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# Electromagnetic field modelling radiation through a lightning subsequent arcing back - approach analysis

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**Abstract**—several works had been carried out within the electromagnetic field modeling radiation through a lightning subsequent arcing back, the purpose of this paper is to cover a theoretical aspect survey related to the electromagnetic computation. This computation rests upon the current load dispatching and for performing this computation we have been induced to choose the current share starting from the lightning channel planned before hand to that effect a comparative analysis of a miscellaneous engineering models has been carried out, at that effect a comparative analysis of a miscellaneous engineering models has been carried out, at the end of this analysis the (MTL) model has been selected, the obtained outcome strengthened through the experimental process undergone in this respect , has revealed or showed that the analysis approach and the computing(data processing)tools used during their process turned out to be very satisfactory

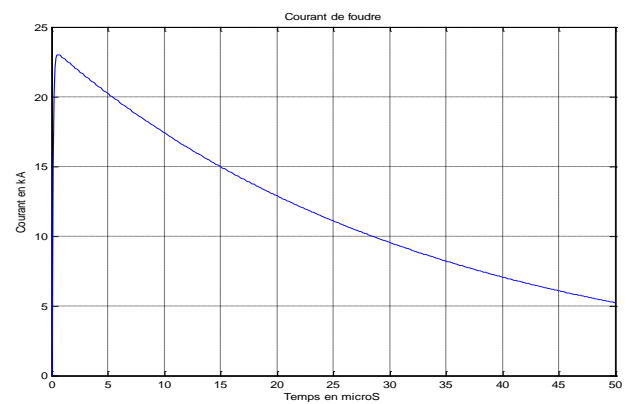
**Keywords**—*Electromagnetic, Lighting, Vertical electric field, Communication line pattern.*

## I. INTRODUCTION (HEADING 1)

Resorting to a digital tool for the CEM problem analysis became an increasing necessity so as one would have on reach a practical results starting from the models on pattern being step up beforehand. The electromagnetic field computation represents in that way on regarded of a great interest, the stake of such surveys is the implementation of the digital tools for the engineer in order to analyze the disturbance as consequence from this fields over electric system, this system are getting more and more vulnerable due to the electromagnetic alters. The lightning is an under tension phenomenon closely linked to the forming of the under tension clouds the stormy clouds there for the lightning is no more than expression or a mere expression of the storm. The two other expressions as dangerous as well, which are precipitation such as (rain, hail) and the wind. The lightning is very violent and short field discharge a kind of huge of a several kilon dashing across the atmospheric space.

## II. CUURENT MODELING HAVING ITS STARTING POINT

$$\text{Bi exponentiel : } i(t) = I \left[ \exp\left(-\frac{t}{T_1}\right) - \exp\left(-\frac{t}{T_2}\right) \right]$$

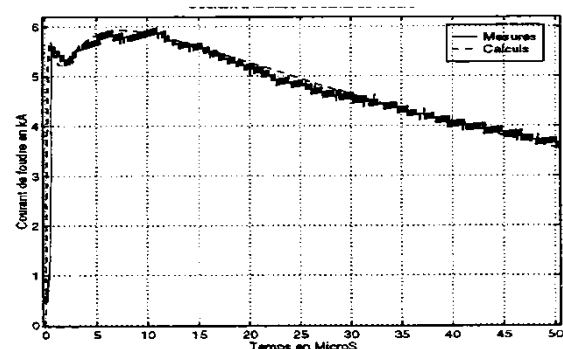


## III. CURRENT MODELLING HAVING ITS STARTING POINT FROM THE LIGHTNING CHANNEL

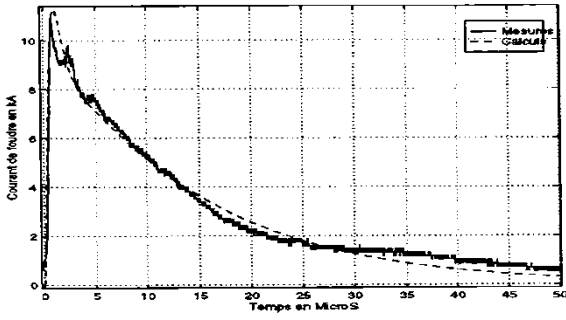
$$I(0, t) = i_1(t) + i_2(t)$$

$$i_1(t) = \frac{I_1}{\eta_1} \cdot \frac{(t / \tau_1)^{n_1}}{1 + (t / \tau_{11})^{n_1}} \exp(t / \tau_{12})$$

	I1	$\tau_{11}$	$\tau_{12}$	n1	I2	$\tau_{21}$	$\tau_{22}$	n2
Cas1	5.20 kA	0.2 $\mu$ S	1.2 $\mu$ S	2	5.55 kA	1.9 $\mu$ S	75 $\mu$ S	2
Cas2	10.5 kA	0.6 $\mu$ S	0.9 $\mu$ S	2	7 kA	1.4 $\mu$ S	14 $\mu$ S	2



