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COMPUTER SCIENCE
SOFTWARE ENGINEERING
INFORMATION SYSTEMS

A. L. STEENKAMP (RED.)
Papers delivered at the

SAICSIT • 95

Research & Development Symposium

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CONTENTS

vii  PREFACE
ix   WELCOMING MESSAGE
xi   OPENING MESSAGE
xii  ORGANISING COMMITTEE
xii  SPONSORS
xiii EXHIBITORS
xiii SYMPOSIUM PROCEEDINGS

STREAM 1
COMPUTER SCIENCE

1    PROF JEFFERY ZUCKER (Invited address)
     Tabular Notations

3    DR BRUCE WATSON (Invited address)
     Trends in Compiler Construction

13   S A BEREZNER & A E KRZESINSKI
     Loss Probabilities for Circuit-switched Networks

23   W SMUTS
     Paying for High Speed Network Services

31   A VAHED
     The Recall Performance of Multiple Associative Memories - a Comparison of
     Thresholding Strategies

33   C N BLEWETT & G J ERWIN
     Application of Scripts for Deadlock Avoidance

49   M WAYA & R BLIGNAUT
     I/O Performance Modelling & Evaluation - Keeping your Company Competitive

65   H L VIKTOR & I CLOETE
     Simplification of Rules Extracted from Neural Networks
G HILIEBRAND
Higraphs: An Overview of Theory and Application

D M TOTEV
Cuneiform Representation of Textual Data

E CLOETE
The Design of a 2D Non-linear Filter for Digital Image Processing

J HEIDEMA, W A LABUSCHAGNE & ROSENBLATT*
Power-order Semantics for Nonmonotonic Logic I

J HEIDEMA, W A LABUSCHAGNE & T A MEYER*
Power-order Semantics for Nonmonotonic Logic II

N NTLATLAPA
Rank-one Update of Cholesky Factorization

TUTORIALS

D LUBINSKY
Machine Learning and Data Mining

B WATSON
Taxonomies and Toolkits: Users for the Mathematics of Program Construction

STREAM 2
SOFTWARE ENGINEERING

PROF DANIEL TEICHROEW (Invited address)
Whatever happened to Software Engineering?

J WESSON, G DE V DE KOCK & P R WARREN
Task Analysis: The Missing Link in Software Development Methodologies

I M IKRAM
A Method to Generate Occam Skeletons from Formal Specifications

D M THORNTON & A L STEENKAMP
A Quality Assurance Reference Model for Object-orientation

S B NGUBANE
A Measurement Strategy to Support Total Quality Management in a Systems Development Environment
153  V RAM  
A Case-based Reasoning Approach to Intelligent Retrieval in Reusable Software libraries

155  Z VILJOEN & A L STEENKAMP  
Computer Supported Cooperative Work as Applied in Software Development

181  D F VAN WYK, J S BENADE & A L STEENKAMP  
The Development of a Computer-based, Integrated Product Definition for Artillery Products

195  J BARROW  
A Writing Support Tool for Distance Students

211  P KOTZÉ  
An Option Space for Network Structures in Computer-based Instruction

POSTERS

225  R BOSUA  
A Structured Approach to Integrate Heterogeneous CASE tools

227  M LOOCK ET AL.  
Object-oriented Development: Knowledge Base Support for Design

STREAM 3  
INFORMATION SYSTEMS

229  PROF HANS KLEIN (Invited address)  
New Directions in Research on Information Requirements Analysis: The Language Connection

237  M ZELLOUF, R AUBRY & P PREVOT  
An Organisational Model for Simplifying the Complexity of Managing Software Project

241  D PETKOV & O MIHOVA-PETKOVA  
A Network Model for the Prioritization of Factors Affecting Software Development Productivity

243  J DARATOS & A L STEENKAMP  
An Object-oriented Strategy for Banking

251  T M ADDISON & S HAMERSMA  
Critical Success Factors for Implementing CASE at a Selection of Companies in South Africa
253  G F GANCHEV
    Development of a Compiler Construction Toolkit for an Introductory Course in Compiling

255  L FRONEMAN & J D ROODE
    Rethinking IS Curricula for South Africa

275  C DE VILLIERS & J D ROODE
    An Alternative Teaching Approach for Information Systems

BOOK PRESENTATION

283  G J ERWIN & C N BLEWETT
    Business Computing: An African Perspective

GENERAL INFORMATION TECHNOLOGY

285  T NEPAL & S MELVILLE (General)
    An Investigation into Timetabling at Tertiary Institutions in Southern Africa

293  I M VENTER & R BLIGNAUT
    Understanding Factors that Influence Success Rate of Students in Computer Literacy

297  A S SITHOLE
    Options for Developmental Cooperation in IT Education and Training:
    The Zimbabwe Case

323  R VON SOLMS
    Research in Information Technology at South African Technikons

327  A RADOVANOVIC & D M VENTER
    An Internet Connection in South Africa
PREFACE

On the occasion of the first symposium of the South African Institute for Computer Scientists and Information Technologists I wish to welcome everyone to this forum for the exchange of ideas and results on research and development in the disciplines of Computer Science, Software Engineering and Information Systems. The growing demand for information and computer systems of ever-increasing size, scope and complexity has emphasized the need for approaches which acknowledge the interrelationships between the various technology strands in the field of information technology. The three disciplines of this symposium reflect the broader interests of the membership of our restructured institute. It has been a pleasure to participate in the organisation of this event that has attracted such a number of fine contributions. I wish to acknowledge and thank all the members of the organising and programme committees who contributed their efforts to make the symposium the success that we aimed for. A special word of thanks to Persetel and Siemens for providing financial support, to the University of South Africa for making its services and venues available, and to the administration of the Computer Society of South Africa for their assistance. We are also indebted to the Department of Computer Science and Information Systems of UNISA who made the resources and infrastructure of the Centre for Software Engineering available to organise the symposium. Special mention is due to our efficient secretary El-marié Botha who devoted so much effort to the administration of the symposium and preparation of the proceedings.

