

XSICEL 2021

Transición energética en la 4ta revolución industrial



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Characteristics of the Initial Breakdown Pulses in Negative Cloud-to-Ground Flashes Occurred in the Central Region of Colombia

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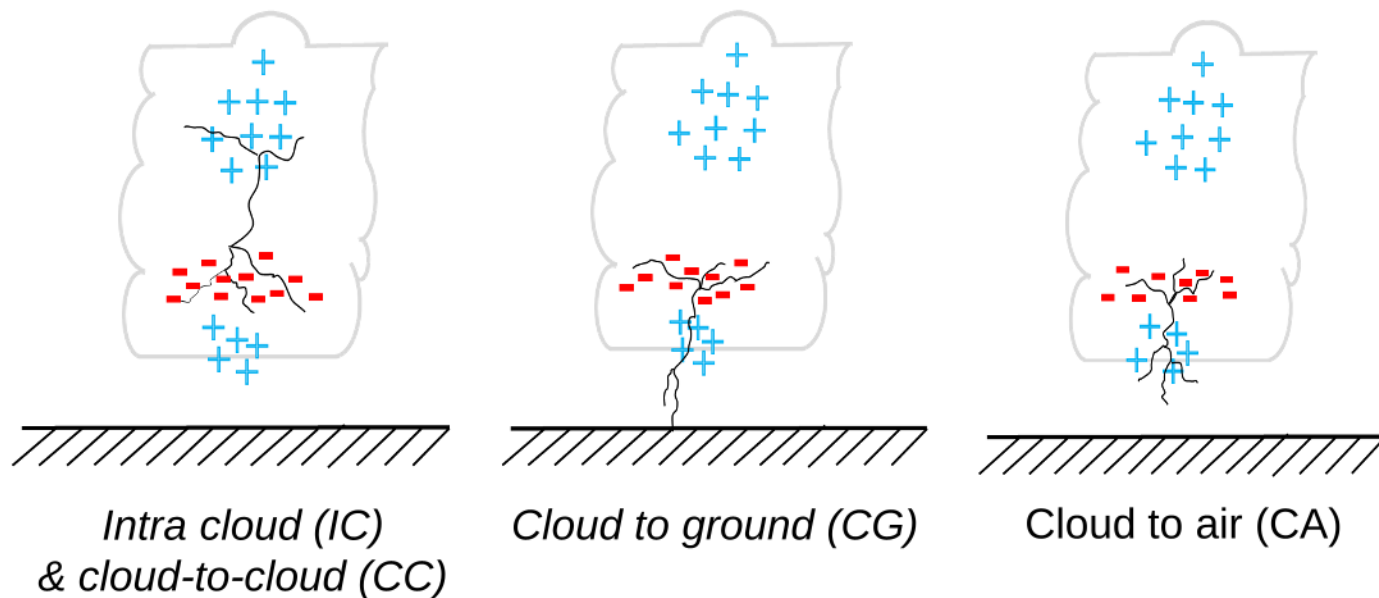
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I. Introduction

- A lightning flash is a transient discharge of high intensity with an extension measured in kilometers
- This meteorological phenomenon usually is produced by electric charge centers separated in thunderclouds
- Lightning flashes are usually categorized as:
 1. Intra cloud (IC)
 2. Cloud to cloud (CC)
 3. Cloud to ground (CG)
 4. Cloud to air and cloud to ionosphere



