

**2021 Southern African Universities  
Power Engineering  
Conference/Robotics and  
Mechatronics/Pattern Recognition  
Association of South Africa  
(SAUPEC/RobMech/PRASA 2021)**

**Potchefstroom, South Africa  
27-29 January 2021**



IEEE Catalog Number: CFP2148U-POD  
ISBN: 978-1-6654-4788-1

**Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP2148U-POD
ISBN (Print-On-Demand):	978-1-6654-4788-1
ISBN (Online):	978-1-6654-0345-0

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# TABLE OF CONTENTS

<p>INVESTIGATION AND MITIGATION OF TEMPORARY OVERVOLTAGE CAUSED BY HARMONIC FILTERS IN AN OIL REFINERY.....</p> <p style="padding-left: 20px;"><i>Prenushka Ayar, Olatunji Ajibola Akinrinde, Evans Eshiemogie Ojo</i></p>	1
<p>THE INVESTIGATIONS OF THE IMPACTS OF THE INTEGRATION OF WIND ENERGY INTO DISTRIBUTION NETWORK.....</p> <p style="padding-left: 20px;"><i>Ramesh Kumar Behara, Evans Eshiemogie Ojo, Timothy Kayode Akindeji</i></p>	8
<p>A FURTHER LOOK INTO THE SERVICE LIFETIME COST OF SOLAR PHOTOVOLTAIC ENERGY TRANSFORMERS .....</p> <p style="padding-left: 20px;"><i>B. A. Thango, K. Moloi, J. A. Jordaan, A. F. Nnnachi</i></p>	14
<p>POWER DISTRIBUTION SYSTEM FAULT DIAGNOSTIC USING GENETIC ALGORITHM AND NEURAL NETWORK .....</p> <p style="padding-left: 20px;"><i>K. Moloi, A. A. Yusuff</i></p>	21
<p>AN ARTIFICIAL INTELEGENCE ENERGY MANAGEMENT SYSTEM FOR AN EDUCATIONAL BUILDING .....</p> <p style="padding-left: 20px;"><i>R. Pretorius, B. J. Kotze</i></p>	26
<p>THE STUDY OF ELECTRICAL POWER GENERATION FROM TIDAL ENERGY IN SOUTH AFRICA .....</p> <p style="padding-left: 20px;"><i>Namhla F. Mtukushe, Evans E. Ojo</i></p>	33
<p>OPTIMAL POWER GRID INTEGRATION WITH DISTRIBUTED GENERATION USING GENETIC ALGORITHM.....</p> <p style="padding-left: 20px;"><i>K. Moloi, J. A. Jordaan, Y. Hamam</i></p>	39
<p>TOWARD COLLABORATIVE REINFORCEMENT LEARNING AGENTS THAT COMMUNICATE THROUGH TEXT-BASED NATURAL LANGUAGE .....</p> <p style="padding-left: 20px;"><i>Kevin M. Eloff, Herman A. Engelbrecht</i></p>	44
<p>THE INFLUENCE OF THE SIGNAL DISTORTIONS ON THE SATELLITE BASED NAVIGATION SYSTEMS.....</p> <p style="padding-left: 20px;"><i>Bheki Madonsela, Innocent Davidson, Chrispin Mulangu</i></p>	50
<p>ADAPTIVE MODEL PREDICTIVE CONTROL FOR FREQUENCY CONTROL FOR TWO AREA INTERCONNECTED POWER SYSTEM.....</p> <p style="padding-left: 20px;"><i>Igbineweka Ernest Uyioghosa, Akshay Kumar Saha</i></p>	56
<p>ANOMALY DETECTION MONITORING SYSTEM FOR HEALTHCARE.....</p> <p style="padding-left: 20px;"><i>Tlou Boloka, Gerrie Crafford, Windy Mokuwe, Beatrice Van Eden</i></p>	62
<p>DEVELOPMENT OF WEATHER INVARIANT ELECTRIC POWER TRANSFORMER OIL PURIFICATION SYSTEM.....</p> <p style="padding-left: 20px;"><i>C. D. Roycroft, A. A. Yusuff</i></p>	68
<p>KNOWLEDGE TRANSFER USING MODEL-BASED DEEP REINFORCEMENT LEARNING .....</p> <p style="padding-left: 20px;"><i>Tlou Boloka, Ndivhuwo Makondo, Benjamin Rosman</i></p>	75
<p>A COMPARATIVE EVALUATION OF CONVENTIONAL AND COMPUTATIONAL INTELLIGENCE TECHNIQUES FOR FORECASTING ELECTRICITY OUTAGE.....</p> <p style="padding-left: 20px;"><i>A. K. Onaolapo, R. Pillay-Carpanen, D. G. Dorrell, E. E. Ojo</i></p>	81

