Recent Advances
November 16 2011
RMIT AGR 8:9:66
Newcastle University AGR

PROGRAMME

8:45 to 9:15 Registration.

9:15 – 10:45 From RMIT

Tristan Barnett**: Automating Online Video Poker for Profit**
Andrey Kostenko: **On forecasting counts with exponential smoothing ***
Andreas Ernst**: Parallel Ant Colony Optimisation for a Resource Constrained Scheduling Problem**

10:45 – 11:00 Morning Tea

11:00 - 12:30 From Newcastle

Kristian Krabbenhoft**: Variational Mechanics using Mathematical Programming Methods**
Martin Savelsbergh**: Network Infrastructure Optimization: The Incremental Shortest Path Problem**
Sebastian Ruther**: Integrating Aircraft Routing with Crew Pairing and Tail Number Assignment***

12:30 – 01:30 Lunch

1:30 – 2:30 From Newcastle
Natashia Boland**: Turbo-charging the Feasibility Pump**
Fatemeh Charkhsaz**: Single Period Production Problem with Scrap and Rework***

2:30 – 2:45 Afternoon tea

2:45 – 4:45 From Melbourne

Bizhan Jamshidnezhad: **An Agent-Based Simulation of the Relationship between Quality Management and Productivity***
Moshe Sniedovich**: On the Power of the Written (and peer-reviewed) Word**
Mohsen Jafari Songhori**: Imperfect competency and coordination in complex systems ***
Rodolfo García-Flores**: "A comparison of methods for solving the sensor location problem".**

*** Student papers**

Title: Automating Online Video Poker for Profit

Speaker: Tristan Barnett
Strategic Games
strategicgames.com.au

Abstract:
The arrival of online casinos in 1996 brought games that you would find at land-based casinos to the computer screens of gamblers all over the world. A major benefit in online casinos is in the automation of systems across several computers for favourable games; as this has the potential to make a significant amount of profit. This article applies this concept to online progressive video poker games. By establishing a set of characteristics to compare different games, analyses are carried out to identify which game should be the starting point for building an automated system. Bankroll management and playing strategies are also analyzed in this article, and are shown to be important components if profiting from online gambling is going to be a long term business.

Title: **On forecasting counts with exponential smoothing**

Speaker: Andrey Kostenko

Abstract: Within the topic of model-based forecasting with exponential smoothing, this paper seeks to contribute to the understanding of the property of certain stochastic processes to converge almost surely to a constant. It provides a critical discussion of the related views and ideas found in the recent forecasting literature and aims at elucidating the present confusion by review and study of the classical and less known theorems of probability theory and random processes. The paper then argues that a useful role of exponential smoothing for modelling and forecasting sequential count data is limited and methods that are either not based on exponential smoothing or use exponential smoothing in a more flexible way are worthy of exploration. An approach to forecasting such data based on applying exponential smoothing to the probabilities of each count outcome is thus introduced and its merits are discussed in the context of pertinent statistical literature.

Title: Parallel Ant Colony Optimisation for a Resource Constrained Scheduling Problem

Authors: Andreas Ernst, Gaurav Singh, Dhananjay Thiruvady

Abstract:
In this talk we consider a problem of scheduling several jobs on multiple machines satisfying precedence and resource constraints. Each job has a due date and the objective is to minimize the cumulative weighted tardiness across all jobs. We investigate how to efficiently obtain heuristic solutions on multi-core computers using an Ant Colony Systems framework for the optimisation. The talk will discuss some of the challenges that arise in designing a multi-threaded heuristic and provided computational results for some alternative algorithm variants. The results showing that the ACS heuristic is more effective particularly for large problem instances than other methods developed to date.

Title: Variational Mechanics using Mathematical Programming Methods

Speaker: Kristian Krabbenhoft

Abstract: The relation between mechanics and optimization goes back at least to Euler and was further strengthened by the Lagrangian and Hamiltonian formulations of Newtonian mechanics. Since then, numerous variational formulations of mechanical phenomena have been proposed and although the link to optimization often has been somewhat obscured in the subsequent development of numerical methods, it is in fact as strong as ever. In this talk, I will summarize some of the recent developments in the application of modern mathematical programming methods to problems involving the simulation mechanical phenomena. While the methodology is quite general, emphasis will be on the static and dynamic deformation processes in civil engineering, geomechanics and the earth sciences

Title: Network Infrastructure Optimization: The Incremental Shortest Path Problem

Speaker: Martin Savelsbergh

Abstract: A water and sewage system, a power grid, a telecommunication network, are all examples of network infrastructures. Network infrastructures are a common phenomenon in many industries. A network infrastructure is characterized by physical links and connection points. Examples of physical links are pipes (water and sewage system), fiber optic cables (telecommunication network), power lines (power grid), and tracks (rail network). Such network infrastructures have to be maintained and, often, have to be upgraded or expanded. Network upgrades and expansions typically occur over a period of time due to budget constraints and other considerations. Therefore, it becomes important to determine both when and where network upgrades and expansions should take place so as to minimize the infrastructure investment as well as current and future operational costs.
We introduce a class of multi-period network infrastructure expansion problems that allow us to study the key issues related to the choice and timing of infrastructure expansions and their impact on the costs of the activities performed on that infrastructure. We focus on the simplest variant, an incremental shortest path problem (ISPP). We show that even ISPP is NP-hard, we introduce a special case that is polynomially solvable, we derive structural solution properties, we present an integer programming formulation and classes of valid inequalities, and discuss the results of a computational study.

