Technical Presentation Session
Sponsored by IAS Chapters and Membership Department (CMD) and CMD YP Committee

PE Session Series
POWER AND ENERGY

SESSION PE7

Date: Saturday, 14 November 2020
Time:
12:00-13:30 UTC (Coordinated Universal Time)
13:00-14:30 CET (Central European Time, UTC+1)
07:00am-08:30am EST (US Eastern Standard Time, UTC-5)
05:30pm-07:00pm IST (Indian Standard Time, UTC+5:30)
Time converter: https://www.worldtimebuddy.com/

The event is organized and hosted by IAS CMD.
Co-host is Region-7 Winnipeg Section University of Manitoba IEEE Student Branch IAS/PES/PELS Chapter, Canada

Lecture 1

Simplified Numerical Models in Simulating Corona Discharge and EHD Flows

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Sara Mantach is currently a PhD candidate in Electrical and Computer Engineering at the University of Manitoba, Canada. Since January 2019, she has been working under the supervision of Professor Behzad Kordi in the McMath High Voltage Lab. She received her B.E. degree in Electrical and Computer Engineering in 2015 from the American University of Beirut in Lebanon. Then in 2018, she received her M.E.Sc degree in Electrical and Computer Engineering from University of Western Ontario. Her master's thesis was about simulating Corona Discharge and EHD Flows using simplified numerical models. Her current research is focused on the development of machine learning algorithms; specifically deep learning algorithms; in order to classify and localize sources of partial discharges

that take place in high voltage insulation systems. In addition to receiving the International Graduate Student Entrance Scholarship (2018), she is the recipient of the Price Graduate Scholarship for Women in Engineering (2020). Sara is the current chair of IEEE IAS/PES/PELS student branch chapter in the University of Manitoba.

Abstract:

Corona discharge is used in many practical applications. For designing and optimization of corona devices, the discharge phenomenon should be numerically simulated. Most often, the corona discharge model is simplified by neglecting the process dynamics and assuming a limited number of reactions and species. In the extreme case, monopolar corona models with just one species and no reactions are studied. However, there is a problem with determining boundary conditions for the space charge density. The simplest solution to this problem was suggested by Kaptzov, who hypothesized that the electric field on the electrode surface remains constant and equal to the value at the onset conditions, which is known from a semiempirical Peek's formula. Experimental data confirm good accuracy of this approach. However, it is impossible to experimentally measure the surface electric field at different voltage levels and compare it to Peek's value. My talk will discuss different methods for simulating corona discharge in 1D wire-cylinder geometry in air at atmospheric pressure. The classical model based on Kaptzov's hypothesis is compared with other approaches. The first model is still a single-species one, but it uses direct ionization criterion. Two other models consider a higher number of species and some number of reactions, so the ionization layer is included. The surface electric field can differ from Peek's value by almost 43%. In addition, the results of numerical investigations of the EHD flow generated by dc corona discharge in the point-plane configuration in atmospheric air are presented. A computational model of the discharge includes the ionization layer and three ionic species. The most important ionic reactions (ionization, attachment, recombination and detachment) are considered. The results of the corona simulations were used to predict the secondary EHD flow. All flow parameters (velocity components, pressure, streamlines) are determined. In addition to main flow vortex reported before, a local vortex near the discharge tip has also been discovered. COMSOL, a commercial finite element package, was used in simulations.

Lecture 2

Design, analysis, fabrication and control of attraction type electromagnetic levitation prototype

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Janardan Kundu has been working in the area of electromagnetic levitation including set-up design, fabrication, control and testing since 2013. He did his M. Tech in Electrical Engineering from NIT Allahabad. After post-graduation he joined as a CSIR Senior Research Fellow at IIEST Shibpur in 2013 and done Ph. D there. Previously he served as a faculty at Indian Institute of Engineering Science & Technology, Shibpur. He is currently working as an Asst. Professor at Bikaner Technical University, Bikaner. His research area is electromagnetic levitation, nonlinear control systems, optimization & adaptive control etc. He has published 13 research papers in journal, international and national conferences. He has attended IEEE annual meeting at USA in 2015 and

2016 with AMTGP travel award. He has served IEEE-IAS Student Branch Chapter Chair of Kolkata Section (R10) and IEEE SB Chair of Indian Institute of Engineering, Science & Technology, Shibpur Student Branch. The chapter won the global "Continued Performance Outstanding Small Chapter Award 2015" in the Outstanding Chapter Award Contest by IEEE at Texas, USA. He has been awarded 2nd Prize in Young Scientists' Meet by Ministry of Science and Technology, Govt. of India at India International Science Festival (IISF), IIT Delhi in 2015.

Abstract:

This work presents a comparative study on the design, modelling, electromagnetic analysis based on finite-element software, fabrication and experiment on four levitation prototypes based on steel ball and plates. No mechanical restrainer has been used in the transverse direction for the levitation. This aspect of the work is an improvement over existing work reported in the published literature. The entire set-up has been designed, fabricated, analytically investigated and experimentally evaluated and verified. The finite-element model (FEM) has been derived using standard commercial package(s). The analytical model has been obtained using specific permeance concepts following Robert Pohl’s method. Excellent correlation between the predicted and experimental results is a highlight of the work. The stability against transverse mechanical perturbation has also been investigated. Control system design and implementation is successfully done.