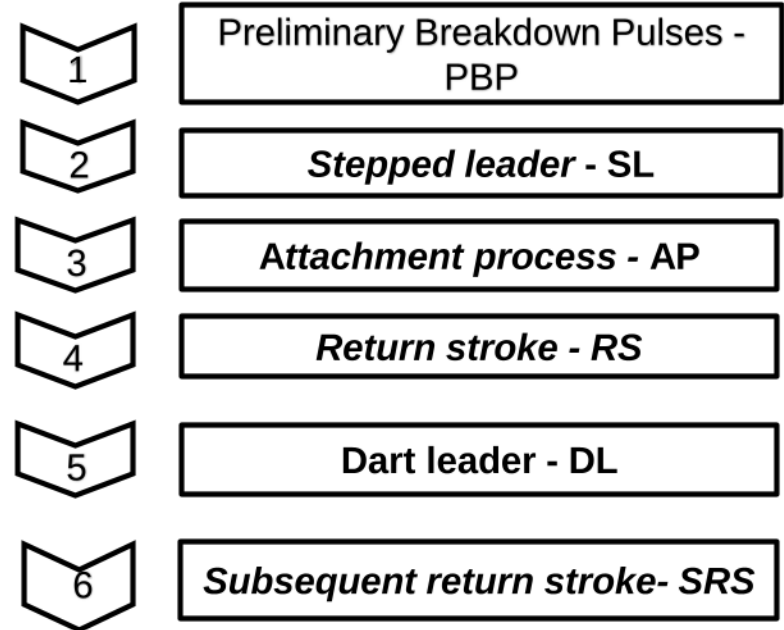
I. Introduction



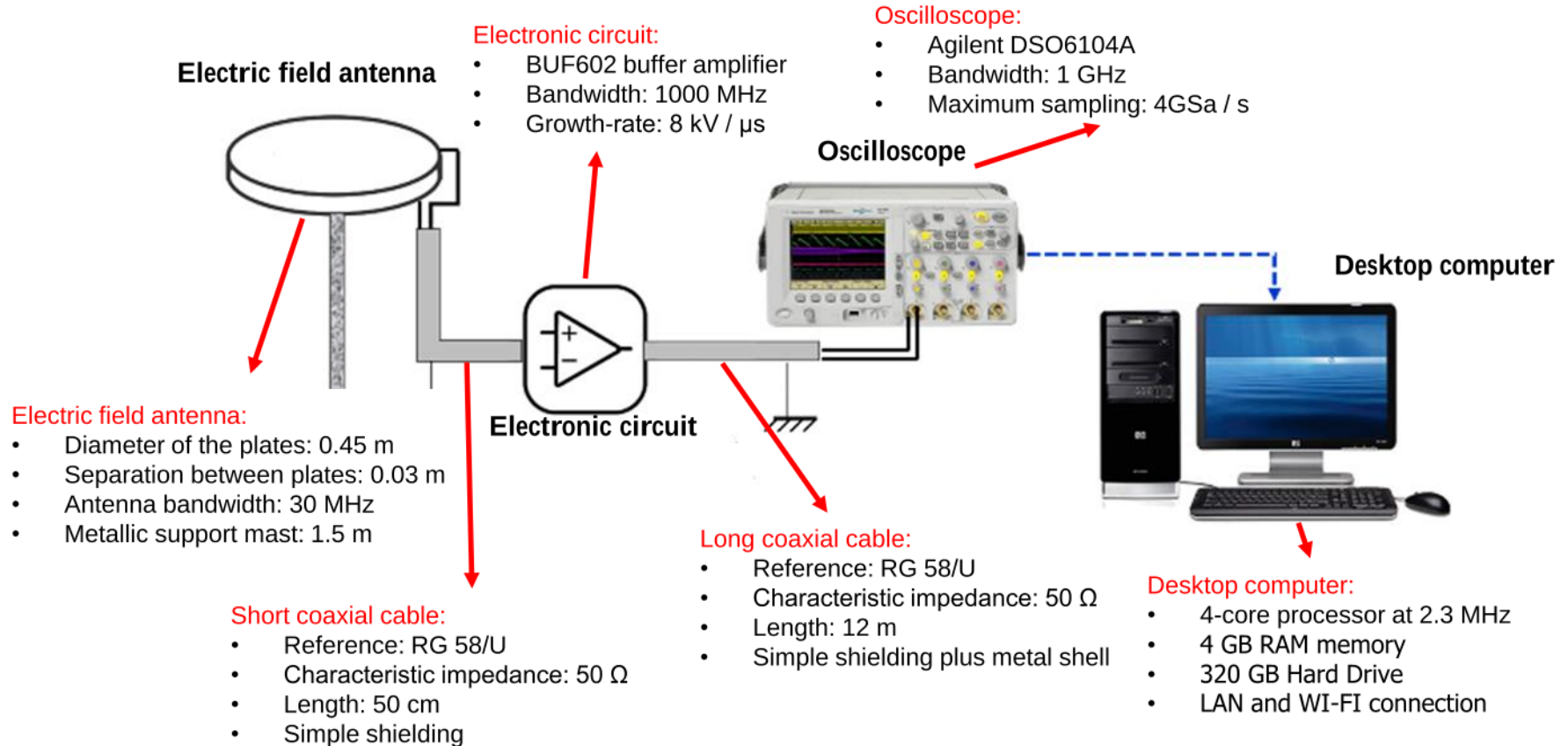
I. Introduction



Stages of a CG Lightning flash