THE ECONOMIC AND ENVIRONMENTAL IMPACT OF REPLACING GEYSER WITH AIR SOURCE HEAT PUMP WATER HEATER .....	87
<i>Stephen Tangwe, Kanzumba Kusakana</i>	
POWER QUALITY ANALYSIS FOR A SOLAR-GRID INTEGRATED SYSTEM USING SUPPORT VECTOR MACHINE .....	93
<i>K. Moloji, B. A. Thango, A. F. Nnnachi, J. A. Jordaan, Y. Hamam</i>	
VULNERABILITY ANALYSIS OF FALSE DATA INJECTION ATTACKS ON THE FREQUENCY STABILITY OF ISOLATED MICROGRIDS .....	98
<i>Anuoluwapo O. Aluko, R. Pillay Carpanen, David G. Dorrell, Evans E. Ojo</i>	
WHY SOLAR PV IS SUCH A LUCRATIVE OPTION FOR SOUTH AFRICAN MUNICIPAL CUSTOMERS .....	104
<i>Sanjeeth Sewchurran, Innocent E. Davidson</i>	
PROFILE SOLAR GEYSER HEATING WITH STANDBY ELEMENT INCLUDING USAGE UTILIZING PREDICTION FOR OPTIMAL HEATING .....	111
<i>D. De Bruyn, B. Kotze</i>	
PERFORMANCE IMPACT OF NETWORK CONDITIONS ON AN IIOT SYSTEM. ....	117
<i>R Bock, Kr Uren, G Van Schoor</i>	
HIGH IMPEDANCE FAULT DETECTION BASED ON HS-TRANSFORM AND DECISION TREE TECHNIQUES .....	123
<i>A. Nakho, K. Moloji, Y. Hamam</i>	
INVESTIGATING AN ALTERNATE DETECTOR FOR SOLAR-BLIND ULTRAVIOLET CAMERAS FOR HIGH-VOLTAGE INSPECTION .....	128
<i>Casper Coetzer, Taryn Becker, Nicholas West, Wilhelm Leuschner</i>	
IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK INTO THE COPPER AND COBALT LEACHING PROCESS .....	134
<i>Kasongo K. Brest, Kaboko Jean Jacques Monga, Mwanat M. Henock</i>	
RRT BASED PATH PLANNING FOR MOBILE ROBOTS ON A 3D SURFACE MESH.....	139
<i>Cebisile Mthabela, Daniel Withey, Chioniso Kuchwa-Dube</i>	
DETECTION AND CLASSIFICATION OF SINGLE PHASE TO GROUND FAULTS UNDER HIGH RESISTANCE GROUND PATHS IN POWER SYSTEMS USING MACHINE LEARNING.....	145
<i>A. Nakho, Y. Hamam</i>	
THE RECENT TREND OF INCREASING FAULT CURRENT LEVELS AND MITIGATION MEASURES.....	151
<i>Vasu Chetty, Innocent E. Davidson, Glushan Sharma</i>	
FERRORESONANCE: A REVIEW OF THE PHENOMENON AND ITS EFFECTS .....	158
<i>S. J. Kruger, J. A. De Kock</i>	
EFFECTS OF FREQUENCY AND VOLTAGE RELAYS ON TURBINE-GENERATOR SHAFT FATIGUE DUE TO ISLANDING.....	164
<i>Bombay Babi, Pitshou Bokoro</i>	
DESIGN AND CONSTRUCTION OF A SMART ULTRASONIC WALKING STICK FOR THE VISUALLY IMPAIRED.....	170
<i>Henry O. Omoregbee, Mabel U. Olanipekun, Ayobami Kalesanwo, Oluwaferanmi A. Muraina</i>	

