FINITE ELEMENT ANALYSIS METHODOLOGY FOR THERMAL, ELECTRICAL AND MECHANICAL EFFECTS OF LIGHTNING STRIKE OF METALIC AIRCRAFT STRUCTURES

ABSTRACT

According to statistical data, lightning strike incidents for commercial aircraft occur approximately twice a year. The average frequency of lightning strikes occurs once every 3,000 flight hours. For military aircraft, the risk of lightning is often worse compared to civilian aircraft due to unsafe weather conditions and unknown flight routes. Lightning strike incidents depend on the altitude of the aircraft. Most strikes occur at or below cloud level altitudes during ascent or descent from cruising altitude. Therefore, short-haul commercial aircraft routes increase the likelihood of exposure to lightning environments. Lightning currents enter an aircraft at one point and exit at another point. Generally, the effects of lightning can be classified as "direct" and "indirect." Examples of direct effects include dielectric breakdown, disintegration of airframes, bending, melting, burning, vaporization of aircraft surfaces or equipment. In terms of structural integrity, indirect effects on the aircraft's outer surface are of primary concern. Due to direct effects, lightning strikes can cause severe structural damage in both metallic and composite structures. These damages can occur in various forms such as melting, sublimation at the lightning strike point, Joule heating, magnetic force effects, acoustic shock, arcing at connection points, and ignition of flammable fuel vapor in fuel tanks. The aim of the thesis is to simulate Lightning Strike Thermal, Electrical and Thermal damage on the metalic aircraft structures by using Finite Element Method. At the end of the thesis, simulations will be validated with the actual tests lightning strike tests.