



Article

The Physical Experimental Modelling of the Formation Processes of Upward Discharges from Grounded Objects in the Artificial Thunderstorm Cell's Electric Field

Nikolay Lysov ^{*}, Alexander Temnikov, Leonid Chernensky, Alexander Orlov, Olga Belova, Tatiana Kivshar, Dmitry Kovalev, Garry Mirzabekyan, Natalia Lebedeva and Vadim Voevodin

Department of Electrophysics and High Voltage Technique, Moscow Power Engineering Institute, National Research University, 111250 Moscow, Russia

^{*} Correspondence: lysovny@mspe.i.ru; Tel.: +7-91-6845-6253

Abstract: The results of the physical modelling of the formation processes of upward discharges from grounded objects in the artificial thunderstorm cell's electric field are presented. We established the considerable influence of the electrode tip's radius on the pulse streamer corona stem's parameters and, subsequently, on the probability of the transformation of the impulse streamer corona first flash's stem into a first stage of upward leader. We determined the diapason of the optimal tip radii for a lightning rod or lightning conductor, which allows for the most probable formation of the first impulse streamer corona, with the parameters providing the best conditions for the upward leader's start, the purpose of which is the lowering of the probability of lightning striking the object under protection. A considerable difference between the electrical characteristics of the first impulse corona flash with and without the streamer-leader transition was established. It was shown that the amplitude of the streamer corona flash current impulse is considerable, but not the main defining factor of the streamer-leader transition. It is established that the charge value of the streamer corona first flash is not a threshold requirement for the formation of the upward leader from a ground object, but only defines the probability of the successful upward leader formation. Based on the analysis of the experimental data received, we suggest that there is a dependency between the probability of upward positive leader formation from the grounded objects and the charge value of the first pulse streamer corona flash for the rod (centered) and rope (elongated) lightning conductors and objects in the electric field of the thundercloud and downward lightning leader. The obtained results can be used for mathematical modelling of the formation processes of upward discharges from grounded objects in the artificial thunderstorm's electric field, as in a natural thunderstorm situation.

Keywords: lightning; upward discharges; artificial thunderstorm cell; physical simulation; first impulse streamer corona flash; stem; streamer-leader transition; model lightning rod and lightning conductor; probabilistic criterium



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1. Introduction

Despite the obvious successes in solving lightning protection problems and researching lightning physics, presently we are still facing some considerable and relevant fundamental and practical problems in the physics of lightning formation, lightning striking grounded objects, and ensuring their reliable lightning protection [1–5]. The reason for this is the increasing technical functionality and complexity of the grounded objects, which, in turn, leads to increased requirements for their lightning protection systems.

More specifically, the research is focused on the formation processes of upward discharges from grounded objects and lightning rods (conductors), which generally determine the probability of lightning striking a grounded object and the efficacy of its lightning protection, as well as how the regulatory documents and calculation methods used in the lightning protection industry can be perfected [1,2,4–9]. Modelling of upward leader

Experimental Modelling In Engineering

Tobias Bleicker

A decorative graphic element consisting of a light blue horizontal bar with a rounded right end, and a red circular glow behind it.

Experimental Modelling In Engineering:

Experimental Modelling in Engineering F. W. David, H. Nolle, 2013-10-22 Experimental Modelling in Engineering presents the principles of experimental modeling methodically and in such a generalized manner that they may lend themselves to application in practically all fields of technology The book covers related topics such as modeling based on conditions of similarity units and dimensions the applications of homogeneity and dimensionally homogenous equations in the field and the selection of variables in dimensional analysis Also covered in the book are topics such as the use of models in experiments the principle of similarity examples in experimental modeling and problems in dimensional analysis and model design The text is recommended for engineers who would like to know more about the principles concepts behind experimental modeling as well as its applications in engineering and other related fields

Design and Modeling for Computer Experiments Kai-Tai Fang, Runze Li, Agus Sudjianto, 2006 Emphasizing a practical approach Design and Modeling for Computer Experiments provides useful techniques for statisticians engineers and scientists to apply the methodologies presented

