

Incorporating the SAIEE Transactions

SAIEE AFRICA RESEARCH JOURNAL Vol 100 No.3 pp 61-88

September 2009 **Volume 100 No. 3**

SAIEE AFRICA RESEARCH JOURNAL

(SAIEE FOUNDED JUNE 1909 INCORPORATED DECEMBER 1909) AN OFFICIAL JOURNAL OF THE INSTITUTE ISSN 1991-1696

President Mr du Toit Grobler **Vice-Presidents** Mr Andries Tshabalala Mr Mike Cary

Immediate Past President Mr Ian McKechnie **Deputy President** Dr Angus Hay **Honorary Treasurer** Mr Les James

Secretary and Head Office

Ms Gerda Gever

South African Institute for Electrical Engineers (SAIEE) PO Box 751253, Gardenview, 2047, South Africa

Tel: (27-11) 487-3003 Fax: (27-11) 487-3002 E-mail: geyerg@saiee.org.za **Editorial Board**

Chairperson Prof IK Craig

ARJ Editor-in-Chief Prof BM Lacquet

EDITORS AND REVIEWERS

EDITOR-IN-CHIEF

Prof. B.M. Lacquet, Faculty of Engineering and the Built Environment,

University of Witwatersrand, Johannesburg, South Africa beatrys.lacquet@wits.ac.za

MANAGING EDITOR

Dr.S. Sinha Dept of Electrical Electronic & Computer Engineering University of Pretoria, Pretoria, South Africa ssinha@ieee.org

SPECIALIST EDITORS

Communications, Signal Processing:

Prof. L.P. Linde, Dept. of Electrical, Electronic & Computer Engineering, University of Pretoria, Pretoria, South Africa

Prof. S. Maharaj, Dept. of Electrical, Electronic & Computer Engineering University of Pretoria, Pretoria, South Africa

Dr O. Holland, Centre for Telecommunications Research, London, United Kingdom

Prof. F. Takawira, School of Electrical, Electronic and Computer Engineering,

University of KwaZulu-Natal, Durban, South Africa

Computer, Information Systems and Software Engineering: Prof. A. van der Merwe, Meraka Institute, CSIR, Pretoria, South Africa

Prof. E. Barnard, Meraka Institute, CSIR, Pretoria, South Africa

Prof. B. Dwolatzky, Joburg Centre for Software Engineering,

University of the Witwatersrand, Johannesburg, South Africa

Control and Automation:

Dr B. Yuksel, University of Tokyo, Japan

Electromagnetics and Antennas:

Prof. J.H. Cloete, Dept. of Electrical and Electronic Engineering,

University of Stellenbosch, South Africa

Prof. T.J.O. Afullo, School of Electrical, Electronic and Computer Engineering,

University of KwaZulu-Natal, Durban, South Africa

Dr R. Geschke, Dept. of Electrical and Electronic Engineering, University of Stellenbosch, South Africa

Electron Devices and Circuits:

Prof. M. du Plessis, Dept. of Electrical, Electronic & Computer Engineering, Pretoria, University of Pretoria, South Africa

Energy and Power Systems:

Prof. M. Delimar, Faculty of Electrical Engineering and Computing,

University of Zagreb, Zagreb, Croatia

Engineering and Technology Management:

Prof. J-H. Pretorius, Faculty of Engineering and the Built Environment,

University of Johannesburg, Johannesburg, South Africa

Prof. L. Pretorius, Graduate School of Technology Management (GSTM), University of Pretoria, Pretoria, South Africa

General Topics / Editors-at-large:

Dr P.J. Cilliers, Hermanus Magnetic Observatory, Hermanus, South Africa Prof. M.A. van Wyk, Dept. of Electrical and Information Engineering,

University of Witwatersrand, Johannesburg, South Africa

INTERNATIONAL PANEL OF REVIEWERS

W. Boeck, Technical University of Munich, Munich, Germany

W.A. Brading, Australia

Prof. G. De Jager, Dept. of Electrical Engineering, University of Cape Town, Cape Town South Africa

Prof. B. Downing, Dept. of Electrical Engineering, University of Cape Town, Cape Town, South Africa

Dr W. Drury Control Techniques Ltd. United Kingdom

PD Evans, Dept. of Electrical, Electronic & Computer Engineering, The University of Birmingham, Birmingham, UK

Prof. J.A. Ferreira, Electrical Power Processing Unit, Delft University of Technology, Delft, The Netherlands

O. Flower, University of Warwick UK

Prof. H.L. Hartnagel, Dept. of Electrical Engineering and Information Technology,

Technical University of Darmstadt, Darmstadt, Germany

C.F. Landy. Engineering Systems Inc., USA D.A. Marshall, ALSTOM T&D, France

Dr M.D. McCulloch, Dept. of Engineering Science, Oxford, United Kingdom

Prof. D.A. McNamara, University of Ottawa, Ottawa, Canada

M. Milner, Hugh MacMillan Rehabilitation Centre, Canada

Prof. A. Petroianu, Dept. of Electrical Engineering, University of Cape Town, Cape Town, South Africa

