Proceedings
of the tenth South African

SYMPOSIUM
ON
NUMERICAL MATHEMATICS

Ballito 2, 3 & 4 July 1984

sanum & the
dept. of computer science
university of natal
durban

Proceedings of the tenth South African

SYMPOSIUM

ON

NUMERICAL MATHEMATICS

Ballito, 2, 3 and 4 July 1984

edited by
JA Snyman

Report number CS.07.03.03.84

Published by the Department of Computer Science
University of Natal, Durban 1984.

ISBN 0-86980-406-5

ISSN 0379-8844

PREFACE

For the three days July 2-4, 1984 numerical mathematicians of South Africa as well as two leading numerical analysts from overseas gathered in Ballito, Natal, to celebrate the special event of the Tenth South African Symposium on Numerical Mathematics. This event was organised by the South African Society for Numerical Mathematics (SANUM) in conjunction with the University of Natal. A record total of 38 papers were read at this gathering. Invited papers were presented by Dr Sean McKee of the Oxford University Consortium for Industrial Numerical Analysis and by Dr GR Joubert of Philips, Eindhoven.

The Proceedings are a published record of 33 of the papers presented. The choice was left to the authors as to whether they wished to publish their papers in full or as a summary. All contributions included in the Proceedings are published as received from the authors.

This preface provides the opportunity to thank all the speakers, chairmen of sessions and participants for their contributions. Our thanks also to the University of Natal, in particular the head of the Department of Computer Science Prof Sartori-Angus and his very able assistant Ms Ethel Carte, for helping with the organisation of the Symposium.

Financial support for this meeting was again obtained from IBM (South Africa). In times of escalating costs it would not have been possible to present this Symposium without IBM's help and this support is gratefully acknowledged.

Jan Snyman
(Vice-Chairman : SANUM)

September 1984

PARTICIPANTS

S Adali *(Dept. of Mechanical Engineering, University of Natal, Durban)*
L Baart *(Council for Scientific and Industrial Research, Pretoria)*
GN Bakkes *(Inst. of Ground-water Studies, University of the Orange Free State)*
RAB Bond *(Department of Mathematics, University of Natal, Durban)*
NJ Breytenbach *(I.M.T., Simonstown)*
JP Du Plessis *(University of Stellenbosch)*
E Eitelberg *(Dept. of Electrical Engineering, University of Natal, Durban)*
J Flachs *(Council for Scientific and Industrial Research, Pretoria)*
T Geveci *(Council for Scientific and Industrial Research, Pretoria)*
JS Goodey *(Technikon, Pretoria)*
BM Herbst *(University of the Orange Free State)*
GR Joubert *(Philips, Eindhoven)*
JD Kies *(Department of Computer Science, University of Western Cape)*
DP Laurie *(University of Potchefstroom)*
DS Lubinsky *(Council for Scientific and Industrial Research, Pretoria)*
MF Maritz *(University of the Orange Free State)*
S McKee *(Oxford University)*
AF Meiring *(Universtiy of Pretoria)*
HG Miller *(Council for Scientific and Industrial Research, Pretoria)*
DM Murray *(I.M.T., Simonstown)*
JD Neethling *(NUCOR, Pretoria)*
L Pretorius *(Council for Scientific and Industrial Research, Pretoria)*
RM Quick *(Council for Scientific and Industrial Research, Pretoria)*
BD Reddy *(Dept. of Applied Mathematics, University of Cape Town, Rondebosch)*
H Riphagen *(Council for Scientific and Industrial Research, Pretoria)*
CH Rohwer *(I.M.T., Simonstown)*
AG Sartori-Angus *(Department of Computer Science, University of Natal, Durban)*
SW Schoombie *(Dept. of Applied Mathematics, University of the Orange Free State)*
JA Snyman *(Dept. of Applied Mathematics, University of Pretoria, Pretoria)*
D van Foreest *(Dept. of Oceanography, University of Cape Town)*
FD van Niekerk *(Department of Mathematics, University of Pretoria)*
NSJ van Rensburg *(Dept. of Applied Mathematics, University of Pretoria)*
HJ van Walsem *(Department of Chemical Engineering, University of Pretoria)*
D Vermeulen *(UCOR, Pretoria)*

HJ Viljoen *(Department of Chemical Engineering, University of Pretoria)*
JAC Weideman *(Dept. of Applied Mathematics, University of the Orange Free State)*
CJ Wright *(Dept. of Applied Mathematics, University of the Witwatersrand)*
Y Yavin *(Council for Scientific and Industrial Research, Pretoria)*
TJ Ypma *(Dept. of Applied Mathematics, University of the Witwatersrand)*

CONTENTS

	page
Preface	iii
Participants	iv
UCINA - A vehicle for academic-industrial collaboration *by S. McKee*	1
Weakly singular discrete integral inequalities and their applications *by J. Dixon and S. McKee*	29
Parallel mimd algorithms for initial-boundary value problems *by G.R. Joubert*	70
Tridiagonal system solvers for an experimental parallel computer *by G.R. Joubert and E. Cloete*	96
Practical error estimation in numerical integration *by D.P. Laurie*	112
Splitting methods for the Cubic Schrödinger Equation *by J.A.C. Weideman*	114
The adjustment of accelerometer data *by D.M. Murray*	116
Friction factor prediction for fully developed laminar twisted-tape flow *by J.P. du Plessis and D.G. Kröger*	118
Linear stability of stiff differential equation solvers *by T.J. Ypma*	122
Stability of numerical solutions of equations arising in the dynamic fracture of curved composite beams *by S. Adali*	124
Variational inequalities and penalty methods in plasticity *by B.D. Reddy*	126
A structured quadratic program *by N.J. Breytenbach*	128
The quadratic isoparametric transformation of the triangle *by M.L. Baart*	130
Some properties of an estimate of structured Jacobians and Hessians *by J. Flachs*	132
Collocation with non-polynomial B-Splines *by C.J. Wright*	134
Numerical nonlinear instability in the Korteweg-De Vries equation *by M.F. Maritz*	152

page

Convolution with the aid of B-Splines
by C.H. Rohwer 154

Numerical Differentiation in the Tokamak Plasma Equilibrium problem *by J.D. Neethling* 162

Solution of Burgers' equation with large Reynolds numbers
by F.D. van Niekerk 166

Die numeriese oplossing van Burger se vergelyking met groot Reynolds getalle deur 'n ruimte-tyd eindige-element-metode
by F.D. van Niekerk 168

A simple general purpose A_2-stable numerical method for dynamical systems with stiff oscillations *by E. Eitelberg* .. 180

Modular simulation of complex dynamical systems
by E. Eitelberg 182

The construction of an arc of bifurcation points for a tubular reactor model *by H. Viljoen* 184

Product integration rules *by D.S. Lubinsky* 188

The application of spectral methods in numerical weather prediction *by H.A. Riphagen* 192

Nonlinear instability
by B.M. Herbst 212

A stochastic pursuit-evasion differential game on a Torus: A numerical solution *by Y. Yavin* 214

Numerical methods for the solution of non-linear optimization problems *by J.D. Kies* 216

Multiple solutions of an elliptic partial differential equation
by H.J. van Walsem 220

A galerkin approach for modelling oceanic fronts in coastal waters *by D. van Foreest* 222

"Richardson's Second Method" and stiff O.D.E. systems
by R.A.B. Bond 224

Procedures for global optimization
by J.A. Snyman 226

Boundary elements applied to reservoir problems containing singularities *by G.N. Bakkes and J.F. Botha* 250