II. Theoretical aspects

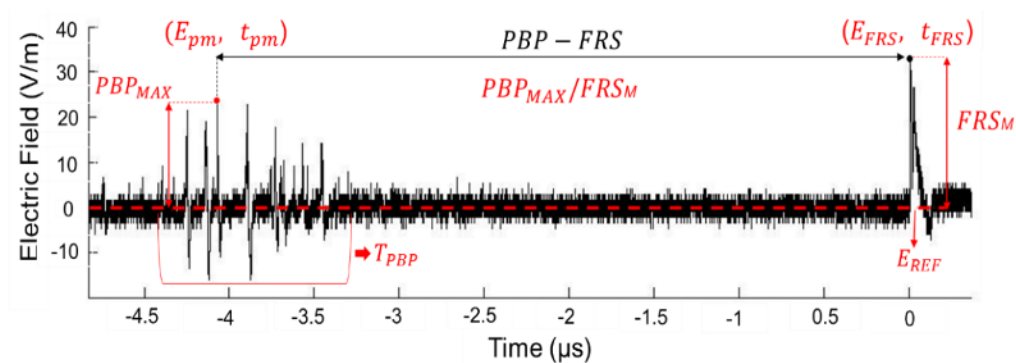
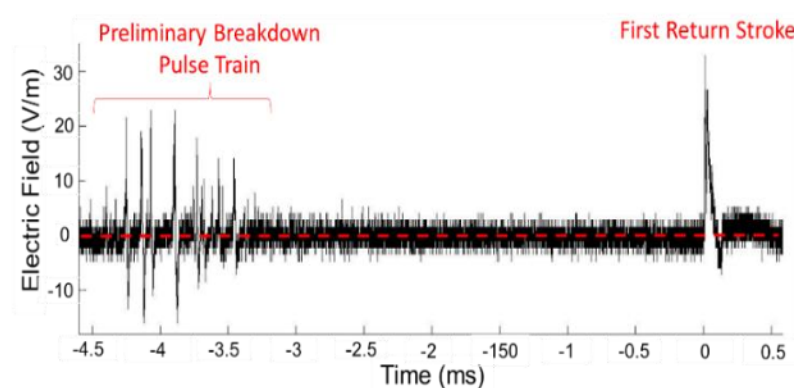
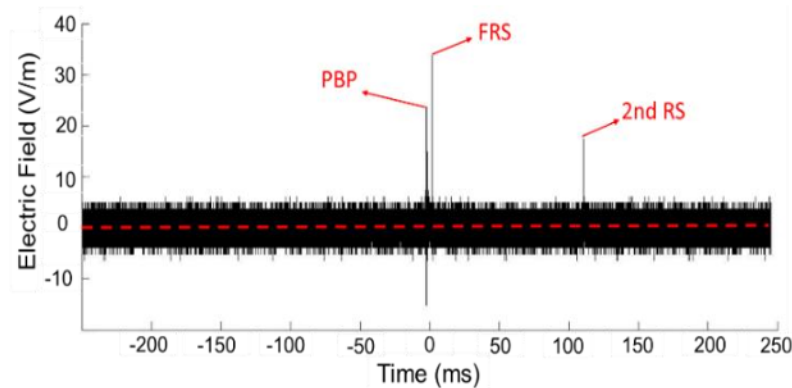