Cas 2 (12089504.A2):



$$E_{Z_{ind}}(r, z, t) = \frac{1}{4\pi\epsilon_0} \int_{-H}^H \frac{2(z-z_c)^2 - r^2}{cR^4} i(z_c, t-R/c) dz_c$$

$$E_{Z_{ray}}(r, z, t) = \frac{1}{4\pi\epsilon_0} \int_{-H}^H \frac{r^2}{c^2 R^3} \cdot \frac{\partial}{\partial t} i(z_c, \tau - R/c) dz_c$$

**A. THE CURRENT LOAD DISPATCHING MODELING OF THE LIGHTNING CURRENT IN THE CHANNEL**

Model MTL (modified transmission line) :

Si  $zc < v \cdot t$   $i(zc, t) = \exp(\lambda/zc) \cdot i(0, t-zc/v)$   
 Si  $zc < v \cdot t$   $i(zc, t) = 0$   
 Si  $zc > H$   $i(zc, t) = 0$

Géométrie of problem:

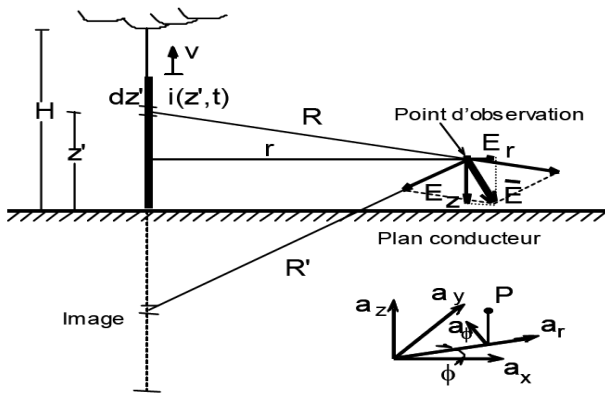


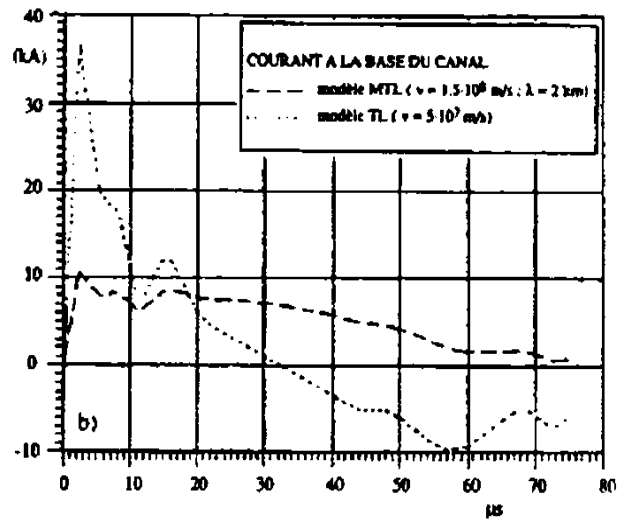
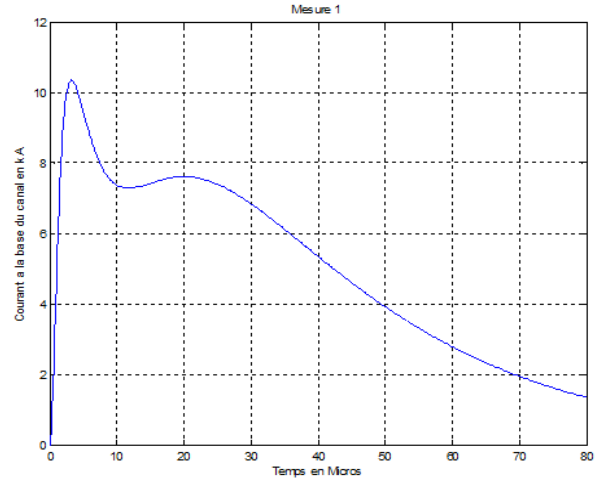
Fig.1 Lightning channel based current with the following parameter

Table 2

I1	$\tau_{11}$	$\tau_{12}$	n1	I2	$\tau_{21}$	$\tau_{22}$	n2
10,5kA	2	4,8 $\mu$ s	2	9 kA	20 $\mu$ s	26 $\mu$	2

As for the vertical under tension field EZ;

$$E_{Z_{el}}(r, z, t) = \frac{1}{4\pi\epsilon_0} \int_{-H}^H \frac{2(z-z_c)^2 - r^2}{R^5} \int_0^t i(z_c, \tau - R/c) d\tau dz_c$$



Comparing the both result shows a perfect agreement which, probate strongly the theoretical approach adopted by the channel based current.