DESIGN OF LOW-FREQUENCY QUASI-DC GIC VOLTAGE STABILITY LABORATORY PROTOCOL .....	177
<i>N. S. Sithebe, D. T. O. Oyedokun, H. K. Chisepo</i>	
SMART INVERTERS IN LV NETWORKS: A REVIEW OF INTERNATIONAL CODES AND STANDARDS, AND OPPORTUNITIES FOR SOUTH AFRICA .....	183
<i>Ria Xavier, Bernard Bekker, Munyaradzi Justice Chihota</i>	
MODELING AND SIMULATION OF RADIAL-GRID TOPOLOGY BASED ON MULTI- TERMINAL VSC-HVDC SYSTEM .....	189
<i>Sindisiwe C. Maanda, Innocent E. Davidson</i>	
DECENTRALIZED CONTROL SCHEME APPLIED TO DOMESTIC ELECTRIC WATER HEATERS TO MINIMIZE FREQUENCY DEVIATIONS: INITIAL RESULTS. ....	196
<i>Ouma Et Bosaletsi, Prof Willem Cronje</i>	
ANALYSIS AND HARMONIC MITIGATION IN DISTRIBUTION TRANSFORMERS FOR RENEWABLE ENERGY APPLICATIONS .....	202
<i>Leon S. Sikhosana, Udochukwu B. Akuru, Bonginkosi A. Thango</i>	
FINANCIAL FEASIBILITY OF SOLAR PV WITHIN ETHEKWINI MUNICIPALITY- RESIDENTIAL CUSTOMERS .....	208
<i>Sanjeeth Sewchurran, Innocent E. Davidson</i>	
SCENARIO-BASED ANALYSIS OF THE ADEQUACY OF A SOUTH AFRICAN GRID TO SUPPLY PEAK DEMAND IN 2030 .....	214
<i>Siyanda Ncwane, Thamsanqa Ngcobo</i>	
FINANCIAL FEASIBILITY OF SOLAR PV WITHIN ETHEKWINI MUNICIPALITY - BUSINESS CUSTOMERS .....	220
<i>Sanjeeth Sewchurran, Innocent E. Davidson</i>	
BATTERY TRIPPING UNIT FOR SPACE CONSTRAINED SUBSTATION CONTAINER APPLICATIONS.....	227
<i>Johan Venter, Daniel Rodrigues Van Niekerk</i>	
CHARACTERISING DOUBLE CAVITY PARTIAL DISCHARGES .....	233
<i>Mbongeni Hlongwane, Richard Kalobwe Links, Cuthbert Nyamupangedengu</i>	
PRELIMINARY DESIGN OF A BAGASSE BASED FIRM POWER PLANT FOR A SUGAR FACTORY .....	239
<i>Moses Jeremiah Barasa Kabeyi, Oludolapo Akanni Olanrewaju</i>	
DEVELOPMENT OF A FUNDING MODEL FRAMEWORK FOR POWER TRANSMISSION PROJECTS.....	248
<i>Siphehile G Satimburwa, Caswell Ndlhovu, Ronald Marais</i>	
MISCELLANEOUS ENERGY PROFILE MANAGEMENT SCHEME FOR OPTIMAL INTEGRATION OF ELECTRIC VEHICLES IN A DISTRIBUTION NETWORK CONSIDERING RENEWABLE ENERGY SOURCES.....	254
<i>Kayode E. Adetunji, Ivan Hofsajer, Adnan M. Abu-Mahfouz, Ling Cheng</i>	
POTENTIAL OF ELECTRICITY GENERATION THROUGH ANAEROBIC DIGESTION AND INCINERATION TECHNOLOGY FOR SELECTED DISTRICTS IN LESOTHO .....	260
<i>T. D. Sechoala, O. M. Popoola, T. R. Ayodele</i>	

