PROCEEDINGS OF THE MATHEMATICS IN INDUSTRY STUDY GROUP

2018

Mathematics in Industry Study Group South Africa
MISGSA 2018

The writing of a Technical Report for the Proceedings of the MISGSA was coordinated by the moderator of the problem. Sections of the Report were written by the moderator and by other members of the study group who worked on the problem.

The Editor of the Proceedings was

Prof D P Mason (University of the Witwatersrand, Johannesburg)

The Technical Reports were submitted to the Editor. Each Report was refereed by one referee. On the recommendation of the referees the Reports were accepted for the Proceedings subject to corrections and minor revisions. The Editor would like to thank the referees for their assistance by refereeing the Reports for the Proceedings.

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PREFACE

The fifteenth Mathematics in Industry Study Group (MISG) in South Africa was held in the School of Computer Science and Applied Mathematics at the Unversity of the Witwatersrand, Johannesburg, from Monday 15 January to Friday 19 January 2018.

The total number of registered participants at the MISG was sixty-six. There were seventeen Academic Staff, one Postdoctoral Fellow, thirty-three Graduate Students and six Industry Representatives. The invited guests were:

Graeme Hocking	Murdoch University, Western Australia, Australia
Neville Fowkes	University of Western Australia, Australia
Sarah Mitchell	University of Limerick, Ireland
Tim Myers	Centre de Recerca Matematica, Barcelona, Spain
Dr Denis Ndanguza	University of Rwanda, Rwanda
Dr Brendan Florio	University of Western Australia, Australia

The South African Universities and Institutes which were represented were:

African Institute for Mathematical Sciences
North-West University
University of Cape Town
University of Johannesburg
University of KwaZulu-Natal
University of Pretoria
University of South Africa (UNISA)
University of Stellenbosch
University of the Witwatersrand
University of Zululand

Participants also came from the following Universities:

Covenant University, Nigeria
University of Lagos, Nigeria

The MISG was officially opened on Monday morning by Professor Ebrahim Momoniat, Dean of the Faculty of Science, University of the Witwatersrand.

The MISG followed the established format for Study Group meetings held throughout the world. South African industry had been approached to submit problems during 2017. Six problems were submitted. On Monday morning each Industry Representative made a twenty-five minute presentation in which the problem was described and outlined. The academics and graduate students then split into small study groups and worked on the problems of their choice. Some participants worked on one problem while others moved between problems and made contributions to several problems. Each problem was co-ordinated by an academic moderator and one or more student moderators. The role of the academic moderator was to co-ordinate the research on the problem during the week of the meeting and also to do preparatory work including literature searches before the meeting. The main function of the student moderators was to present short reports at the end of each working day on the progress made that day. The moderators were in contact with the Industry Representatives throughout the meeting. On Friday morning there was a full report back session to industry. Each senior moderator, with assistance from the student moderators, made a twenty-five minute presentation, summing up the progress made and the results that were obtained. Each Industry Representative then had five minutes to comment on the progress and the results which were reported. The MISG ended at lunch time on Friday.

The MISG was preceded by a Graduate Modelling Camp from Wednesday 10 January to Saturday 13 January 2018. The objective of the Graduate Modelling Camp is to provide the graduate students with the necessary background to make a positive contribution to the MISG the following week. The students were given hands-on experience at working collaboratively in small groups on problems of industrial origin, some of which were presented at previous MISG meetings, at interacting scientifically and at presenting oral reports on their findings. Five problems were presented to the graduate students. The problems and the presenters were:

On-line sales and data analytics	Jeff Sanders, African Institute for Mathematical Sciences and University of Stellenbosch

Gas venting	Neville Fowkes University of Western Australia
Instabilities in fluids	David Mason University of the Witwatersrand
Flaws in plate glass	Neville Fowkes University of Western Australia
Polynomial time approximation scheme for the knapsack problem	Montaz Ali University to the Witwatersrand

The graduate students worked in small study groups on the problem of their choice. Each group presented their results at a report back session on Saturday afternoon.

The sponsors of the Graduate Workshop and the MISG were:

- Hermann Ohlthaver Trust
- African Institute for Mathematical Sciences
- DST-NRF Centre of Excellence in Mathematical and Statistical Sciences
- Faculty of Science, University of the Witwatersrand
- School of Computer Science and Applied Mathematics, University of the Witwatersrand

We thank the sponsors without whose support the Graduate Workshop and the MISG could not have taken place.

STUDY GROUP

Participants

Academic staff	
Ali, Montaz	University of the Witwatersrand
Adamu, Patience	Covenant University, Nigeria
Adeleke, Olawale	Covenant University, Nigeria
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Florio, Brendan	University of Western Australia, Australia
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Khalique, Masood	North-West University
Krishnannair, Syamala	University of Zululand
Laurie, Henri	University of Cape Town
Mason, David	University of the Witwatersrand
Michell, Sarah	University of Limerick, Ireland
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S'yanda, Mungwa	Stellenbosch University
Sawyerr, Babatunde	University of Lagos, Nigeria
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Graduate Students	
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Alochukwu, Alex	University of Johannesburg
Atherfold, John	University of the Witwatersrand
Bekker, Rebecca	University of Pretoria
Blomerus, Wessel	University of Stellenbosch
Borole, Letabo	University of the Witwatersrand
Bouchareb, Yasser Salah	AIMS
Chukwu, Williams	University of Johannesburg
Denham-Dyson, Ivor	University of the Witwatersrand
Dlamini, Anastacia	University of Johannesburg
Dlongolo, Simphiwe	University of KwaZulu-Natal
Dumani, Phindile	University of Pretoria
Egbelowo, Oluwaseun Francis	University of the Witwatersrand
Hlophe, Nkosinathi	AIMS
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Josias, Shane	University of Stellenbosch
Julyan, Jonathan	University of the Witwatersrand
Langat, Vincent	AIMS

