

Evaluation of electromagnetic fields associated with inclined lightning channel using second order FDTD-hybrid methods

ABSTRACT

Evaluation of electromagnetic fields caused by the lightning channel is an appealing topic in order to consider the indirect effects of lightning on the power lines. A common assumption for the calculation of electromagnetic fields at the observation point is a vertical lightning channel, but the fact is that in reality the lightning channel is seldom vertical on the ground surface. In this study, the electromagnetic fields due to inclined lightning channel at various observation points with different angles and with respect to the image of lightning channel on the ground surface were explored. This study also proposes general equations that can estimate the electric fields due to inclined lightning channel through the 2nd FDTD method. The proposed method supports the notion of vertical lightning channel, while the channel angle, with respect to z-axis, is assumed to be zero. This method was validated through the data gathered from four fields: three at a close distance from inclined lightning channel and one at an intermediate distance from vertical lightning channel. Similarly, due to inclined lightning channel, the effects of geometrical and current parameters on the electromagnetic fields are considered. This study substantiates different coupling models with FDTD structure directly at the time domain without a need for extra converters.

Keyword: Lightning; Channel angle; Close distance; Coupling models; Current parameters; FDTD method