



# Newsletter

Operations Research Society of South Africa  
Operasionele Navorsingsvereniging van Suid-Afrika

**JUNE 2008**

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## FROM THE EDITOR



**Basic Kok**

Welcome to the mid-year edition of the ORSSA newsletter 2008! I'm sure many of you are looking forward to the upcoming IFORS conference in Jo'burg and I too look forward to seeing you at this exciting event!

We kick off this edition with a letter from our Vice-president Marthi Harmse on behalf of our president Sarma Yadavalli, who is heavily focused on the organisation of the IFORS conference, a

truly colossal task.

The member interview this month is with Francois Bester, the new business editor for the newsletter and an upcoming OR consultant and entrepreneur. It was my pleasure to hear Francois thoughts on OR in practice and to introduce him to the society.

Our feature article this month (incase you were squinting at the front cover and wondering what to make of it) is entitled *A Multi-objective Evolutionary Meta-algorithm with an Application to Water Distribution System Design*, written by Mr Darian Raad of the department of Logistics at the University of Stellenbosch. The piece showcases meta-heuristics for water distribution system design and incorporates evolutionary algorithms, genetic algorithms and swarm theory. Darian's charisma and extensive knowledge shines through his writing and I can guarantee an entertaining and fascinating read.

During the course of my current research which is in the military domain, I have come across some fascinating applications of OR in war, which as many of you know was the generally accepted birth place of OR. Our OR anecdotes column this month is therefore entitled *The birth of OR during WWII* and features some of the exemplary work done by OR giants like Patrick Blackett and Frank Yates during the war years.

I hope you enjoy this issue as much as I enjoyed compiling it!

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### International Federation of Operational Research Societies (IFORS) Conference 13-18 July 2008

**Sandton Convention Center, Johannesburg**

*Operational Research: Developing communities, managing the connections amongst them.*

Regular Registration : Deadline 30 June 2008

Student Registration : Deadline 30 June 2008

<http://www.ifors2008.org>

*proudly hosted by ORSSA*





## FROM THE PRESIDENT'S DESK

by Marthi Harmse (marthi.harmse@sasol.com)

ORSSA Vice-President



Marthi Harmse

Dear ORSSA friends

Here I am again, typing to you from my notebook. This time I do it on behalf of our dear President, Sarma Yadavalli, who has to put all his energy and precious time into the upcoming triennial conference of the International Federation of Operational Research Societies (IFORS).

The conference is hosted, as all of you are aware, for the first time in Africa and only for the second time in the southern hemisphere, at the Sandton Convention Centre from 13 to 18 July 2008. I cannot wait to welcome all our Operations Research friends from all over the world to South Africa! I assume everyone will seize this rare opportunity – whether you have to walk there, beg the Salvation Army for a bed or live on water and dry bread for a month beforehand. The programme is very enticing (available on [www.ifors2008.org](http://www.ifors2008.org) > Programmes > Delegate Programme > download provisional programme). Before the conference there is a free GAMS workshop, Clem Sunter will do the official opening of the conference, Donald Ratliff will make a presentation on supply chain management, Luk van Wassenhove will make a presentation on humanitarian logistics, Vijay Chandru will make a presentation on bringing computers to the world, and after the conference an international workshop on stochastic and applied global optimisation will be hosted. A splendid welcome reception is planned as well as a full day for excursions and a glorious gala dinner. If for some very unfortunate reason you cannot participate, please ask a friend to take notes and pictures for you. Next time – which happens only in 2011 – you will have to swim to Melbourne!

One of the reasons you have to be at the conference, is that the annual ORSSA dinner will be hosted during the conference when

we will honour the best paper published by a member during 2007, long-standing full members who have served the society in an exemplary manner for a considerable period of time, individuals who have served the profession of Operations Research in an exemplary fashion through outstanding achievements and/or contributions typically over a long period of time, as well as the winners of the ORSSA/SAS student competition.

Another reason you have to be there is that, preceding our annual dinner, we will have our annual general meeting. At this meeting we have to vote on important matters such as our membership fees. I know that currently everyone is experiencing hard financial times and that it is difficult to convince your family that they too must live on water and dry bread just because you want to be part of a society that is a natural professional home to you. Unfortunately ORSSA faces challenges too, including to biannually publish an official accredited journal (ORiON), quarterly publish this newsletter, maintain a website ([www.orssa.org.za](http://www.orssa.org.za)), annually host a conference (often of international nature such as this and last year), host chapter activities, make annual awards, actively participate in international Operations Research bodies, liaise with other professional bodies such as the South African Council for Natural Scientific Professions, participate in African initiatives, advertise job opportunities and provide opportunities to network with professional peers to get exposed to how Operations Research is applied elsewhere, and thereby better equip Operations Research practitioners.

In the next few weeks you will receive a letter proposing to raise our membership fees to be more in line with other professional bodies in South Africa. Please ensure that you are there to vote – your vote really matters. Please let your voice be heard by contacting any executive committee member on how you and I can make ORSSA an even greater home to Operations Research in South Africa.

(Nice chatting to you again.)

