Lightning Damage Evaluation in Carbon Fiber Composite Polymer Structure

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Lightning Damage Evaluation in Carbon Fiber Composite Polymer Structure Catalin Mandache*, Marc Genest, Behnam Ashrafi, Dennis Krys National Research Council Canada 1200 Montreal Rd, Ottawa, Ontario, K1A 0R6, Canada *corresponding author, email: catalin.mandache@nrc-cnrc.gc.ca, phone: 1-613-991-2132 While metallic aircraft structures are largely unaffected by lightning strikes, not the same statement could be made about carbon fiber reinforced polymer (CFRP) ones. CFRPs have low electrical conductivity and high anisotropy, and for this reason they are covered with metallic meshes, generally of aluminum or copper, to redistribute the electrical charge when the plane encounters lightning events. During these phenomena, electrical discharges could lead to physical damage, called direct effects, such as: ablation, erosion, explosion, structural weakening and degradation. Although relatively rare, when aircraft is affected by lightning strikes, structural inspections are necessary to determine the need and magnitude of repairs. Since the extent of lighting strike damage on laminated composite is difficult to determine and quantify visually, other non-destructive evaluation (NDE) techniques must be used. In this work, we compare established techniques, such as pulse-echo ultrasonics, x-ray radiography, eddy currents, and thermography with a novel investigative approach, based on planar capacitive sensing and imaging. This has the advantage of being non-contact, and requiring only single-side access to the part. The technique's capabilities to detect dielectric changes and breakages in conductive layers make it an ideal candidate for the NDE of CFRP aircraft structure for lightning effects. The outcomes of capacitive imaging inspections on laboratory introduced lightning damage on CFRP panels are discussed along the advantages and disadvantages of the technique compared to more established ones.