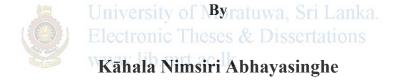
Lightning Warning System Based on Slow Field and Fast Transient Variations, Suitable for Oceanic Tropics



Thesis submitted in partial fulfillment of the requirements of the degree of Master in Science of the University of Moratuwa

August 2007

DECLARATION

"I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university and to the best of my knowledge and belief it does not contain any material previously published or written or orally communicated by another person except where due reference is made in the text or in the figure captions or in the table captions".

	Signature of the candidate
To the best of our knowledge the above part	iculars are true and accurate.
Name of Supervisor	<u>Signature</u>
Dr. E. C. Kulasekara, Department of Ele	etronic and Sri Lanka.
Telecommunication Engineering, Univ	ses & Dissertations versity of
Moratuwa, Moratuwa, Sri Lanka.	
Dr. G. A. C. Gomes, Department of Physics	, University
of Colombo, Colombo, Sri Lanka.	

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LIST OF ABBRIVIATIONS

Abbreviation Description

ac Alternating current

AM Amplitude modulation

DSO Digital storage oscilloscope

EM Electromagnetic

GPS Global positioning system

HF High frequency

IMPATS Improved accuracy using combined technology

LDS Lightning detection systems

LED Light emitting diode

LF Low frequency

LPATS Lightning position and tracking system

MDF Method of direction finding

MF Medium frequency

RMSE Root mean square error

SAFIR Systeme de surveillance et d'alerte foudre par interferometrie

radioelectriqu

SSE Sum of square error

TOA Time of arrival

UHF Ultra high frequency
ULF Ultra low frequency

VHF Very high frequency

ABSTRACT

Lightning causes a lot of property and human damage all over Sri Lanka. It has been a major requirement to develop a low cost lightning warning system.

The environmental vertical static electric field changes from 0.1 kVm⁻¹ under fair weather conditions to extreme values like 10 kVm⁻¹ under thunderstorm conditions. Also, lightning discharges generate electromagnetic radiation from ultra low frequency (ULF) through ultra high frequency (UHF) with peak energy emission at 10 kHz.

The work discussed in this thesis uses both the static field variation and the electromagnetic radiation emitted by lightning discharges to predict a thunderstorm. A portable transient detector using an envelope detector tuned to 1600 kHz is used to detect electromagnetic radiation emitted by lightning discharges. An operational amplifier circuit having a slow response with a horizontal plate antenna is used to detect the static field variation. Final decision is made by a third circuit and three levels of alarms are released accordingly.

Using the transient detector only, a warning can be released 25 minutes before the close by thunderstorm with 95% level of confidence. With the entire system, the confidence of the warning further increases.

The cost of the transient detector is about 2500 Sri Lankan rupees with a rechargeable battery bank. The entire system with a battery backup costs about 5000 Sri Lankan rupees.

According to the observations made by the transient detector the delay between cloud flashes and ground flashes shows a distribution of the form of a fractional function with a maximm at 27.52 minutes.

The newly designed lightning warning system shows an acceptable grade of performance with its low cost.