Prof. K.F. Poole, Holcombe Dept. of Electrical and Computer Engineering, Clemson University, United States of America

Prof. J.P. Reynders, Dept. of Electrical & Information Engineering, University of the Witwatersrand, Johannesburg, South Africa

I.S. Shaw, University of Johannesburg, SA

H.W. van der Broeck, Phillips Forschungslabor Aachen, Germany

Prof. P.W. van der Walt, University of Stellenbosch, Stellenbosch, South Africa

Prof. J.D. van Wyk, Dept. of Electrical and Computer Engineering, Virginia Tech, United States of America

RT Waters, UK

TJ Williams, Purdue University, USA

Additional reviewers are approached as necessary

Published by

SAIEE Publications (Pty) Ltd, PO Box 751253, Gardenview, 2047, Tel. (27-11) 487-3003, Fax. (27-11) 487-3002,

E-mail: SAIEEPublications@saiee.org.za

Additional reviewers are approached as necessary

ARTICLES SUBMITTED TO THE SAIEE AFRICA RESEARCH JOURNAL ARE FULLY PEER REVIEWED PRIOR TO ACCEPTANCE FOR PUBLICATION

The following organizations have listed SAIEE Africa Research Journal for abstraction purposes:

INSPEC (The Institution of Electrical Engineers, London); "The Engineering Index" (Engineering Information Inc.)

Unless otherwise stated on the first page of a published paper, copyright in all materials appearing in this publication vests in the SAIEE. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, magnetic tape, mechanical photocopying, recording or otherwise without permission in writing from the SAIEE. Notwithstanding the foregoing, permission is not required to make abstracts on condition that a full reference to the source is shown. Single copies of any material in which the Institute holds copyright may be made for research or private use purposes without reference to the SAIEE.

SAIEE AFRICA RESEARCH JOURNAL - NOTES FOR AUTHORS

This journal publishes research, survey and expository contributions in the field of electrical, electronics, computer, information and communications engineering. Articles may be of a theoretical or applied nature, must be novel and must not have been published elsewhere.

Nature of Articles

Two types of articles may be submitted:

- Papers: Presentation of significant research and development and/or novel applications in electrical, electronic, computer, information or communications engineering.
- Research and Development Notes: Brief technical contributions, technical comments on published papers or on electrical engineering topics.

All contributions are reviewed with the aid of appropriate reviewers. A slightly simplified review procedure is used in the case of Research and Development Notes, to minimize publication delays. No maximum length for a paper is prescribed. However, authors should keep in mind that a significant factor in the review of the manuscript will be its length relative to its content and clarity of writing. Membership of the SAIEE is not required.

Process for initial submission of manuscript

Preferred submission is by e-mail in electronic MS Word and PDF formats. PDF format files should be 'press optimised' and include all embedded fonts, diagrams etc. All diagrams to be in black and white (not colour). For printed submissions contact the Managing Editor. Submissions should be made to:

> The Managing Editor, SAIEE Africa Research Journal, PO Box 751253, Gardenview 2047, South Africa. E-mail: researchjournal@saiee.org.za

These submissions will be used in the review process. Receipt will be acknowledged by the Editor-in-Chief and subsequently by the assigned Specialist Editor, who will further handle the paper and all correspondence pertaining to it. Once accepted for publication, you will be notified of acceptance and of any alterations necessary. You will then be requested to prepare and submit the final script. The initial paper should be structured as follows:

- TITLE in capitals, not underlined.
- Author name(s): First name(s) or initials, surname (without academic title or preposition 'by')
- Abstract, in single spacing, not exceeding 20 lines.
- List of references (references to published literature should be cited in the text using Arabic numerals in square brackets and arranged in numerical order in the List of References).
- Author(s) affiliation and postal address(es), and email address(es).
- Footnotes, if unavoidable, should be typed in single spacing.
- Authors must refer to the website: http://www.saiee.org.za/arj where detailed guidelines, including templates, are provided.

Format of the final manuscript

The final manuscript will be produced in a 'direct to plate' process. The assigned Specialist Editor will provide you with instructions for preparation of the final manuscript and required format, to be submitted directly to: The Managing Editor, SAIEE Africa Research Journal, PO Box 751253, Gardenview 2047, South Africa. E-mail: researchjournal@saiee.org.za

Page charges

A page charge of R200 per page will be charged to offset some of the expenses incurred in publishing the work. Detailed instructions will be sent to you once your manuscript has been accepted for publication.

Additional copies

An additional copy of the issue in which articles appear, will be provided free of charge to authors. If the page charge is honoured the authors will also receive 10 free reprints without covers.

Copyright

Unless otherwise stated on the first page of a published paper, copyright in all contributions accepted for publication is vested in the SAIEE, from whom permission should be obtained for the publication of whole or part of such material.