Doctoral Award – Previous Winners

- 2021 - Glory Alozie
- 2020 - Jake Clarkson
- 2019 - Márton Benedek, Lucy Morgan
- 2018 - Geraint Palmer
- 2017 - Jeeu Fong Sze, University of Kent
- 2016 - Itamar Megiddo, University of Strathclyde
- 2015 - Çagri Koç, University of Southampton
- 2014 - Martin Takác, University of Edinburgh
- 2013 - T Lidbetter, London School of Economics
- 2012 - Kabir Rustogi, University of Greenwich
- 2011 - Richard Wood, Cardiff University
- 2010 - F Liberatore, University of Kent
- 2009 - A Strauss, Lancaster University
- 2008 - K Kaparis, Lancaster University

Citations

2021 Doctoral Award Winner

Dr Glory Alozie, University of Strathclyde

The Distance-Based Critical Node Detection Problem: Models and Algorithms

Glory Alozie's thesis studies models and algorithms for the distance-based critical node detection problem in a network. This problem assesses the vulnerability of the network to the failure of nodes, which causes reduced connectivity of the network. Applications are widespread: these include telecommunication networks, networks supplying water, gas and electricity, and networks providing supplies in humanitarian logistics and military settings.

The thesis describes the development of new mixed integer programming (MIP) formulations that are computationally more effective than previously proposed formulations. Additionally, a heuristic is proposed for large networks. The heuristic combines ideas from evolutionary algorithms with neighbourhood search to generate near-optimal solutions. Extensive computational testing has been performed using a combination of publicly available benchmark datasets and randomly generated datasets based on some real-world instances. Computational results show the benefit of using the new MIP formulation over the previous formulations. Also, the heuristic is shown to generate optimal or near-optimal solutions for most instances.

The external examiner commented about "fine doctoral work" and stated that "there is strong interest in the findings for both theoreticians and practitioners". The co-supervisors wrote: "the best dissertation we have seen over many years of our careers". Glory Alozie is currently collaborating with the Air Force Research Laboratory in the US who are interested in applying the results of her research.

Runners-up:

Edin Husic, London School Of Economics and Political Sciences, "*Nash welfare, valuated matroids, and gross substitutes*"

Edwin Reynolds, Lancaster University, "*Modelling, solution and evaluation techniques for train timetable rescheduling via optimisation*".

THE OPERATIONAL RESEARCH SOCIETY

2020 Doctoral Award Winner

Dr Jake Clarkson, Lancaster University

Optimal Search in Discrete Locations: Extensions and New Findings

A classical search problem involves finding an object hidden in one of several discrete locations according to some known probability distribution. The objective is for the searcher to discover the object in minimum expected time. Such problems have obvious military applications, but a rescue team searching for a survivor of a disaster or a salvage team searching for the remains of a ship or aircraft provide other potential applications. In his thesis, Jake Clarkson presents two extensions of this classical search problem.

The first extension is applicable for situations where two possible types of search are available. The search can either be slow, which results in a higher probability of finding the object, or faster but with a lower probability of finding the object. The thesis develops sufficient conditions for the optimal search of a location to use the slow speed or to use the fast speed. This allows the optimal search problem to be solved in many cases, and also leads to effective heuristic policies with performance guarantees in other cases.

The second extension deal with a situation where the object corresponds to a hider who aims to remain undetected for a maximum expected time. In this variant, the searcher has no knowledge of the probability distribution with which the hider is located, and instead the probability distribution is chosen by an adversary who tries to make the search as hard as possible. The resulting problem is a semi-infinite search game. The thesis introduces a variety of innovative ideas to produce a successful analysis.

The lead supervisor comments that the thesis “exhibits a depth of insight and power of analysis which in my extensive experience of supervising and examining PhDs is without parallel”. Two joint external examiners state that “this dissertation is the best we have examined”. In terms of the first extension with alternative speeds, the examiners predict that “it will become highly cited and lead to a new branch of the search theory literature and application”. In terms of the second extension involving a search game, they state that “previous work has produced partial analyses and discussion of special cases, but Jake’s work has in all essentials solved the problem”.

2019 Doctoral Award Winners

The quality of the theses this year was very high, and they were all worthy. The panel made the decision that this year there would be joint winners.

Márton Benedek

Computing the Nucleolus of Cooperative Games

Márton Benedek's thesis on cooperative game theory addresses the issue of how decision makers collaborate by forming coalitions and how the players within a coalition share the benefit in a fair and stable way. A key problem in this area is to compute the nucleolus, which is designed to minimize the dissatisfactions that coalitions could experience under the sharing scheme that is used. However, computing the nucleolus is notoriously difficult because of the large number of potential coalitions that could be formed.

The thesis contains the development of a novel algorithm for computing the nucleolus. It exploits the relationships between primal and dual representations of the problem. Computational tests show that it can handle problems involving over 30 players, whereas previously proposed algorithms are limited to 15 players. Open-source code for different algorithm implementations has been made available. A recent publication has applied the algorithms to model a European gas network with a view to using the nucleolus to assess the bargaining strengths of the different countries in the coalition.

The external examiner commented that: "Márton produced a truly remarkable PhD thesis in Operational Research.

It has all the features of a fine piece of work in this discipline". Further comments are "the theoretical and algorithmical achievements are significant and influential to the field" and "the descent-based algorithm should be the current benchmark for computing the nucleolus of a general-structure cooperative game".

Lucy Morgan

Quantifying and Reducing Input Modelling Error in Simulation

The focus of Lucy Morgan's thesis is input modelling for simulation and quantifying its effects on the simulation output. There are three significant contributions:

- a method for quantifying input uncertainty for simulation models having a piecewise-constant inhomogeneous Poisson arrival process.
- an approach for quantifying bias caused by input modelling, which can occur in complex systems when simulation outputs are non-linear functions of its inputs.
- a spline-based method for modelling and generating arrivals from an inhomogeneous Poisson process.