Marthi Harmse



September 3rd-5th 2008, University of Augsburg, Germany

Today's business has gone global in most manufacturing and service industries leading to an increased complexity of the underlying production, distribution and selling processes. Operations Research represents one of the most successful instruments for organizing such business processes, as many applications in the areas of, e.g., supply chain management or financial management show. However, still many new challenges are on the horizon, in particular when taking environmental effects into account. OR 2008 represents a platform for both, describing successful applications as well as discussing new developments.

<http://www.wiwi.uni-augsburg.de/or2008/>

## MEMBER INTERVIEW: FRANCOIS BESTER

by Basie Kok (bkok@dip.sun.ac.za)



Francois Bester is the current newsletter business manager for ORSSA and I have had the pleasure of recently working alongside him. I have naturally been impressed by his business savvy and efficiency and was intrigued to learn that he has recently started an Operations Research consultancy.

### Francois Bester

After graduating from Stellenbosch University with a BComm in 2000, Francois worked in a financial position at Westcape Bandag until 2002, and thereafter as a general manager at Bester Bodyworks until 2004 when he took a position as production manager at Distell. Francois worked at Distell until he began fulltime with his consultancy in 2008.

### How long have you been involved in OR and what attracted you to it?

I have been involved in Operations Research for approximately 2-3 years. My wife is an OR practitioner and always came home with the most interesting stories about what challenges she faced, and that is where my interest in OR started.

### Are you intrigued by any specific branch of OR?

I am mostly working with scheduling, and route planning problems at the moment, and area of great interest for me.

### You are currently business manager for the ORSSA newsletter. Could you share some insight into what you have experienced so far, and your vision for the newsletter and ORSSA as a whole from a business perspective?

I would like to expand the newsletter and ensure that there is more constructive interaction between industry and academia. I believe industry could bring a lot more to the newsletter, and it would be my aim to reach a broader audience with the newsletter in this respect.

### You have recently started an Operations Research Consultancy called OPRECON. Could you share a little about it and perhaps comment on the demand for your services in the Western Cape and in the country as a whole.

OPRECON is the short for Operations Research Consulting. It is currently a start-up company, based in the Western Cape. We are currently focussing mainly on the Wine and Paper industries and also on small to medium enterprises based in the Western Cape and Gauteng Provinces. Currently we have three to four contract workers, two of whom are OR professionals. We have not actively started to advertise inside South Africa and we are already extremely busy. It seems the current economical changes are forcing people to face unique challenges and make better decisions. Offering decision support in these environments seems to be invaluable within the current economic climate. OR is not well known in South Africa and

the biggest challenge so far has been in educating the industry about the great role OR could play in improving their processes as well as financial decisions.

### What role do you think ORSSA can play in bringing together clients and OR consultancies? What definitive steps do you we, as a society can take to fulfil this role?

I believe that the ORSSA society could play a bigger role in getting the industry and academy together by ensuring that training institutions get more involved in real life problems in the industry. They could also play a role in ensuring that the industry knows more about what OR is in general and what it can be used for. I believe that the ORSSA society can start by promoting OR at school level.

### Many fascinating papers will most likely be presented at the upcoming IFORS conference by our OR colleagues from overseas. In your experience as a consultant, and from what you have seen within the society, what makes OR practice in the developing world different from the developed?

I do not have a lot of experience internationally in OR, and had to discuss this with an OR practitioner with experience in developing and developed countries, Eva Neves. This was her response: *“Based on my experience, I believe that OR techniques are more widely used in developed countries. In my opinion, this is mainly due to the fact that OR and its applications are more widely known by businesses and the benefits have been proved over and over again in some of the biggest and most successful companies. The fact that universities in some countries have a better link to businesses has enhanced the use of the actual techniques in specific industries. In under developed countries, this link between academia and the real world is not apparent, and by no means strong enough.*

*Furthermore, under developed countries tend to have more basic needs and the use of OR techniques are not necessarily seen as provided a big enough economic benefit in the areas of importance for the country.*

*It is important to note that some of the areas where OR could provide a huge benefit are still not developed, even in the countries where OR plays a role in some industries. Some OR practitioners focus on finding non-OR solutions (E.g. IT solutions or simple business ideas) to business problems and, even though they call it OR, it is something a lot of other specialties could do. It seems to me this is in the area where again universities and businesses are not being successful enough in the linking of technical knowledge to solve real business problems.*

*Finally, OR specialist teams exist in many organizations in the developed world; something I have not extensively observed in the under developed world, for example. These teams are mainly formed by OR trained staff, whilst other types of disciplines (e.g. industrial engineers) do not get involved in traditionally OR areas. This is not true throughout the under developed world.*

*I must admit that I don't believe that sometimes OR is used*

*as much as it should anywhere in the world. Once a technique has been used to solve a problem, not much evolution occurs in bettering the technique or choosing another one. The meaning and purpose of OR is not really clear to many people and this causes confusion with regards to its potential anywhere."*

I believe that in general OR is such a well know field in the developed countries that the battles faced are not educating the industry on what OR can do, but rather how to make already good processes better, whereas in developing countries the battle is more on how to get people to believe in the power of "The Science of Better"!

