

# Transient Analysis of Telecommunication Cable Excited by External Field

Liu Suling, Gao Yougang, Shen Yuanmao

(School of Telecommunication Engineering, Beijing University of Posts and Telecommunication,  
Beijing ,China)

(E-mail: lsllgy-20001218@163.com)

**Abstract:** Cables in modern electronic systems serve to transmit power as well as signals throughout the system. So the cables in various system are important approach coupling the external electromagnetic field energy. Since the voltages caused by external field on cables can result in damages to either the power system, the electronic control and management system, the protection of the electronic systems resisting interference is very important.

In this paper, the multi-conductor transmission line (MTL) theory is used to calculate the transient response occurring on a telecommunication cable excited by a plane wave field as with a radio-frequency. Firstly, the influence on the voltages by external EM field is examined by the finite-difference time domain (FDTD) method. Secondly, in fact, a telecommunication cable consists of large numbers of individual wires that packed into bundles. However the analysis of transient response using MTL theory requires the knowledge of the per-unit-length parameters that become large in size and complex with the increasing of the wires number. It is known that a multiconductor line in which the currents and voltages induced by incident electromagnetic field are same distributed can be represented by an equivalent single-wire line. For a single-wire line, the parameters of the inductance and capacitance of per-unit-length are derived according to the voltages and currents of the cable, then the voltages and currents are computed with the equivalent single-wire line model. It can be seen that the simplified single-wire line shows a agreement with the other literature results. In order to analyze exactly and generally the effects on the voltages induced by the incident plane wave field, the influence on voltages by the cable length and electric parameter of the ground is discussed. It can be seen that the rise time of the response and the peak value of the induced voltages are almost same but the decade time is different according to the cable length, the cable is longer, the decade time is longer. The effect of electric parameter of the ground on induced voltages is computed by considered transient ground resistance. When considered the transient ground resistance, The results show that the transient ground resistance affect the response of the time, the rise time is short and the response time is delayed, the reason is discussed, at the same time.