays the c-scan image in real-time during a hand scan. In the third example, an ultrasonic signal processing technique is used to assess the degradation of rubber. The rubber is between a solid rocket motor structure and launch vehicle. Some extent of cavitation and porosity are expected in the rubber. The attenuation they cause on the ultrasonic signal varies with pressure on the rubber layer. To evaluate degradation or increase in cavitation, a composite scan from multiple scans is made to reflect the worst attenuation for each pixel. Statistical evaluation is then made to represent the attenuation levels of good and bad areas. A new parameter is then generated to represent the wholeness of the scanned area and an empirical mathematical relationship established between this parameter, aging and strength of the rubber layer.