



## **The CIP analysis of electromagnetic field created by line current**

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Numerical analysis of electromagnetic (EM) field created by lightning discharge, especially return stroke, is very important to clarify the characteristics of lightning EM wave propagation. Because pulsive electric current produces EM field by Return stroke, we need the calculation method with no frequency dispersion in order to exactly solve the EM field propagation with little deformation of EM waveform. In this case a method whose dispersion error is as little as possible must be adopted. For this reason the authors have adopted the electromagnetic analysis using the Constrained Interpolation Profile (CIP) Method. This method is a new technique of time domain numerical analysis, which is proposed recently by Yabe et al. as a solution to overcome numerical errors due to numerical dispersion and oscillation. A salient feature of the CIP method is that not only the electromagnetic fields themselves but also their spatial derivatives are used. We calculated the EM field created by the simple line current model, as a preliminary investigation for the analysis of EM field created by return stroke. By comparing the CIP result, the FDTD result, and the theoretical result, we clarified that the CIP result closely resembles the theoretical result and that the phase error between the CIP result and the theoretical result does not appear. As a result, the field wavefront remains unchanged as it propagates. Moreover, the comparison between the FDTD method and the CIP one has indicated that the CIP method is better with regard to both the used computer memory and calculation accuracy than the FDTD method, which has widely used for electromagnetic analysis in recent years. This study has suggested the CIP method satisfies the condition to analyze EM field by lightning return stroke. We intend to investigate this EM field by the CIP analysis in the near future.