MODELLING AND SIMULATION OF A DC-EXCITED VERNIER RELUCTANCE MACHINE AS A SYNCHRONOUS CONDENSER .....	267
<i>Mkhululi Mabhula, Abraham Botes, Maarten J. Kamper, Udochukwu B. Akuru</i>	
REAL-TIME SIMULATION OF PHOTOVOLTAIC SYSTEM AND ITS PERFORMANCE UNDER PARTIAL SHADING CONDITIONS .....	273
<i>Ntuba Irene Nkhasi, Akshay Kumar Saha</i>	
REVIEW OF PROACTIVE OPERATIONAL MEASURES FOR THE DISTRIBUTION POWER SYSTEM RESILIENCE ENHANCEMENT AGAINST HURRICANE EVENTS.....	279
<i>Okeolu Samuel Omogoye, Komla A. Folly, Kehinde O. Awodele</i>	
A FRONT-END TECHNIQUE FOR VISUAL GOLD DETECTION AND LOCALIZATION – TOWARDS AUTOMATION OF THE GOLD PANNING PROCESS. ....	285
<i>Blessing Chipfurwe Makoni, Molaletsa Namoshe, Oduetse Matsebe</i>	
INDUCTION MOTOR MODELLING IN DYNAMIC POWER SYSTEM STUDIES-A COMPARISON OF TWO METHODS.....	291
<i>Te Carter, J.A. De Kock</i>	
A COMPARATIVE STUDY ON DIRECT TORQUE CONTROL ALGORITHMS APPLIED TO A DOUBLY FED INDUCTION GENERATOR.....	297
<i>Kumeshan Reddy, Akshay Kumar Saha</i>	
ALGORITHMIC MUSIC COMPOSITION USING PROBABILISTIC GRAPHICAL MODELS AND ARTIFICIAL NEURAL NETWORKS .....	303
<i>Marc Marsden, Ritesh Ajoodha</i>	
DESIGN AND COMPARISON OF THREE SURFACE-MOUNTED PM MOTORS FOR A LIGHT ELECTRIC VEHICLE .....	307
<i>Francois Du Plessis, Stavros Pastellides, Rong-Jie Wang</i>	
RESPONSE OF A 25 KV AC RAILWAY TRACTION SYSTEM TO LIGHTNING CURRENT TRANSIENTS AND MITIGATION MEASURES.....	313
<i>M. L. Tlhabanyane, C. Gomes</i>	
THE EFFECT OF CABLE LENGTH ON FERRORESONANCE IN LOW-LOSS DISTRIBUTION TRANSFORMERS.....	321
<i>Abdullahi Ibrahim Abdi, J J Walker, Jules Simplicie Djeumen</i>	
AN EMPIRICAL ANALYSIS AND APPLICATION OF THE EXPECTATION- MAXIMIZATION AND MATRIX COMPLETION ALGORITHMS FOR VARYING DEGREES OF MISSING DATA .....	325
<i>Evans Thulare, Ritesh Ajoodha, Ashwini Jadhav</i>	
A POWER ELECTRONIC STARTER MOTOR EMULATOR FOR INVESTIGATING BATTERY BEHAVIOUR.....	332
<i>Kevin J. Fourie, Jason D. Van Schoor, Lesedi Masisi</i>	
DRIVER ACTIVITY RECOGNITION THROUGH DEEP LEARNING.....	338
<i>Francois Nel, Mkhuselel Nxande</i>	
DEEP SIMILARITY LEARNING FOR SPORTS TEAM RANKING.....	344
<i>Daniel Yazbek, Jonathan Sandile Sibindi, Terence L. Van Zyl</i>	

REMOTE MECHANICAL SWITCH TO REGULATE ELECTRICITY CONSUMPTION IN A HOUSEHOLD..... 350  
*Gerald K. Kirui, Learn L. Chiloane, Yu-Chieh J. Yen*

LOADABILITY ASSESSMENT OF A PHOTOVOLTAIC PENETRATED GRID TO OFFSET INTERMITTENCY AND REDUCE TOTAL LOSSES USING BATTERY ENERGY STORAGE SYSTEM ..... 356  
*Nomhle Loji, Kabulo Loji, Remy Tiako, Innocent E. Davidson, Timothy K. Akindeji*

DISCRIMINATING BETWEEN MAGNETIZING INRUSH CURRENT AND FAULT CURRENT IN POWER TRANSFORMER PROTECTION USING WAVELET TRANSFORM..... 362  
*Franklin Eguavoen Obakpolor, Akshay Kumar Saha*

**Author Index**