**What is your goal as an Operation Researcher in South Africa?**

1. Assist in developing the country by applying OR methods.
2. Assist in improving the economy by investing in making better decisions in small to medium enterprises.
3. Ensure that up and coming Operations Researchers in South Africa get experience in real life problems before entering the work force

**1st International Conference on Applied Operational Research (ICAOR'08)**

15-17 September 2008

American University of Armenia  
Yerevan, Armenia

**Abstract**

The conference is a yearly forum which brings together academics and practitioners from around the world with an opportunity to discuss current issues in an informal setting. The ICAOR 2008 conference will take place at American University of Armenia (AUA) in the city of Yerevan. We invite you to join your colleagues for this international meeting.

**Important Dates**

- 10-Jun-08 - Registration deadline
- 30-Jun-08 - Camera-ready deadline
- 15-Sep-08 - Conference starts

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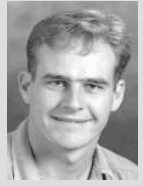
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BY GORAN DRAGOSAVAC,  
NATIONAL PRODUCT MANAGER  
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## Analytics: Batting with Stats

**Any organisation can generate intelligence garnered from its organisational data pertaining to certain aspects of business, be it revenue per customer, employee or average sales using simple calculations, but that simply isn't business analytics.**

Companies that use analytics look way beyond the basic statistics. They look from both inside and outside the organisation and analyse the data using complex techniques to gain a comprehensive understanding of their business and their competitors.

*Decision making in the presence of risk is becoming a more and more rational task, to a degree where it even can be partially automated.*

Ultimately it's the customers that drive the difference. Organisations that are at the top of their game with business analytics don't behave like traditional companies, they act on the intelligence and customers notice it in every interaction. In today's business boardroom, decision making has never been harder and the managers that are best able to weigh up the risks and make appropriate decisions have always been the most successful.

Sometimes this means being bold, often it means being conservative, but more than ever, it means that gut feeling and basic instincts count less. Decision making in the presence of risk is becoming a more and more rational task, to a degree where it even can be partially automated. Analytics makes use of predictive modelling to identify, for example, which customers are the most profitable, those who are likely to be profitable in future, and those who are heading for the door to competitors. Analytics can also be used to create complex models of how their operational costs relate to their financial performance, for example.

Analytics requires a significant investment in technology, the accumulation of massive

amounts of data, and the formulation of company-wide strategies for managing data. This should be done in a coordinated way as part of an overall strategy that is driven and supported by top management and pushed down to every employee within a company so that they have the best tools to make decisions faster.

However, while many organisations have embraced analytics as a competitive advantage, there are few that have reached this level of proficiency, but those who have, are leaders in their fields – be it in retail, finance, travel or entertainment.

At most of the successful organisations that I know, business intelligence is part and parcel of their key strategy, and they have multiple initiatives underway that involve complex data and statistical analysis that is managed at an enterprise level. In order to achieve this, companies must undergo substantial changes in order to compete on quantitative turf.

In traditional organisations, business intelligence is generally well managed by departments, which select their own tools, control their own data warehouses and do their own training. As a result, the proliferation of spreadsheets and databases inevitably leads to multiple versions of key indications within an organisation, and creates a breeding-ground for errors.

Companies need to have centralised groups to ensure that the critical data and databases are well managed, analysed and acted upon, and that the data can be shared across the enterprise in consistent formats, definitions and standards.

While management buy-in seems like an obvious part of creating an analytics powerhouse, sometimes it's not all that simple. Deriving benefits from advanced analytics also requires a change in company culture, processes, and behaviour as well as upskilling staff. This in turn requires executive leadership from the very top and those who have the

passion to make things work. Ideally that should be the CEO and not just business unit leaders.

While those leaders who drive the project do not necessarily have a degree in statistics and number-crunching, they do need to understand the theory behind various statistical methods to understand their limitations.

For analytical-minded leaders, the challenge really lies in the right focus. They really have to choose where to direct their resource-intensive efforts that together, serve an overarching analytics strategy. Then there is the issue of culture. Employees should be urged to base decisions on facts. And they should know that their performance is gauged in the same way. Lastly, competing with analytics means competing on technology. While successful organisations investigate the latest statistical algorithms and decision science approaches, they also monitor and push the IT frontier.

Enterprise resource planning, customer relationship management, point of sale, and other systems ensure that no transaction or significant exchange goes unnoticed. But for companies wanting to compete on that information, they must use business intelligence software which presents it in standard formats, integrates it, stores it in a data warehouse and makes it easily accessible to everyone in the organisation.

**To learn more about how to meet the requirements for real-time decision making, contact SAS on +27 11 713 3400 (Johannesburg and Pretoria) or +27 21 912 2420 (Cape Town) or visit our website, [www.sas.com/sa](http://www.sas.com/sa).**



**THE POWER TO KNOW.**





# A Multi-objective Evolutionary Meta-algorithm with an Application to Water Distribution System Design

by Darian Raad, Department of Logistics, Stellenbosch University  
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These days the only excuse for using an ‘ordinary’ genetic algorithm is that of classroom instruction. The primordial ideas of Holland (1975) and others have evolved into a veritable horde of nature-inspired meta-heuristics, furnishing the practitioner with a performing circus of frogs, ants, swarms, social metaphors and self-adaptive cyborgs. With such an awesome abundance of choice, the biggest problem is almost not the one you are trying to solve. The advent of the Multi-objective Evolutionary Algorithm (MOEA) has ushered in an age of efficient innocence – no longer do we have to put a price on human misery by means of weighting coefficient, or endure the nightmare of goal-programming our black-box problem in  $n$  objectives. Pareto-optimality can happily be scalarized in a number of ways and, coupled with a good diversity measure, we have that efficient frontier in no time<sup>1</sup>!

