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Editorial

High-Voltage Engineering and Applications in Our Modern Society

Issouf Fofana [1,*] and Bo Zhang [2]

[1] Modelling and Diagnostic of Electrical Power Network Equipment Laboratory (MODELE), Department of Applied Sciences, Université du Québec à Chicoutimi, Chicoutimi, QC G7H 2B1, Canada
[2] Department Electrical Engineering, Tsinghua University, Beijing 100084, China
* Correspondence: ifofana@uqac.ca

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1. Introduction

Electrical energy is polymorphic, with voltage levels varying between a few volts to MVs and frequencies from a few Hz to MHz. This variability offers flexibility of use. For engineering applications, the choices of electrical parameters are dictated by technical and/or economic criteria. For example:

- In aviation, frequencies from 400 Hz to a few kHz are used.
- Energies produced at power stations are increased to kV levels with the step-up transformers to reduce Joule losses in long-distance transportations [1,2]. Consequently, many AC–DC transmission line projects up to 1200 kV have been constructed or are under way in many countries [3–15]. The application of high voltage in electrical power transmission is the most common, but electrical engineers also use this know-how in many other fields (e.g., [15–21]). Table 1 lists some of the main applications.

Table 1. A few of the main fields of high-voltage applications.

Field	Applications
AC and DC transmission grids	Transmission lines, cables insulators, instrument transformers, distribution/power transformers, generators, reactors, circuit breakers, disconnectors, surge arresters, capacitors, rectifiers, gas-insulated switchgears (GIS), substations, groundings, electromagnetic compatibility, etc.
Lightning	Danger of explosion and fire, disturbances of sensitive electronics, lightning capture, protection against lightning (lightning rod, spark gaps, lightning arrester, ground wire), aviation, etc.
Geomagnetic disturbances	Protection of transmission lines, antenna protection, protection of electronic devices, armored cages, etc.
Electronics	Cathode ray tube, piezoelectric generators, electric ignition, electronic flash, discharge lamps, UV bacteriological filter, etc.
Physics	Electronic microscopy, particle accelerators, laser printers, electromagnetic induction, etc.
Medicine	Biological effects of electric fields, X-ray diagnosis, X-ray therapy, ozone therapy, dielectrophoresis, heaters, etc.
Agro-food	Elimination of bacteria using high-voltage pulses (electroporation), plant growth, etc.
Aerospace and defense applications	Taser, lighting, laser weapons, all-electric aircraft, unmanned aerial vehicles (UAVs), light tactical vehicles, etc.
Materials processing	Treatment of water, sludge, medical waste, cleaning of gas pipes, melting by inertial confinement, treatment of nuclear waste, etc.
Mining engineering	Selective fragmentation of minerals using high-voltage pulses, etc.
Static electrification	Electrostatic generators, electrostatic motors, electrostatic filters, xerocopy, electrostatic printers, electrostatic paint, etc.

This Special Issue, in its final form, focuses the theoretical and practical developments in high-voltage engineering and applications pertaining to electrical engineering.

2. An Outlook of the Special Issue

The 2020 IEEE International Conference on High-Voltage Engineering and Application (ICHVE 2020) was organized by the by Tsinghua University, Beijing (China), and endorsed by the IEEE Dielectrics and Electrical Insulation Society (DEIS). The conference, chaired by Prof. Jinliang He, was held in Beijing, China, from September 6–10, 2020. It was the seventh of a series of successful conferences after Chongqing, China, in 2008; New Orleans, USA, in 2010; Shanghai, China, in 2012; Poznan, Poland in 2014; Chengdu, China, in 2016, and Athens, Greece, in 2018. This conference attracted a great deal of attention from international researchers in the field of high-voltage engineering. It not only provided an excellent platform to share knowledge and experiences on high-voltage engineering, but it also provided the opportunity to present the latest achievements in power engineering, including topics of ultra-high voltage, smart grids, new insulation materials, and their dielectric properties. Due to the impact of the COVID-19 pandemic, this event was held online for the first time. However, it is worthwhile to mention that this conference was by far the largest international one on high-voltage engineering. The conference received 1132 abstracts. Since the pandemic affected some research activities, 730 full texts were received, and 695 papers were finally accepted after review processes by the conference. More than 5000 experts, scholars, and graduate students from all over the world from 20 different countries had the opportunity to attend 52 oral sessions (including 3 keynote speeches and 23 invited speeches), along with 13 open forums through the online platforms Zoom, Weibo, and Bilibili and the opportunity to become acquainted with the trends in high-voltage research. The main research areas covered by the conference papers are shown in Figure 1, which provides a graphical overview of the proportion of papers on each topic.

