

论文

基于FDTD的雷电脉冲对飞机介质舱体内干扰作用的研究

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摘要

该文提出一种利用时域有限差分计算雷电电磁脉冲对飞机碳纤维介质舱体内的干扰作用的分析方法。将雷电通道等效为垂直于无限大导体地面的线天线，利用天线场区划分的概念将雷电电磁场划分为近区场和远区场。在远场情况下，通过在舱体侧设置平面波源来分析雷电脉冲对舱内的干扰；在近场情况下，通过在舱体一侧设置延伸至完全匹配层(PML)，并与PML外金属边界相接的线电流来模拟一段雷电通道，有效避免了传统设置线电流时的静电积累效应，并分析近距离雷电对舱体的干扰。计算结果与解析结果吻合较好。分析解决了雷电脉冲的近场和远场情况下飞机碳纤维舱体内的电场分布及变化情况，为飞机介质舱体的电磁加固提供依据。

关键词 [雷电脉冲](#) [时域有限差分](#) [飞机舱体](#) [线电流](#) [平面波](#)

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A Research of Lightning Pulse Interference with the Medium Cabin in Airplane Based on FDTD

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Abstract

A method of analyzing the lightning pulse interference into the carbon fiber cabin in airplane is developed based on FDTD. The lightning channel is equivalent to be a linear antenna which is vertical on the conductor ground. Therefore the conception of antenna field partition is used to compartmentalize the lightning field. A plane-wave source can be set up beside cabin with FDTD to analyze far-field effect of lightning field. In near field region a segment of filamentary current which is extended into the Perfectly Matched Layer (PML) reaching the Perfectly Electric Conductor (PEC) boundary outside the PML is set up beside cabin to simulate a part of lightning channel using FDTD. This method avoids the charge effect at the two end-points of the linear current. The FDTD results are accurate compared with analytic results. And then the electric field in the cabin of airplane is calculated in near and far field region using this method, providing the warranty for electromagnetic compatibility design of the carbon fiber cabin.

Key words [Lightning pulse](#) [Finite-Difference Time-Domain \(FDTD\)](#) [Cabin of airplane](#) [Filamentary current](#) [Plane-wave](#)

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