In my opinion, the most important developments in population-based meta-heuristics have been the leap to multiple dimensions via Pareto-based fitness and objective space niching, the hybridization of search strategies to improve effectiveness (such as the incorporation of local search and domain heuristics), the dynamic auto-adaptation of optimization parameters which avoids tiresome manual parameter tuning and promises enhanced performance (such as adaptive population sizing), the incorporation of multi-resolution analysis (whether through decomposition into independent sub-problems or iteratively refined global approximation), and the emergence of statistical learning techniques embodied in the class of Estimation of Distribution Algorithms (Pelikan *et al.*, 2006) which render obsolete (or at least very embarrassed) the classical variation operators (*e.g.* genetic crossover and mutation). There is still much research to be done on how to combine these ideas effectively.

This article is about a meta-algorithm named AMALGAM (Vrugt and Robinson, 2007) and its application to the design of water distribution systems. AMALGAM takes hybridization to the highest level and allows for the inclusion of any of the features previously mentioned. It does so by simultaneously considering multiple diverse optimization algorithms, and partitioning the creation of offspring in each generation amongst these algorithms based on their recent performance. The actual algorithm is very simple if one is already familiar with the Non-dominated Sorting Genetic Algorithm (NSGA-II) by Deb *et al.* (2002), a popular MOEA.

It has an almost identical main loop, including the fast sorting of solutions into non-dominated fronts in objective space, and elitist selection based on front membership depth and a crowding distance measure which promotes diversity by favouring isolated solutions.

The only new trick is the formula which controls offspring partitioning. For AMALGAM with  $k$  sub-algorithms this is

$$N_i^{t+1} = \left[ N \frac{S_i^t}{N_i^t} / \sum_{h=1}^k \frac{S_h^t}{N_h^t} \right],$$

where  $N_i^{t+1}$  is the number of offspring to be generated by algorithm  $i$  during generation  $t+1$ ,  $N$  is the population size,  $S_i^t$  is the number of algorithm  $i$ 's offspring which survive the selection process during generation  $t$ , and the whole is scaled by the sum total of the survival ratios of all the algorithms. Each algorithm has access to the entire population from which to harvest and exploit chromosomes in its unique manner, and the best individuals are selected from the union of the parent and combined offspring populations to survive to the next generation. In the hope of extracting utility during a later phase of the search, algorithm deactivation (*i.e.*  $N_i^{t+1} = 0$ ) is avoided by specifying a low minimum number of offspring.

Vrugt and Robinson (2007) tested AMALGAM using four competitive sub-algorithms, each with very different search mechanisms and strengths. These were NSGA-II, Adaptive Metropolis (Gelman *et al.*, 1995), Differential Evolution (Price *et al.*, 2005), and Particle Swarm Optimization (Hu *et al.*, 2003). They applied AMALGAM to a set of challenging multi-objective benchmark problems in the continuous domain, and achieved a tenfold improvement in efficiency over the best of the sub-algorithms used on their own. Previous theory and numerical experiments have suggested the impossibility of developing a single algorithm which performs efficiently over a diverse set of problems, also known as a ‘No Free Lunch’ theorem (Wolpert and Macready, 1997). The philosophy underlying AMALGAM is that the diverse strengths of these different meta-algorithms can be combined and exploited dynamically to produce a faster, more robust search than is possible with any one of the algorithms on its own. Anyone for lunch?

The author was involved in a study which applied AMALGAM to multi-objective water distribution system (WDS) design (Raad *et al.*, 2008). The problem is that of finding the combination of pipe sizes (chosen from a discrete set) for a given network specification which satisfies consumer demands over time within the required pressure and velocity constraints. This formulation also allows for the design of the actual

## DISCLAIMER

The views expressed in this newsletter are those of the contributors, and not necessarily those of the Operations Research Society of South Africa. The Society is not responsible for the accuracy of details concerning conferences, advertisements, etc., appearing in this newsletter. Members should verify those aspects themselves if they intend to respond to them.

<sup>1</sup>Actual performance may vary.



network layout by inputting one which is redundant and supporting pipe elimination. For each potential configuration, a hydraulic simulation must be conducted to calculate the system flows and pressures. For this purpose the popular hydraulic simulator EPANet 2 (Rossman, 2000) was employed.

This is an inherently multi-objective problem, since there is always a trade-off between cost and various system benefits. Therefore the desired output of optimization is an approximation of the true Pareto-optimal solution set. It is highly desirable to provide surplus capacity to make the system robust against failure and extremes of demand, and furnish room for growth. Typically one must analyze performance under multiple demand loading conditions, including a zero-flow scenario. In order to obtain an accurate estimate for probabilistic hydraulic reliability (the probability that consumer demand and hydraulic requirements are met), one must conduct Monte-Carlo simulations, varying the demand. This is a computationally intensive procedure since each configuration under each demand sampling requires a full hydraulic simulation, aggravated by the use of population-based algorithms. Therefore a surrogate measure of WDS reliability, called *network resilience* (Prasad and Park, 2004), was employed which is based on the sum of the surplus power at the demand nodes (all points where water is extracted from the network) adjusted by the degree of similarity between connected pipes at these nodes. Where applicable, multiple demand scenarios were employed. The objectives considered were capital cost and surrogate reliability, and a penalty term was added to the cost for infeasible solutions in order to strive towards feasibility.

