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The Distribution Of Lightning Striking Points On Aircraft Using The Leader Progress Method

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Lightning is one of the major natural disasters threatening aircraft flight safety. Aircraft lightning zoning is the premise of lightning protection design, and the first step in locating the lightning striking zones is determining the locations where lightning leaders may initially attach to aircraft. The lightning strike to aircraft starts with the development of a positive discharge from the aircraft, followed few milliseconds later, by the inception of a negative discharge propagating in the opposite direction. The location of the inception points of both discharges are important in order to identify the most threatened zones of the aircraft in the initial lightning phase.

For a given aircraft geometry and an given ambient field direction, the method for analyzing the distribution of lightning striking points when aircraft was struck based on the leader progress method was introduced, by which the numerical simulation model of aircraft was developed. According to SAE ARP5412 "Aircraft Lightning Environment and Related Test Waveforms" and SAE ARP5416 "Aircraft Lightning test methods", the key factors such as the discharging electrode, the voltage waveform, the discharge gap, flight attitude, and the number of discharge were determined. The charge simulation method were employed to simulate the lightning leader channel propagating toward the aircraft, by which analysis of numerically simulated lightning striking points on aircraft were conducted. The location of the entry points which were the starting point of the positive leader and the exit points which were the starting point of the negative leader was obtained. The distribution probabilities of the entry points and the exit points were obtained. The minimum ambient field which allows the start of the positive leader and the negative leader was obtained. The ambient field which allows a stable propagation of the positive leader and the negative leader was obtained. The research of lightning attachment experiment on scale model of airplane was also conducted in the laboratory, and the distribution probabilities of lightning striking point were basically identical to the simulation results, verifying the feasibility of the numerical simulation method, which have an important reference value for aircraft lightning protection designs.

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