Concurrent Engineering Approaches for Sustainable Product Development in a Multi-Disciplinary Environment Josip Stjepandić, Georg Rock, Cees Bil, 2012-08-10 The CE Conference series is organized annually by the International Society for Productivity Enhancement ISPE and constitutes an important forum for international scientific exchange on concurrent and collaborative enterprise engineering These international conferences attract a significant number of researchers industrialists and students as well as government representatives who are interested in the recent advances in concurrent engineering research and applications Concurrent Engineering Approaches for Sustainable Product Development in a Multi-Disciplinary Environment Proceedings of the 19th ISPE International Conference on Concurrent Engineering contains papers accepted peer reviewed and presented at the annual conference held at the University of Applied Sciences in Trier Germany from 3rd 7th of September 2012 This covers a wide range of cutting edge topics including Systems Engineering and Innovation Design for Sustainability Knowledge Engineering and Management Managing product variety Product Life Cycle Management and Service Engineering Value Engineering

Identification of Parametric Models Eric Walter, Luc Pronzato, 1997-01-14 The presentation of a coherent methodology for the estimation of the parameters of mathematical models from experimental data is examined in this volume Many topics are covered including the choice of the structure of the mathematical model the choice of a performance criterion to compare models the optimization of this performance criterion the evaluation of the uncertainty in the estimated parameters the design of experiments so as to get the most relevant data and the critical analysis of results There are also several features unique to the work such as an up to date presentation of the methodology for testing models for identifiability and distinguishability and a comprehensive treatment of parametric optimization which includes greater consideration of numerical aspects and which examines recursive and non recursive methods for linear and nonlinear models

Hydraulic and Civil Engineering Technology VIII Mijia

Yang, Pijush Samui, João C.G. Lanzinha, Jianhui Hu, 2023-12-15 All of us are dependent on a built environment constructed and maintained by civil and hydraulic engineers and for those working in these fields keeping up to date with the latest technological developments is vital for the safe and efficient design and operation of this infrastructure This book presents the proceedings of HCET 2023 the 8th International Technical Conference on Frontiers of Hydraulic and Civil Engineering Technology held from 25-27 September 2023 in Wuhan China HCET is an international conference which aims to enhance the development of hydraulic and civil engineering in China with a focus on high end intelligent and green technologies It seeks to do this by consolidating global wisdom and achievements and providing scientific support HCET also offers an excellent opportunity for scientists researchers and engineers from around the world to exchange their findings and discuss developments establishing a basis for national and international collaboration A total of 316 contributions were received for the 2023 edition of which 187 were ultimately accepted after a rigorous review process and checks for quality and plagiarism Topics covered include the research and development of concrete structure design and analysis structural mechanics and structural engineering building and future materials hydraulic engineering geological exploration and earthquake engineering building technology urban planning road bridge and traffic engineering energy infrastructure environmental engineering and advanced engineering technologies and interdisciplinary sciences and applications Covering a wide range of subjects related to hydraulic engineering and civil engineering technology and associated transdisciplinary sciences the book will be of interest to all those working in the field

Engineering Experiment Station Series University of Wisconsin.
Engineering Experiment Station, 1908 *Cassier's Engineering Monthly*, 1911 **Oil Field Engineering**, 1916
Shipbuilding & Marine Engineering International, 1922 *International Journal of Engineering Research in Africa* Vol. 74 Akii Okonigbon Akaehomen Ibadode, 2025-06-02 The 74th volume of the journal contains articles that present research results and engineering solutions in materials science biogas upgrading techniques green building materials grey water treatment and solar water pumping orthogonal simulation test for evaluating fretting wear in low speed diesel engine connecting rods and the development of a control system for a waste to energy thermal power plant This edition will be helpful to a wide range of engineers from various industrial branches **Engineering Production**, 1920 *International Marine Engineering*, 1916 *Radio & Model Engineering*, 1928 Engineering News and American Contract Journal, 1904
Transactions of the International Engineering Congress, 1916 Transactions of the International Engineering Congress, 1915, 1916 *Marine Engineering/Log*, 1898 **Engineering**, 1926 *The Model Engineer and Amateur Electrician*, 1905 *Mechanical Engineering* American Society of Mechanical Engineers, 1921 History of the American society of mechanical engineers Preliminary report of the committee on Society history issued from time to time beginning with v 30 Feb 1908

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