The following algorithms were selected for this study to be used within the AMALGAM framework: NSGA-II, NSGA-II-JG (a 'jumping gene' variation of the former), a Greedy Design Heuristic based on engineering judgement, and a basic Particle Swarm Optimizer (PSO). The first three algorithms are specifically formulated for multi-objective optimization, and the PSO algorithm is a single objective formulation which fails to find feasible solutions on its own. The greedy algorithm uses various practical steps to search for improved neighbouring solutions, such as identifying the pipe causing the greatest pressure loss and incrementing its diameter. A number of WDS benchmark systems were used to test AMALGAM.

## QUERIES AND CONTRIBUTIONS

Address all queries or contributions to the editor:

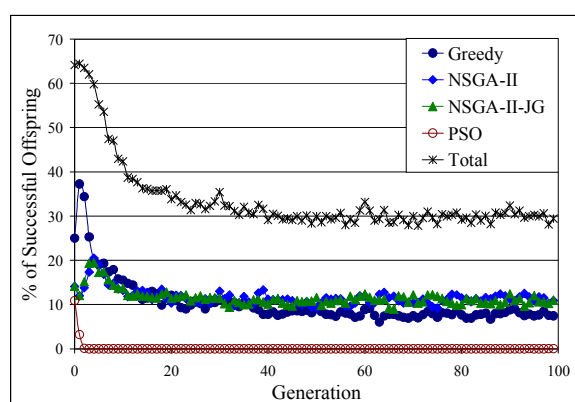
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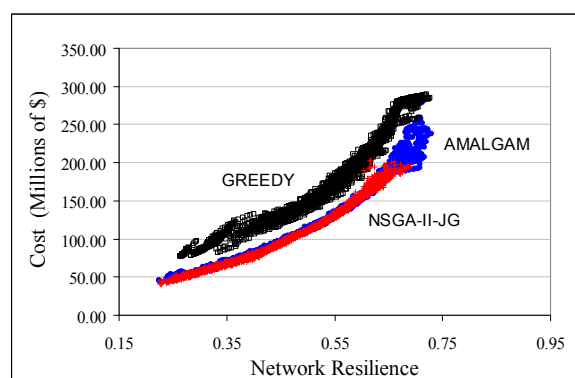
The dynamic performances of the sub-algorithms per generation on a typical benchmark system for 20 optimization runs are presented in Figure 1 (performance is expressed as the average percentage of successful (surviving) offspring relative to total population size). The greedy algorithm dominates the search initially and gradually becomes less useful towards the end of the run, when the two NSGA-II algorithms vie for the lead. The PSO algorithm contributes only during the first few generations of the search, and thereafter fails to locate new solutions. However, it is interesting to note that AMALGAM performs better overall with PSO included than without it, which clearly hints at the power of diversity.

In testing, AMALGAM generally exhibits superior performance when compared to the sub-algorithms on their own, both in terms of Pareto-optimality and diversity (spread) along the Pareto-front (although the NSGA-II-JG algorithm was very competitive on certain benchmarks).



**Figure 1:** Average % of successful offspring per generation per sub-algorithm on Benchmark 1.

The objective vectors of the results for optimization on a second benchmark WDS appear in Figure 2. The aggregation of 20 final approximation sets per algorithm is shown for the Greedy, NSGA-II-JG and AMALGAM algorithms. It is clear that the Greedy algorithm output is entirely dominated by that of the other algorithms. Furthermore, although both NSGA-II-JG and AMALGAM seem to converge fairly reliably to a similar Pareto-front, AMALGAM is able to find additional solutions of high reliability.



**Figure 2:** Aggregation of approximation sets (20 runs per algorithm) in objective function space for Benchmark 2.

AMALGAM was applied to a new South African WDS development project in Ekurhuleni (East Rand, Gauteng Province) called the R21 Corridor development area, where currently no water infrastructure exists. The task is to design the bulk infrastructure for a gravity WDS (*i.e.* one without pumps), which will supply water to new residential and industrial areas. The basic network layout (Figure 3) and technical information has been supplied by GLS Software<sup>2</sup>. The design guidelines for hydraulic limits and demand scenarios are taken from the Johannesburg Water and Tshwane Municipality guidelines (including the SANS 100090 standard for fire fighting). The proposed system comprises 82 pipes. It was decided to augment it by an additional 7 pipes (represented by dotted lines) to create a redundant layout. An hourly time-series of demand was considered using typical demand patterns for residential and industrial zones, as well as a zero-flow condition and an industrial fire scenario at nodes 1–4.