Title: Integrating Aircraft Routing with Crew Pairing and Tail Number Assignment

Speaker: Sebastian Ruther

Abstract: A common issue when integrating airline planning processes is the long planning horizon of the crew pairing problem. We propose a new approach to the crew pairing problem through which we retain a significant amount of flexibility. This allows us to solve an integrated aircraft routing, crew pairing, and tail number assignment problem only few days before the day of operations and with a rolling planning horizon. The model simultaneously schedules appropriate rest periods for all crews and maintenance checks for all tail numbers.
A Branch-and-Price method is proposed in which each tail number and each 'crew block' is formulated as a subproblem.

Title: Turbo-charging the Feasibility Pump

Speaker: Natashia Boland

Abstract: The Feasibility Pump (FP) has proved to be an effective method for finding feasible solutions to Mixed-Integer Programming problems. We investigate the benefits of replacing the rounding procedure with a more sophisticated integer line search that efficiently explores a larger set of integer points with the aim of obtaining an integer feasible solution close to an FP iterate. An extensive computational study on 1000+ benchmark instances demonstrates the effectiveness of the proposed approach.

Title: Single Period Production Problem with Scrap and Rework

Speaker: Fatemeh Charkhsaz

Abstract: The classical single period problem (SPP) has wide applicability especially in service industries which dominates the economy. In this paper a single period production problem, is considered, as a specific type of SPP. The SPP model is extended by considering the probability of scrap and rework in production at the beginning and during the period. The optimal solution which maximizes the expected value of total profit obtained. In the case of producing the scrap items and defective items which should rework, the optimal profit of system in comparison to ideal production system reduces. Also, the reduction of profit is more sensitive by increasing the probability of producing scrap items in comparison with the probability of producing defective items. These results would help the managers in order to make the right decision about changing or revising machines or technologies.

Title: An Agent-Based Simulation of the Relationship between Quality Management and Productivity

Speaker: Bizhan Jamshidnezhad
Department of Mechanical Engineering
The University of Melbourne

Abstract: This talk presents an innovative model for describing the effects of QM on organizational productivity, traditionally researched by statistical models. Learning inside organizations combined with the information processing metaphor of organizations is applied to build a computational model for this research. A reinforcement learning (RL) algorithm is implemented in the computational model to characterize the effects of quality leadership on productivity. The results show that effective quality leadership, being a balanced combination of exploration of new actions and exploitation of previous good actions, outperform pure exploration or exploitation strategies in the long run. However, pure exploitation outperforms the exploration and RL algorithms in the short term. Furthermore, the effects of complexity of customer requirements on productivity are investigated. From the results it can be argued that more complexity usually leads to less productivity. Also, the gap between random action algorithm and RL is reduced when the complexity of customer requirements increases. As regards agent types, it can be inferred that well-balanced business processes comprised of similar agents (in terms of agents' processing time and accuracy) perform better than other scenarios.

Keywords: quality management, productivity, agent-based simulation, complexity

Title: On the Power of the Written (and peer-reviewed) Word

Speaker: Moshe Sniedovich
Department of Mathematics and Statistics
The University of Melbourne

Abstract:

In this presentation I briefly discuss practical and philosophical issues related to the role of the peer-review process in maintaining the quality of scientific publications. The discussion is based on, among other things, my experience over the past eight years in containing the spread of voodoo decision theories in Australia. To motivate the discussion, I ask: how do you justify the use a model of local robustness (operating in the neighborhood of a wild guess) to manage Black Swans and Unknown Unknowns?

Title: Imperfect competency and coordination in complex systems

Authors: Mohsen Jafari Songhori, Alan Smith
Department of Mechanical Engineering
The University of Melbourne

Design of a complex system needs both micro and macro level competencies to capture the underlying structure of complex problem satisfying convergence to good solution point. Systems such as complex organizations, complex New Product Development (NPD) and complex network of firms (Supply Chains or SC) require competencies at both macro (coordination and integration) and micro (capable designers, teams for NPD and capable firms in SC) entities. Given high complexity in such problems at both macro and micro levels, a couple of different errors can happen at each: 1) Either acceptance of a wrong solution or rejection of a right solution at micro level. 2) Either coordination of a couple of entities that do not need any coordination [e.g. teams or designers working in NPD might put too much time in meetings and firms in SC might lose their flexibility due to limitations from powerful and leader firms in SC] or lack of deployed resources for entities that need coordination [e.g. inconsistencies in decisions made in decentralized systems such as NPD and SC]. In this paper a simple and parsimonious Agent Based Model (ABM) of NK type is build and simulated to study these complex interactive systems. The results of simulations provide some insights on imperfect management of above mentioned complex systems. For instance, we found that asymmetry in any of the above mentioned errors favours a particular policy in management of these systems.

Title: "A comparison of methods for solving the sensor location problem".

Speaker: Rodolfo García-Flores
Research Scientist
Operations Research
CSIRO Mathematics, Informatics and Statistics

Abstract: A problem that frequently arises in environmental surveillance is where to place a set of sensors in order to maximise collected information. In this article we compare four methods for solving this problem: a discrete approach based on the classical k-median location model, a continuous approach based on the minimisation of the prediction error variance, an entropy-based algorithm, and simulated annealing. The methods are tested on artificial data and data collected from a network of sensors installed in the Springbrook National Park in Queensland, Australia, for the purpose of tracking the restoration of biodiversity. We present an overview of these methods and a comparison of results.