

# Severity of Lightning Return Strokes: Simulation Study and Review Notes

Kandasamy Chandrasekaran<sup>a</sup> and Gururaj S. Puneekar<sup>b Ψ</sup>

Department of Electrical Engineering, National Institute Technology, Karnataka, Surathkal, Srinivasnagar, Mangalore-575 025,  
Karnataka, India;

<sup>a</sup>E-mail: vrkchandran@yahoo.com

<sup>b</sup>E-mail: gururaj.puneekar@gmail.com

<sup>Ψ</sup> Corresponding Author

(Received 7 November 2012; Revised 25 February 2013; Accepted 4 June 2013)

**Abstract:** *The literatures on lightning stroke severity indicate that, magnitude of electric field peak due to first-return-stroke is nearly twice that of field peak due to subsequent return stroke. These reports are based on the data collected by lightning detection, information and field measurement systems. In this paper, all such field results from literature are summarised. These are then compared with the results obtained through simulation. Electromagnetic fields generated due to “typical” first (FS) and subsequent (SS) lightning return strokes have been computed using “Modified Transmission Line with Linear current decay” (MTLL) model. These simulation results are discussed, keeping in view, the field data reported in several recent literatures, which compare the severity of first and subsequent-return-strokes. MTLL based engineering model is adopted to compare the severity of lightning return strokes (FS/SS) as a function of radial distance. The effect of worst-case-ground-conductivity on this ratio is reported. MTLL model based comparison on em-field FS/SS ratio for both perfect and worst-case-ground conditions is also reported. These simulation results are compared with those of “Modified Transmission Line with Exponential current decay” (MTLE) model. In general, the present simulation results not only substantiate the fact that FS/SS ratio is nearly two times, but also assess few parameters responsible for low FS/SS ratio (reported in some cases). The present simulation analysis shows that the terrain electrical conductivity affects the FS/SS ratio. This may explain the cause for the low FS/SS ratios.*

**Keywords:** *Electromagnetic fields, First-return-strokes, Ground conductivity, Lightning, Stroke severity, Subsequent-return-stroke*