III. Proposed methodology

- a) Only pulses with amplitude larger than twice the average noise level were included
- b) The individual pulses considered inside a PBP train where those separated by less than 2 ms between them
- c) Only pulse trains with at least three individual pulses were analyzed

- (a) The time between the first and the last detectable pulse (T_{PBP})
- (b) The time interval between the largest peak of the PBP train and the maximum value of the FRS ($PBP - FRS$ interval)
- (c) The ratio between the peak value of the PBP train and its FRS (PBP_{max}/FRS ratio)
- (d) Number of pulses contained in the train (No. pulses)

III. Proposed methodology



III. Proposed methodology

Number of samples (N)

Minimum Value (Min)

Geometric Mean (GM)

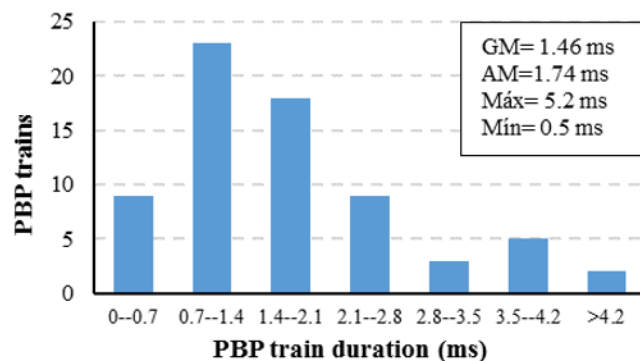
Maximum Value (Max)

Arithmetic Mean (AM)

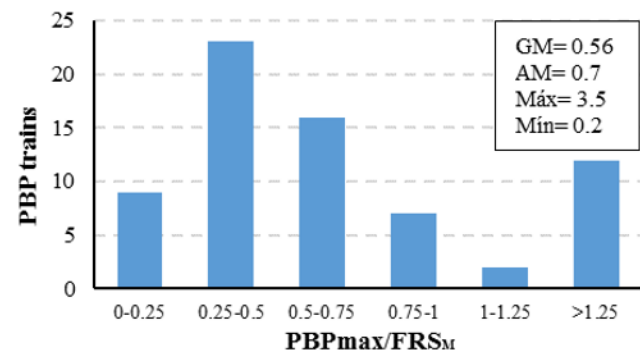
Parameter	N°	Min	Max	AM	GM
TPBP (ms)	69	0.5	5.2	1.74	1.46
PBP-FRS (ms)	69	0.7	298.6	35.67	10.24
PBPmax/FRS	69	0.2	3.5	0.70	0.56
Pulses per train	1019	3	44	14.77	11.85
IPT (μ s)	950	2.3	1950	125.68	74.26
TPULSE (μ s)	1019	1	83.8	17.19	11.86