A paper describing the spline-based method was a Finalist for the Best Theoretical Paper Award at the 2019 Winter Simulation Conference.

In addition to the strong theoretical contributions provided within the thesis, the practical relevance of the bias quantification was demonstrated in a case study for an NHS call centre.

Also, the spline-based method has been implemented as an R package, which is available for download. This will help with the future use of the method both in academia and by OR practitioners.

The external examiner commented that “the thesis is one of the best that I have ever read”. A further remark from the examiner mentions the “significant new methodology in simulation input analysis”, which will “help ensure that simulation analysts are able to report more accurately on the true level of uncertainty in their inputs”.

2018 Doctoral Award Winner

Geraint Palmer

Modelling Deadlock in Queueing Systems

Runners-up:

Andrew Starkey and Christoph Werner

2017 Doctoral Award Winner

Jeeu Fong Sze, University of Kent

Hybridisation Search for a Class of Vehicle Routing Problems

Jeeu Sze's thesis introduces a hybrid algorithm for vehicle routing that incorporates variable neighbourhood search and large neighbourhood search, which are rarely used in combination. To exploit this novel approach, new and powerful data structures were developed and a neighbourhood reduction scheme was designed to speed-up the search. The hybrid algorithm performed very well in the computational tests reported in the thesis.

The vehicle routing problems considered in the thesis focus on arrival times of the vehicles at each customer. Motivated by applications in humanitarian aid following a disaster, minimising the sum of arrival times and the maximum arrival time were considered as objectives, rather than adopting the classical objective of minimising the total distance travelled. The flexibility of

hybrid algorithm for solving both the min-sum and min-max versions of the problem emphasises its versatility.

The external examiner commented that "I would expect that the excellent results achieved by the work, would be the subject of attention, reference and scrutiny by other researchers" and also stated "the methodology developed in the thesis offers a good platform for the research community in VRP to further investigate and extend the proposed ideas".

Runner-up:

Mohsen Mesgarpour, University of Westminster "Predictive Risk Modelling of Hospital Emergency Readmission, and Temporal Comorbidity Index Modelling Using Machine Learning Methods"

2016 Doctoral Award Winner

Itamar Megiddo, University of Strathclyde

Modelling for Healthcare Policy

Itamar Megiddo's thesis focuses on agent-based approaches to build models that inform healthcare policy decisions. A centrepiece of his research is the development of IndiaSim, an agent-based model for planning health services in India, which is used in several of the chapters within the thesis. The application of IndiaSim to rotavirus vaccination has influenced the Indian government in introducing the rotavirus vaccine into the Indian Universal Immunisation Programme. As well as the agent-based modelling, the thesis also contains a computational game theoretic analysis that explores the potential for neighbouring countries to coordinate their vaccination strategies in order to maximise their shared benefits.

The thesis starts with a discussion of the implications of the decisions taken by the modeller. For universal health coverage in which everyone in low- and middle-income countries has access to non-impoverishing, high-quality, essential healthcare, the objectives of interest affect the modelling decisions to be made. In the subsequent chapters of the thesis, these general principles are then applied in the ecological modelling of competing bacterial strains, the economic evaluation of health interventions, household financial impact of health conditions, and agent-based modelling of infectious diseases. This collection of studies demonstrates the ability to draw on techniques and insights from different scientific domains and integrate them through modelling as part of a problem solving process.

The external examiner commented that "Itamar displayed mastery of several fields of study through his thesis"; "each of these fields is usually a topic of a single PhD thesis, so it is highly impressive that Itamar's thesis brought them together in a coherent body of work"; and "his work has the potential to make substantial contributions to both operational research and to improving human health worldwide". There are four published papers based on work reported in the thesis, with a fifth paper currently under review, and two further published papers resulting from extensions of the PhD research.

Runners-up:

Andres Felipe Osorio Muriel, University of Southampton, Stefano Starita, University of Kent

2015 Doctoral Award Winner

Çagri Koç, University of Southampton

Çagri Koç with John Hopes

Runners-up: Johanna Garzon-Rozo, University of Edinburgh; Chris Smith, Aston/Warwick, now at the University of Manchester.

2014 Doctoral Award Winner

Martin Takác, University of Edinburgh

Runners-up:

Saeideh Nasiri, Lancaster University; Rob Shone, Cardiff University; Rui Wang, University of Sheffield

2013 Doctoral Award Winner

T Lidbetter, London School of Economics

Runners-up:

C Pickardt, University of Warwick; J Vile, Cardiff University

THE OPERATIONAL RESEARCH SOCIETY

2012 Doctoral Award Winner

Kabir Rustogi, University of Greenwich

Kabir Rustogi with Geoff Royston (President of The OR Society)

2011 Doctoral Award Winner

Richard Wood, Cardiff University

Richard Wood with Geoff Royston (President of The OR Society)

Runners-up:

S Allen, University of Nottingham; Dong Li, Lancaster University

2010 Doctoral Award Winner

Federico Liberatore, University of Kent

Federico Liberatore with Richard Eglese (President of The OR Society)

Runners-up:

Md Asaduzzaman, University of Westminster; G De Maere, University of Nottingham

2009 Doctoral Award Winner

Arne Strauss, Lancaster University

Arne Strauss with Richard Eglese (President of The OR Society)

Runners-up:

S Adeyemi, University of Westminster; A Tako, University of Warwick

2008 Doctoral Award Winner

Konstantinos Kaparis, Lancaster University

Runner-up:

D Arthur, University of Surrey