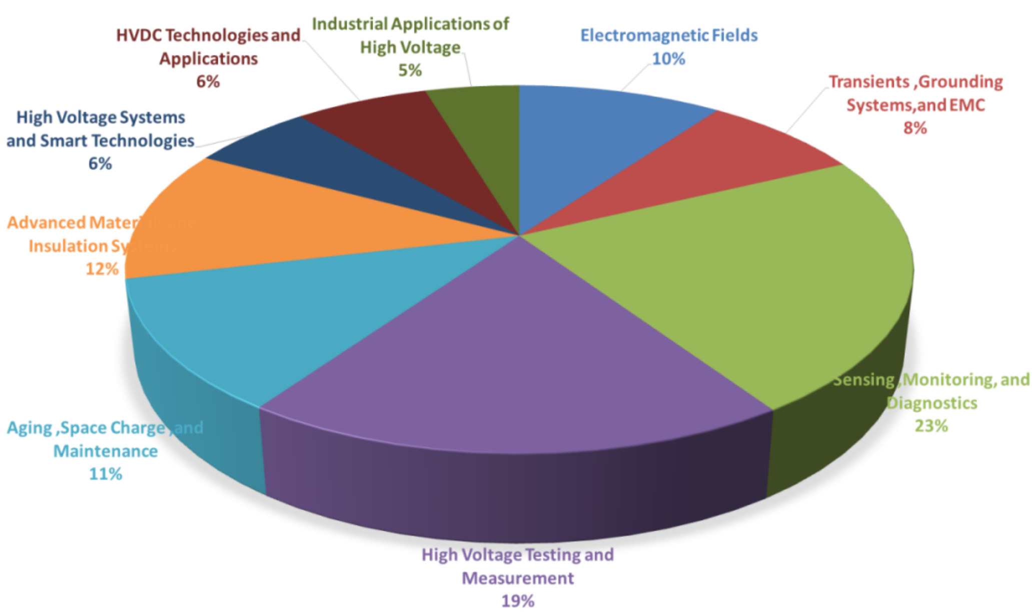

Figure 1. Proportion of papers by topics.

The conference also announced the two winners of the 2020 IEEE Sun Caixin–Stan Gezbosky Awards. Recipients are outstanding researchers recognized for their important contributions to the field of high-voltage engineering. Professor Xingliang Jiang from Chongqing University was the winner of the Lifetime Achievement Award, and Dr. Chuanyang Li from the University of Connecticut was the winner of Young-Professional Achievement Award. Both gave lectures. The conference also selected the 10 best student papers.

This Special Issue includes sixteen (16) high-quality papers presented during the 2020 IEEE International Conference on High-Voltage Engineering and Application (ICHVE 2020) spanning the above research areas. The papers were enriched with additional research outcomes, and the number of submitted papers increased in size by 50% compared to the original conference. The Special Issue was welcomed with great interest, as ICHVE attracts recent advancements in all fields of high-voltage engineering and applications. The editors would like to thank all contributors to this Special Issue.

3. Closing Remarks

The papers published in this Special Issue report on the progress made in various high-voltage applications. A mix of experimental and modelling/simulation investigations are reported. The outcomes will doubtlessly contribute to improving power system design and condition diagnosis/monitoring and, consequently, improve the reliability of these technologies. The articles published in this Special Issue also indicate that research in this field of engineering is very active and that the applications are quite diversified.

Faced with the continuous modernization of our society, more high-voltage applications are expected in various areas: "Things are getting smaller and more powerful". With the years to come, many exciting applications are therefore expected.

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