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Editorial

Lightning Protection

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Lightning causes deaths, injuries, damages, and significant costs and losses around the world. The global lightning flash rate is in the range of 40 to 100 lightning flashes per second, of which about 30 % are cloud-to-ground flashes. The development of theoretical and experimental researches is crucial for a better understanding of the physical phenomenon and for the characterization of lightning parameters, as well as for the development of more effective methods for lightning protection of structures and systems.

Power transmission and distribution lines are often located in areas with high ground flash densities, being therefore subject to lightning-caused power interruptions. In recent years, the growing use of sensitive electronic devices and the increasing demand of utility customers for stability of the power supply have stressed the importance of improving the reliability and power quality levels of electric systems. As lightning is a major source of faults on overhead lines and damages to or malfunction of sensitive electronic equipment, it is essential to evaluate the lightning electromagnetic environment in order to mitigate its effects and improve the power system quality.

This special Hot Topic Issue of the *Journal of Lightning Research* focus on research in the area of lightning protection and consists of 6 articles from great specialists in the field, with the aim to present results of recent and interesting investigations related to lightning interaction with structures and electrical power systems.

The paper by Rakov gives a review of lightning protection concepts introduced by Benjamin Franklin and James Clerk Maxwell and discusses modern approaches to lightning protection of various structures and systems. In particular, the widely used Electrogeometrical Model and the topological shielding are presented. Bonding requirements, needed to avoid side flashes, are discussed. Lightning parameters important for lightning protection, including recent direct measurements of peak currents, are reviewed. Cooray and Zitnik present theoretical and experimental analyzes to understand the way in which the striking distance and the lightning performance of a tower changes when an array of corona-producing needles is placed at its top. The results of the investigation clarify whether the space charge generated by a network of needles is capable of screening a structure to such an extent so as to protect it from a lightning strike. In the paper by Maslowski *et al.,* the topic of stroke current distribution in the case of direct strikes to the lightning protection system (LPS) of buildings is addressed. Experiments on structures simulating residential buildings were carried out in Florida and in Poland using rocket-triggered lightning and a mobile current surge generator, respectively, for different soil conditions and LPS configurations. The results of experiments and numerical modeling of lightning current distribution in the LPS and in the electrical circuit of the two test structures are presented and discussed.

The papers by Disyadej and Grzybowski, Harid *et al.,* and He *et al.* focus on topics related to the lightning performance of power lines. Disyadej and Grzybowski present a detailed description of the background problem of the lightning attractive width and the analysis of the experimental results performed on a 1:100 scale model considering different transmission line models. The effects of overhead ground wires, phase conductors, and the magnitude and polarity of the stroke current are evaluated and, based on the experimental results, new expressions are proposed for the attractive width of transmission lines. Harid *et al.* report the results of an experimental investigation on the impulse characteristics of transmission line tower footings. The ground potential distribution both at the ground surface and below ground is examined under impulse currents and variable-frequency AC currents, and prospective impulse step and touch voltages are determined by measurement of the ground surface potential distribution near the tower base. The non-linear behavior of the impulse impedance of the tower footings under high-magnitude impulse currents is investigated and used to describe the dynamics of soil ionization. He *et al.* deal with lightning induced overvoltages, a subject of great importance for power distribution lines. The paper proposes a subgridding FDTD algorithm for solving the Agrawal *et al.* coupling equations using different temporal and spatial steps on different line branches, thus avoiding long computation times. The two sections adjacent to the branch node are partitioned into a fine grid, while the other part of the line is partitioned into a coarse grid. The method is used to

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§Guest Editor

calculate lightning induced voltages on overhead lines with gapped surge arresters.

In summary, this special issue provides six very interesting papers presenting recent theoretical and experimental developments addressing topics of great importance, and I hope it stimulates further advancements in the field of lightning protection.

I would like to thank all the authors for their contributions, the reviewers for their valuable comments, and the Editor in Chief of the *Journal of Lightning Research* for his kind invitation to act as Guest Editor for this special issue.