Lebese, Thabang	AIMS and University of the Witwatersrand
Levin, Ben	UNISA
Mabasa, Rishile	University of the Witwatersrand
Manjoo-Docrat, Raeesa	University of the Witwatersrand
Marè, Esmari	University of Stellenbosch
Marote, Tsitsi	University of the Witwatersrand
Matsebula, Lunga	University of Johannesburg
Nchabeleng, Mathibele	University of the Witwatersrand
Nchupang, Mojalefa Prince	University of Cape Town
Netshiunda, Emmanuel	University of the Witwatersrand
Nkomo, Nolwazi	University of KwaZulu-Natal
Oloniiju, Shina	University of KwaZulu-Natal
Prag, Krupa	University of the Witwatersrand
Industry Representatives	
Erasmus, Barend	Global Change Institute, University of the Witwatersrand
Ndanguza, Denis	Department of Mathematics, College of Science and Technology, University of Rwanda, Ruwanda
Nhleko, Sihesenkosi	School of Mining Engineering, University of the Witwatersrand
Louber, Richard	Sugar Milling Research Institute, University of KwaZulu-Natal Durban
Starzak, Matthew	Sugar Milling Research Institute, , University of KwaZulu-Natal Durban
Tholana, Tinashe	School of Mining Engineering, University of the Witwatersrand

GRADUATE MODELLING CAMP

Participants

Coordinator	
Mason, David	University of the Witwatersrand
Problem presenters	
Ali, Montaz	University of the Witwatersrand
Fowkes, Neville	University of Western Australia
Kgatle, Rahab	University of the Witwatersrand
Mason, David	University of the Witwatersrand
Sanders, Jeff	AIMS and University of Stellenbosch
Graduate Students	
Abdulsalaam Sakirudeen	University of the Witwatersrand
Alochukwu, Alex	University of Johannesburg
Bekker, Rebecca	University of Pretoria
Blomerus, Wessel	University of Stellenbosch
Borole, Letabo	University of the Witwatersrand
Bouchareb, Yasser Salah	AIMS
Chukwu, Williams	University of Johannesburg
Denham-Dyson, Ivor	University of the Witwatersrand
Dlamini, Anastacia	University of Johannesburg
Dlongolo, Simphiwe	University of KwaZulu-Natal
Dumani, Phindile	University of Pretoria
Hlophe, Nkosinathi	AIMS

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Julyan, Jonathan	University of the Witwatersrand
Khamisa, Basheerah	University of the Witwatersrand
Langat, Vincent	AIMS
Lebese, Thabang	AIMS and University of the Witwatersrand
Levin, Ben	UNISA
Mabasa, Rishile	University of the Witwatersrand
Manjoo-Docrat, Raeesa	University of the Witwatersrand
Marè, Esmari	University of Stellenbosch
Marote, Tsitsi	University of the Witwatersrand
Matsebula, Lunga	University of Johannesburg
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Randrianomentsoa, Rojo Fanamperana	AIMS
Seeban, Nibhana	University of the Witwatersrand
Tholana, Tinashe	University of the Witwatersrand
Tsoirintsoa, Sandra	AIMS
Wang, Yilun	University of the Witwatersrand

PROBLEMS

PROBLEM 1

Title: DIFFUSER TRACER TEST INTERPRETATION

Industry: Sugar

Industry representatives: Richard Loubser and Matthew Starzak, Sugar Milling Research Institute, University of KwaZulu-Natal, Durban.

PROBLEM 2

Title: STOCHASTIC BLOCK ECONOMIC VALUE MODELLING FOR GENERATING PROBABILITY STOPES

Industry: Mining

Industry representatives: Tinashe Tholana, School of Mining Enfineering, University of the Witwatersrand.

PROBLEM 3

Title: AN ALGORITHM FOR STOPE BOUNDARY OPTIMIZATION FOR UNDER-GROUND MINES

Industry: Mining

Industry Representative: Sihesenkosi Nhleko, School of Mining Engineering, University of the Witwatersrand.

PROBLEM 4

Title: MATHEMATICAL MODELLING OF METHANE GAS EXTRACTION FROM LAKE KIVU

Industry: Energy

Industry representative: Denis Ndanguza, University of Rwanda, Rwanda.

PROBLEM 5

Title: ALGORITHM TO COUNT MODERN HOUSES FROM LiDAR DATA SETS OVER RURAL AREAS IN MPUMALANGA

Industry: Environmental monitoring and data analysis

Industry representative: Barend Erasmus, Director, Global Change Institute, University of the Witwatersrand.

PROBLEM 6

Title: SPONTANEOUS COMBUSTION OF STOCK-PILED COAL

Industry: Coal

Industry representative: Barend Erasmus, Director, Global Change Institute, University of the Witwatersrand.