Prof A L Steenkamp
President: SAICSIT
WELCOMING MESSAGE

It is a pleasure to welcome the participants of the first symposium of the South African Institute for Computer Scientists and Information Technologists at the University of South Africa.

Recent developments in computers and information technology have opened new and exciting possibilities for mankind. These developments have irrevocably turned concepts which we thought that we understand into problems, for instance:

- the concept Wealth of Nations does not depend anymore on visible products produced in visible factories, but on the invisible flow of information and services along invisible lines of communication which are managed by virtually invisible machines, using invisible software;

- the concept of the mega-organisation, (like mega states, mega-churches, mega-universities, mega-businesses) with its central control and mega-bureaucracy, is being replaced by the concept of small-is-also-powerful - "organisations" run by individuals all around the globe linked up in virtual structures and are eliminating the powers of states, councils and boards; and

- some of our concepts about education and training of two millenia, are suddenly being replaced by new ones depending upon telematics and information technology, which leaves the traditional educationalist in a state of bewilderment and indecision.

These are important problem areas to be studied - and UNISA has an interest in the solutions to all of them - especially in the problem area of education-over-a-distance, since we are moving towards the implementation of the new technologies to serve our students better.

I am pleased to see that some of the speakers of the symposium are addressing these and other areas of interest, and I express the hope that your deliberations will contribute to their solution.

Prof C J H Schutte
Chief Executive Director:
Science, Technology & Informatics, UNISA
OPENING MESSAGE

*Information Technology* and the undergirding *computer sciences* will have a profound impact on the reconstruction and development of South Africa. This is however not simply a national or regional concern. In order to become a competitive economy the deployment of a national information technology infrastructure and the effective and judicious use of these resources will be critical.

Trained human resources will be required. There is, more importantly, a need to develop an understanding of how information technology can redress and overcome the educational and development deficits which result from our past.

Research in this critical field cannot therefore take place in a vacuum without being informed of our context. I have initiated a process to develop a *Science and Technology White Paper* which will, among other things, address information technology and its impact on the endeavours of science and technology and, more pervasively, on the competitiveness and development needs of the nation.

The *SAICSIT* will I hope, with other specialist institutes and role players, contribute to the direction setting envisaged in the White Paper and develop a rich texture of responses that will enhance our national information technology endeavours. I wish you well for this important symposium.

Dr B Ngubane
Minister of Arts, Culture, Science and Technology
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SYMPOSIUM PROCEEDINGS

Copies of the proceedings will be handed out at the symposium. Delegates who attend the symposium will receive a copy of the proceedings free of charge. Additional copies will be sold at R100.00 each. An order form for the symposium proceedings is in the folder handed to you at registration.
Abstract: Tabular notations were developed by D L Parnas and his co-workers for the formal documentation, inspection and validation of large software systems. Such notations provide a formalism which combines mathematical precision with ease of use. This formalism has, on the one hand, important practical applications in software engineering. On the other hand, investigation of it leads to interesting problems in theoretical computer science.
THE DESIGN OF A 2D NON-LINEAR FILTER FOR DIGITAL IMAGE PROCESSING

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ABSTRACT: A 1D non-linear filter which is based on 'max-min' selectors is extended for use in 2D applications. The objective of this research is to remove impulsive noise without unduly changing original, valid data. Some examples are presented to indicate the use of this new filter as a pre-filter for detecting dense regions of images.

KEYWORDS: image processing, non-linear filtering, max-min operations.

1. INTRODUCTION

Two dimensional (2D) digital filters have a vast number of applications, such as in robotics, sonar, image processing and geophysics, to but mention a few. This paper deals with the development of a new 2D non-linear filter with particularly advantageous features for application in digital image processing (DIP).

Order filters, such as the class of filters derived from median operators, are widely used in non-linear filtering applications as some form of pre-filter to remove impulsive noise without disturbing valid signals. This procedure is usually followed up with a suitable linear smoothing process, depending on a priori knowledge of the data in question.

Due to some unsatisfactory aspects involving the use of median filters in the 1D case, we consider a filtering method based on the application of unsymmetric pairs of order statistic transforms [10]. The aim of this paper is to extend this method for 2D applications, without losing the fundamental desirable properties of the 1D method.

2. THE 1D LULU FILTER

A 1D filter transformation on the input sequence \( X \) can be notated as:

\[
Y = \omega[X], \text{ where } Y \text{ is the output sequence.}
\]

\[
X = \{x_1, x_2, \ldots, x_n\},
\]

\[
Y = \{y_1, y_2, \ldots, y_n\}
\]