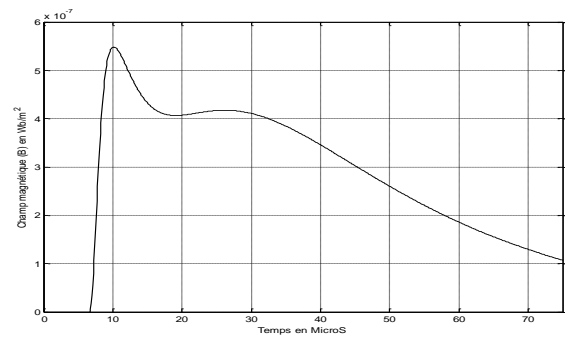


Fig. 4 the typical electric protections in a PV module

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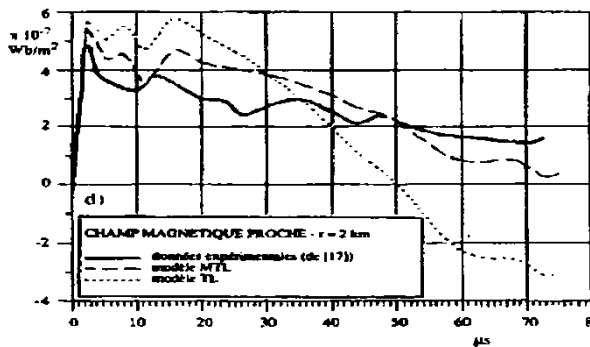


Fig.5 Expérimental curb

Azimuthal magnetic field 2km away from the impact point.

I1	$\tau_{11}$	$\tau_{12}$	n1	I2	$\tau_{21}$	$\tau_{22}$	n2
19,5kA	1 $\mu$ s	2 $\mu$ s	2	12 kA	8 $\mu$ s	30 $\mu$	2

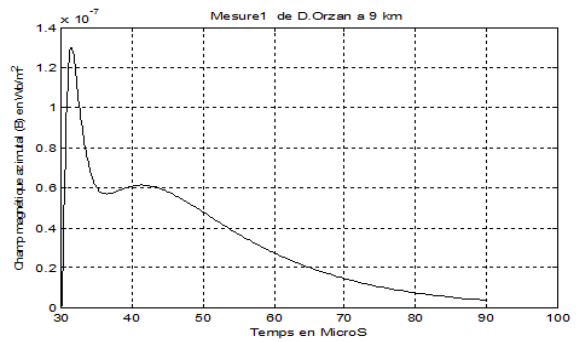


Fig.10 Curb got through a simulation

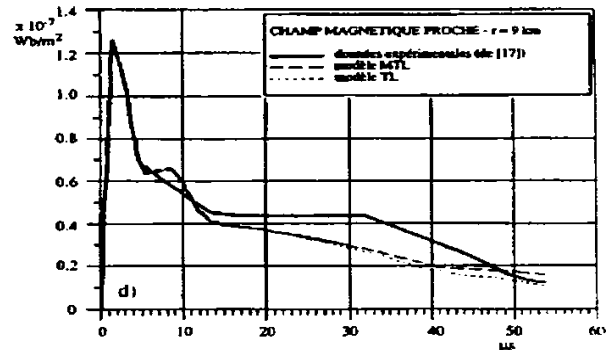


Fig.11 Experimental curb

The azimuthal magnet field 9 Km away from the impact point

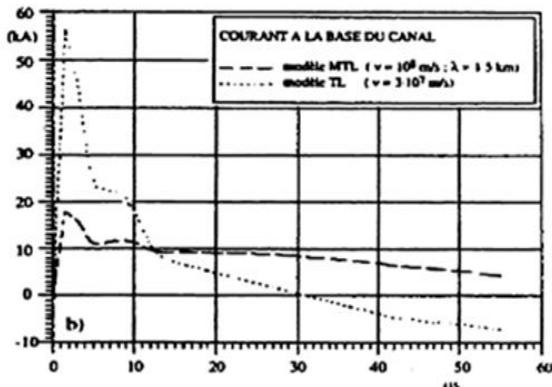
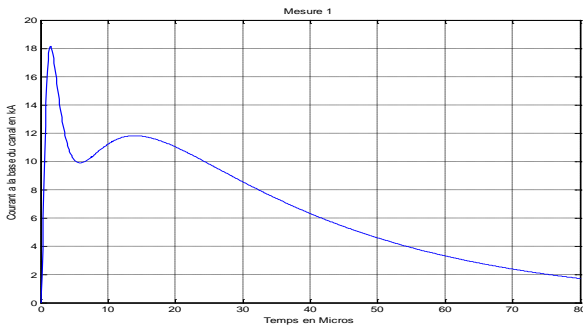


Fig.9 Experimental curb

As compared, these both results reveals a prefect agreement which leads directly to the authentication of the theoretical approach taken up by the channel based current in the following diagrams we represent respectively the speed of the computed azimuthal magnet field and being measured away from the impact point equalling batch result show a perfect agreement especially what matters the first peak.

## CONCLUSION

The parameters have been used throughout the simulations, these are listed below. The conclusion to the paper, we have studied the radiated electromagnetic field calculation through a stroke of a lighting arcing back phase, has been carried out successfully, the implementation of the process data computing of this calculation had been archived thanks to a simulated program ender MATLAB background which provides an inducing friendly senses access to the user, as for the obtained results could encorage to consider the overvoltage calculation resulting from that process through an electromagnetic coupling in the energy converged line

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