P32: Lightning Protection of Aircraft Radome

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Introduction

- It is difficult for aircraft to avoid thunderstorm regions.
- The effects of lightning strikes are a major concern for the aviation industry.
- During its lifetime each aircraft is hit on average by 25 lightning strikes.
- In-flight, statistics indicate that most strikes usually occur at 2km-5km above sea level, where the temperature is close to 0°C [1].
- Lightning tends to strike the extremities of a plane such as nose, tail and wings [2].
- The aircraft extremities are located in Zone 1 as shown in figure below.
- Zone 1 provides regions of high electric field that needed to initiate a lightning discharge by enhancing the ambient electric field.

Zoning

- Zone 1 (Red) - Attachment point
- Zone 2 (Green) - Swept stroke
- Zone 3 (Blue) - Conduction

Lightning Strike to Radome (Nose of Aircraft)

- Radome is one of the parts of an aircraft body that might be struck by lightning.
- Located at the front of an aircraft
  - The aircraft is likely to intercept the lightning discharge when the aircraft passes near a charged cloud.
- Radomes are made of electrical insulating material or non-conducting composites so that the electromagnetic wave can penetrate it freely and reach the radar.
- Radar and communication antennae are located at the nose, so, it is essential to protect the radome from adverse effects generated by lightning.

Lightning effects on radome surfaces

Results

- 2D image slice shows e-field intensification at the tip of solid diverter strip.
- E-field distribution along radome profile at altitude of 0.5 km and 45° flight angle.

Conclusions

- The flight angle of the aircraft has significant influence on the magnitude of the electric field at any given altitude.
- Aircraft positioned at 45° produces the highest value of electric field. In this case, the radome becomes the highest point compared to the other parts of the aircraft. Thus, the electric field is intensified in this area.
- The high magnitude spikes of electric field correspond to the diverter strips tip regions.
- Such field distribution ensures attachment of the lightning strike to the tip of the strip, and is expected to protect the radar installation from the lightning strike effectively.