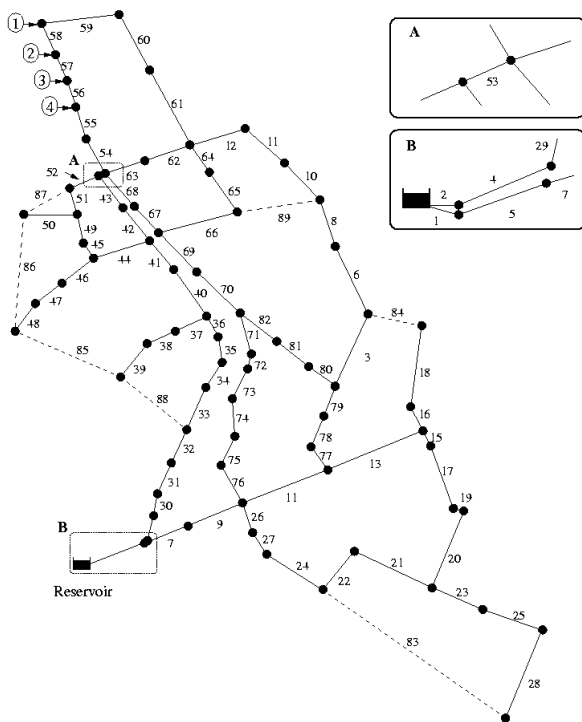


Figure 3: R21 case study layout.

A preliminary design for the R21 Corridor case study was supplied by GLS Software, generated using the partial enumeration method (Gessler, 1985). This design has a cost of R72 100 100 and a network resilience of 0.191 356. Ten optimization runs of 100 generations each were performed, taking less than 7 hours. The aggregated results of the 10 approximation sets appear in Figure 4. The objective function vector of the preliminary design appears as a cross; clearly showing that AMALGAM produces superior results. Two AMALGAM solutions have been highlighted in gray and marked with their resilience values. The solution with a resilience of 0.192 169 incurs a cost of R63 008 600 resulting in a saving of R9.0915 million for a slightly higher resilience than the preliminary design. The solution with a resilience of 0.202 304 incurs a cost of R72 065 100. All 7 additional pipes have been assigned positive diameters in this configuration and the cost is still less than that of the preliminary design. When AMALGAM was executed for 24

hours, it was able to achieve a cost of less than R50 000 000 at the same reliability as the preliminary design, an impressive saving of more than 30%.

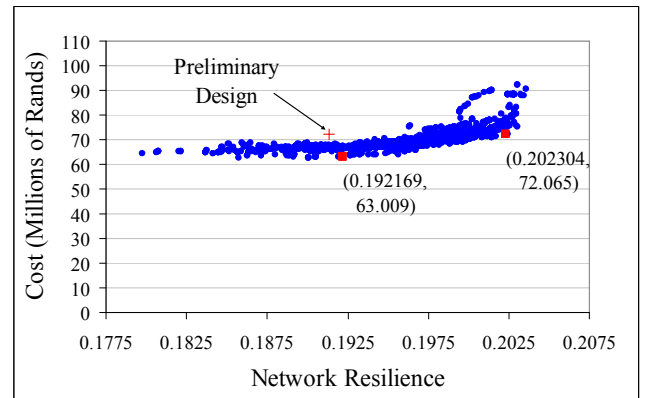


Figure 4: Results of AMALGAM for R21 case study.

As it stands, AMALGAM has several shortcomings. Most importantly, sub-algorithm efficiency is not adequately addressed, since the survival ratio does not take into account the speed of the sub-algorithm. This will definitely pose a problem if speed is critical and algorithm speeds differ by orders of magnitude. A potential solution to this may be the consideration of offspring generation time per algorithm  $T_i^t$ , so that the partitioning formula becomes

$$N_i^{t+1} = \left[ N \frac{S_i^t}{N_i^t T_i^t} / \sum_{h=1}^k \frac{S_h^t}{N_h^t T_h^t} \right]$$

Furthermore, the current formulation assumes no general framework for solution meta-data, particularly how to treat solutions generated by different algorithms (*e.g.* a particle swarm optimizer requires ‘solution velocity’). This was addressed in our study by making it compulsory to supply all such meta-data at the time of solution creation. This might require a healthy dose of imagination. To further enhance robustness and efficiency, AMALGAM could also easily be implemented with an adaptive population scheme using  $\epsilon$ -domination (precision  $\epsilon$  in objective space), as per the  $\epsilon$ -NSGA-II algorithm (Kollat and Reed, 2005).

In future work on WDS design optimization we will consider additional objectives (such as water quality and running costs), additional variables (such as tank and pump capacities), investigate a broader range of sub-algorithms, and focus more on search efficiency. A more technical version of this article will be presented at IFORS 2008.

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## The Second IASTED Africa Conference on Modelling and Simulation

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<b>Important Dates:</b>	
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2008 IEEE Symposium on Computational Intelligence and Games (CIG'08)  
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Games have proven to be an ideal domain for the study of computational intelligence as not only are they fun to play and interesting to observe, but they provide competitive and dynamic environments that model many real-world problems. This symposium, sponsored by the IEEE Computational Intelligence Society with technical co-sponsorship from the IEEE Consumer Electronics Society, aims to bring together leading researchers and practitioners from both academia and industry to discuss recent advances and explore future directions in this field.