STATISTICAL RESULTS OF PBP TRAINS

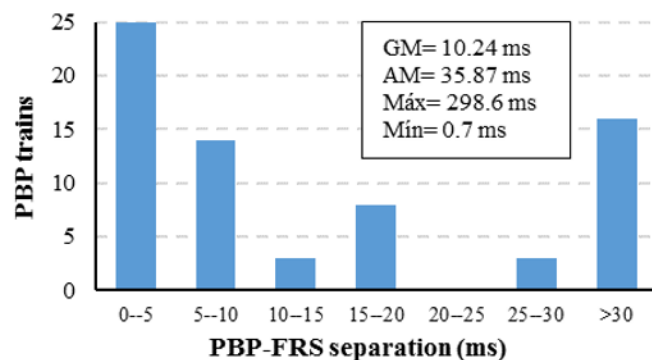
IV. Results



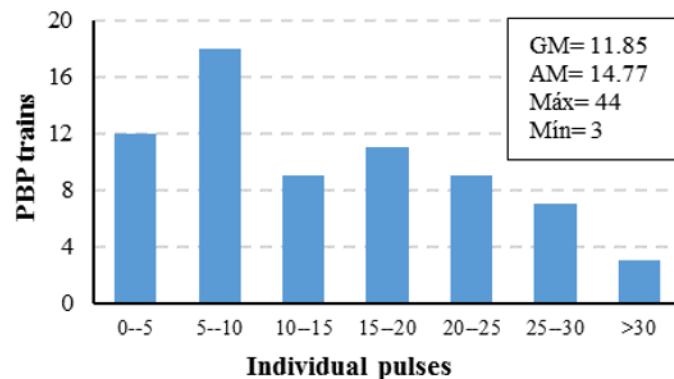
Distribution of the PBP train duration



Distribution of the PBP/FRS ratio

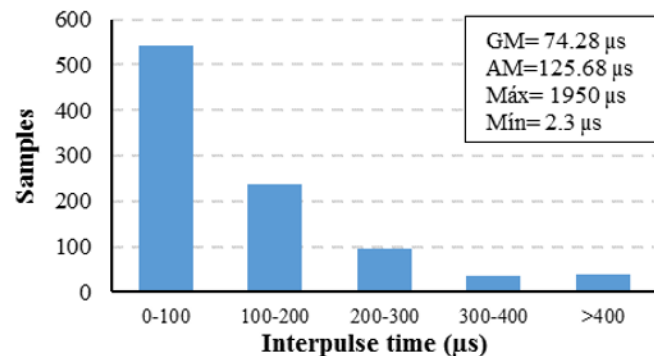


Distribution of the PBP-FRS separation

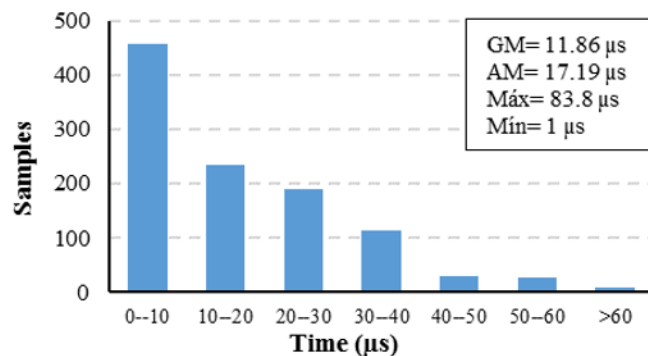


Distribution of individual pulses per train

IV. Results



1. Distribution of time interpulse (IPT)



Distribution of individual pulse duration

V. Conclusions

The analysis and characterization of 69 electric field signatures produced by PBP trains preceding the FRS in negative CG lightning flashes was performed. The waveform of 1019 pulses were analyzed and the following characteristics were found:

- (a) bipolar pulses at the beginning and in the middle of the train
- (b) unipolar pulses at the end of the signatures
- (c) the PBP train starts with small pulses, continues with pulses of greater amplitude, and ends with pulses of lower magnitude
- (d) the initial polarity (bipolar pulses) of the pulses is similar than the FRS

The statistic results show that the duration of the pulse trains has an arithmetic mean of about 1.7 ms, with individual values from 0.5 up to 5.2 ms (maximum and minimum values). On the other hand, the temporal parameter PBP-FRS presents an AM of 35.87 ms, with maximum and minimum values of 0.7 and 298.6 ms, respectively.

V. Conclusions

The time interpulse and the individual pulse duration showed an AM of 125.68 μs and 17.19 μs , whit geometric mean of 74.3 μs and 11.9 μs , respectively. The magnitude ratio PBP_{MAX}/FRSM has a GM of 0.56 and individual values from 0.2 up to 3.5. Finally, the number of pulses per train presents an AM and GM of 14.7 and 11.8 respectively, with maximum and minimum values of 3 to 44 pulses per PBP train.

Future works should be oriented to compare these results with those obtained in other regions (tropical, subtropical and temperate locations)

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Thanks !!!

¿Questions?

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