### Important dates:

Special session, tutorial, and competition proposals: 11 June 2008

Paper submission deadline: 15 July 2008

Decision notification: 15 September 2008

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## WSC 2008 Call for Papers

The Winter Simulation Conference (WSC) is the premier international forum for disseminating recent advances in the field of system simulation. In addition to a technical program of unsurpassed scope and quality, WSC provides the central meeting place for simulation practitioners, researchers, and vendors working in all disciplines in industrial, governmental, military, and academic sectors. The theme for WSC 2008 is "Global Gateway to Discovery".

**LOCATION:** WSC 2008 will be held in vibrant Miami, Florida at the InterContinental Hotel, December 7th-10th. Overlooking Biscayne Bay, the InterContinental is a luxurious international destination located in the heart of the "Gateway to the Americas".

**PAPER DEADLINES AND REQUIREMENTS:** All contributed paper submissions will be **peer reviewed**. Accepted papers will be published in the CD-ROM versions of the conference proceedings, which will be copyrighted and widely disseminated. A paper must accompany all presentations and tutorials except those in the Vendor/Exhibitor track, the Simulation Case Studies track, the Poster Session, and the Ph.D. Colloquium. Instructions, information, submission forms and procedures are available on the WSC website, [www.wintersim.org](http://www.wintersim.org). Please note the following important deadlines:

**April 15, 2008:** Electronically submit contributed papers not previously published or presented. Each submission must be a 3- to 9- page paper, including an abstract of not more than 150 words. Panel papers and papers in the tutorials tracks may be up to 12 pages. Submission implies that an author will attend WSC '08 to present the paper, and all clearance required for publication of the paper will be obtained by July 15, 2008. Use of one of the following formats is required: Microsoft Word or LaTeX. Submissions must be made through the WSC website, [www.wintersim.org](http://www.wintersim.org).

**June 5, 2008:** Contributors will be notified whether or not their paper has been accepted.

**July 17, 2008:** Authors electronically provide a final manuscript meeting all requirements to the Proceedings Editor.

**September 14, 2008:** Deadline to electronically submit abstracts for Simulation Case Studies (submission form available August 1), as well as abstracts for presentations in the Poster Session and Ph.D. Student Colloquium. Simulation Case Studies require involvement from an industrial sponsor.

WSC '08 is sponsored by ACM/SIGSIM, ASA, IEEE/SMC, IIE, INFORMS-SIM, NIST, and SCS.



# OR Anecdotes: The birth of OR during WWII

by Basie Kok ([bkok@dip.sun.ac.za](mailto:bkok@dip.sun.ac.za))

World War II became known as the ‘wizard war’ because of the continuous cycles of counter-counter measures employed by both the German and Allied commands. Through Operational Research (OR) – the scientific scrutiny of new weapons, their deployment and relative efficiency influenced how warfare itself was conducted.

Scientists in the United Kingdom including Patrick Blackett, C. H. Waddington, Owen Wansbrough-Jones, Frank Yates and Cecil Gordon and in the United States George Dantzig, looked for ways to make better decisions in such areas as logistics, training schedules and large scale war strategy. A number of crucial analyses were made in the course of the war which aided the Allied war effort tremendously [1].

Britain introduced the convoy system to reduce merchant shipping losses in the Atlantic, but while the principle of using warships to accompany merchant ships was generally accepted, it was unclear whether it was better for convoys to be small or large. It was noted that small convoys could travel faster, and would also be more difficult for German U-boats to detect, but on the other hand, large convoys could deploy more warships against an attacker, and defend themselves more effectively. A typical trade-off scenario was encountered where the convoy size and composition needed to be optimised. The conclusion, after careful analysis, was that a few large convoys are more defensible than many small ones, and Blackett's team made recommendations to the Admiralty which were implemented successfully [2].



Merchant ships sailed in ‘convoys’ for safety, accompanied by warships.

In another piece of work, Blackett's team analysed a survey carried out by RAF Bomber Command. For the survey, Bomber Command inspected all bombers returning from bombing raids over Germany over a particular period. All damage inflicted by German air defences was noted and the recommendation was given that armour be added in the most heavily damaged areas.

Blackett's team disagreed with the survey and instead made the surprising and counter-intuitive recommendation that armour be placed in the areas which were completely untouched by damage. They reasoned that the survey was biased, since it only included aircraft that successfully came back from Germany. The untouched areas were probably vital areas, which, if hit, would result in the loss of the aircraft.



B-25 Mitchell bomber

When the Germans organised their air defences into the Kammhuber Line [3], it was realised through the work of Blackett's team that if the RAF bombers were to fly in a bomber stream they could overwhelm the night fighters who flew in individual cells directed to their targets by ground controllers, who used the stacked radars in the Kammhuber line to direct them. It was then a matter of calculating the statistical loss from collisions against the statistical loss from night fighters to calculate how close the bombers should fly to minimise RAF losses [4].

## References

[1] *Operations Research History*, Wikipedia the free encyclopedia, Available online at: [http://en.wikipedia.org/wiki/Operations\\_Research](http://en.wikipedia.org/wiki/Operations_Research)

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## CHAPTER NEWS AND EVENTS

### JOHANNESBURG CHAPTER ACTIVITIES:

#### • Annual Conference

**Date :** 13 - 18 July 2008

**Venue :** [Sandton Convention Centre](#)

**Website :** <http://www.ifors2008.org/>

#### • Afternoon Seminar

**Speaker:** TBA

**Topic :** TBA

**Date :** Wednesday 6<sup>th</sup> August 2008

**Time :** 16:00 for 16:15

**Venue :** [Wits Club](#)

**Cost :** Free

#### • Afternoon Seminar

**Speaker:** TBA

**Topic :** TBA

**Date :** Wednesday 3<sup>rd</sup> September 2008

**Time :** 16:00 for 16:15

**Venue :** [Wits Club](#)

**Cost :** Free

#### • Afternoon Seminar

**Speaker:** Montaz Ali

**Topic :** Scheduling of the Brewing Process in  
Brewhouse

**Date :** Wednesday 1<sup>st</sup> October 2008

**Time :** 16:00 for 16:15

**Venue :** [Wits Club](#)

**Cost :** Free

#### • Annual General Meeting and Seminar

**Speaker:** TBA

**Topic :** TBA

**Date :** Wednesday 5<sup>th</sup> November 2007

**Time :** 16:00 for 16:15, AGM starts at 17:15

**Venue :** [Wits Club](#)

**Cost :** Free

More information regarding activities at **other chapters** will be available on the ORSSA website at

<http://www.orssa.org.za/wiki/pmwiki.php?n=Main.Chapters>

as and when it is available. Please visit the website regularly to keep yourself updated on upcoming events and activities in an ORSSA chapter near you!



Operations Research Society of Eastern Africa

## The 4<sup>th</sup> International Operations Research of Eastern Africa Conference

Operations Research in  
Public and Private Sector  
Management



Faculty of Commerce and  
Management  
University of Dar es Salaam

Operations Research Society of Eastern Africa (ORSEA) wishes to invite all operations researchers, trainers, academicians, practitioners, and students interested in and/or using any of the branches of operations research to participate at the conference and to present papers. The conference will be held in Dar es Salaam, Tanzania on 10<sup>th</sup> and 11<sup>th</sup> July 2008. The conference is organized by the ORSEA in collaboration with the Faculty of Commerce and Management, University of Dar es Salaam Tanzania.

### Venue and Accommodation

The conference will be held at the White Sand Hotel. It is situated 20 km from City Centre Dar es Salaam and 23 Km from the Mwalimu Nyerere International Airport.

Accommodation will be available at the conference venue at an additional cost.

### Important dates:

**30th March 2008 :** Deadline for submission of abstracts.

**30th April, 2008 :** Full Paper Submission.

**30th June 2008 :** Deadline for confirmation of attendance.

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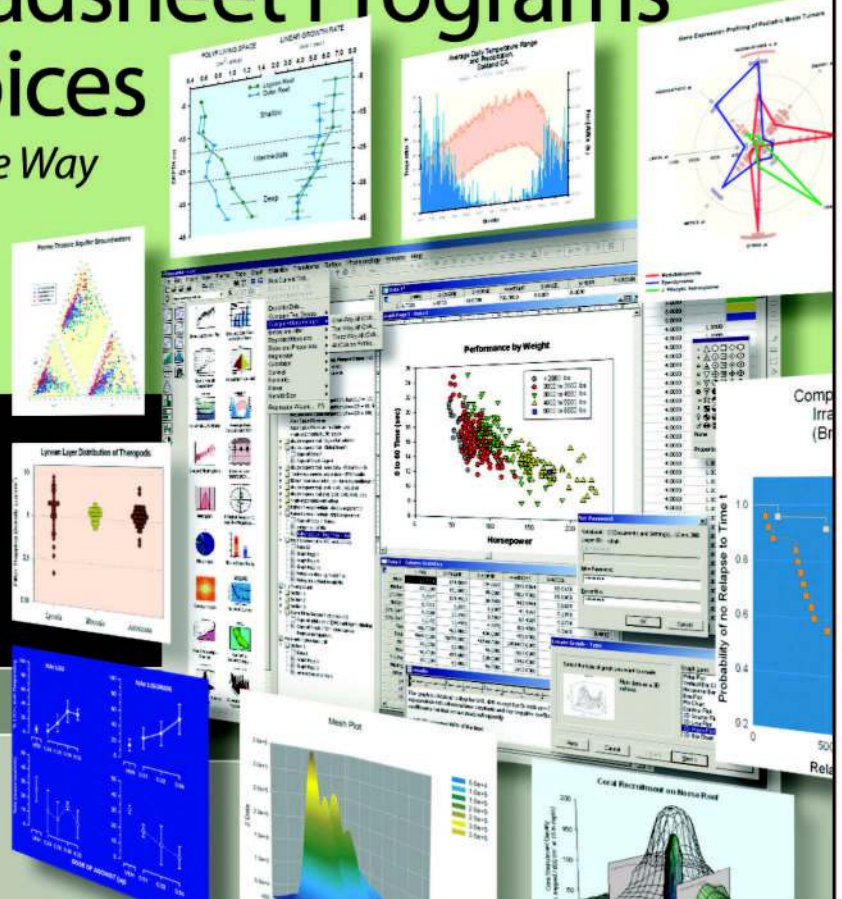
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