NUI Galway
OÉ Gaillimh

School of Mathematics, Statistics and Applied Mathematics
Eighth Annual Research Day
5 April 2017

Programme

	AC201 (Main Concourse)	THB-G011 (Hardiman Building)
9.30-9.35	**Rachel Quinlan** Welcome by the Head of School	
9.35-9.45	**Lucy Byrnes** Welcome by the Dean of Graduate Studies	
9.45-10.30	**Ray Ryan (NUIG)** POWER SERIES: SOME CLASSICAL RESULTS AND SOME OPEN PROBLEMS	
10.30-11.00		Coffee
11.00-11.30	**John Newell (NUIG)** TRANSLATIONAL STATISTICS: DYNAMIC NOMOGRAMS AND MEAN RESIDUAL LIFE	
11.30-12.00	**Lida Fallah (NUIG)** PROPORTIONAL AND ADDITIVE HAZARDS MODELS FOR CLUSTERED SURVIVAL DATA WITH RANDOM EFFECTS	
12.00-12.30	**Giuseppe Zurlo (NUIG)** MECHANICS OF SURFACE GROWTH	
12.30-14.00		Lunch
14.00-14.45	**Alain Goriely (University of Oxford)** ON GROWTH AND FORM AND MATHEMATICS. READING D'ARCY THOMPSON 100 YEARS LATER	
14.45-15.45	Research Blitz (Coordinator: **Hannah Conroy Broderick**) **Michael Tuite** FAULHABER'S FORMULA AND THE RIEMANN ZETA FUNCTION **Haixuan Yang** MATRIX DECOMPOSITION TECHNIQUES FOR BIOINFORMATICS AND OTHERS **Robert Mangan** WRINKLES IN THE OPENING ANGLE METHOD **Rachel Quinlan** KATONA'S FIVE-MINUTE PROOF OF THE ERDOS-KORADO THEOREM **Davood Roshan** INDIVIDUALIZED ADAPTIVE RANGE FOR CLINICAL BIOMARKERS **Qays Shakir** TIGHT GRAPHS ON SURFACES **Petri Piiroinen** CHATTER	
15.45-17.15		Poster Session
16.15-17.15		Reception, Poster Prizes

Contents

1 Introduction

Welcome to the 8th annual Research Day of the School of Mathematics, Statistics and Applied Mathematics. In accordance with (relatively recent) tradition, the day includes a programme of talks that represent diversity of research activities across the disciplines in our School, an exhibition of research posters by our graduate students, an account in this booklet of our research activities, communications and achievements, a blitz session, and a presentation by a visiting speaker. It is a pleasure to welcome Professor Alain Goriely from Oxford University as our guest speaker this year, to give a talk with a special Galway connection. Welcome also to Professor Lucy Byrnes, Dean of Graduate Studies, to open the Research Day.

As we prepare to document our plans and contributions for the Institutional Review of Research Performance later in 2017, this year's Research Day gives us an opportunity to celebrate our successes and consider our future direction. It has been another positive year for us as this document amply demonstrates. In this short introduction I will not attempt to summarize all of our activities but instead focus on some of the achievements of our current and recent research students.

- Five students completed their PhD degrees in our School this year:
  - Adib Makrooni, *Parabolic and equal-rank subroot systems with applications to symmetric spaces and flag manifolds*
  - Stephen Russell, *Sparse grid methods for singularly perturbed problems*
  - Simone Coughlan, *Pathogen genomics of methicillin resistant staphylococcus aureus and leishmania*
  - Peter Keane, *Investigation of intron coevolution and the autoimmune potential of alternative splicing*
  - Brendan Masterson, *On the table of marks of a direct product of finite groups*

- The SIAM NUI Galway student chapter will host the National Student Chapter Conference of the SIAM UKIE Section in May 2017.

- Graduate students in the Applied Mathematics and Mathematics disciplines run the weekly *Postgraduate Modelling Research Group*, with two talks every Friday, not only about modelling!

- The Statistics discipline held a one-day research symposium in September 2016, with ten talks by research students and visitors.

- Meanwhile our recent PhD graduates continue to distinguish themselves (and us!) around the world in their scientific endeavours. A few examples:
  - Tobias Rossmann (PhD 2011) - Humboldt Foundation research fellow, University of Auckland.
  - Paul Geeleher (PhD 2012) - postdoctoral researcher, University of Chicago
  - Tuoi Vo (PhD 2013) - Research Fellow, MACSI, University of Limerick
  - Paul Korir (PhD 2014) - Scientific programmer, European Bioinformatics Institute, Cambridge.
  - Le Van Luyen (PhD 2014) - lecturer, University of Science, Ho Chi Minh

The School of Maths welcomed two new members to its academic and research staff this year, Dieter Degrijse and Valentina Balbi. The School hosted three conferences in 2016 and its members contributed to the organisation of several international conferences including the 18th International Biometric Conference in Victoria, Canada, in July and a mini-workshop on cohomology of arithmetic groups at the Oberwolfach Research Institute in November. The 40th annual instalment of the Groups in Galway conference series will take place in May 2017, and the 4th annual Stokes Summer School for undergraduate and postgraduate researchers in mathematical modelling will take place in June. The 14th Annual Workshop on Numerical Methods for Problems with Layer Phenomena will start tomorrow (April 6) in AC201, with 25 visitors from eight countries.

Thanks to all contributors to the Research Day and to all participants. Thanks especially to organisers Hannah Conroy Broderick, Michel Destrade, Dane Flannery and Michael Mc Gettrick.
Have a good day!

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Rachel Quinlan

Head of School

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2 Abstracts of talks

Lida Fallah
We consider data from a biological control assay with clustered responses and fit multinomial models with a family of link functions for the interval (proportional and additive) hazards function. Random effects on the covariate are considered to account for additional variability within each cluster.

Key words: Discrete Survival Data, Generalized linear models, Proportional and Additive Hazards, Random effects.

Alain Goriely
In 1917, the Scottish biologist and polymath d'Arcy Thompson published "On Growth and Form", his masterpiece. This beautiful and richly illustrated book has been both praised for its visionary ideas and heavily criticised for its position on evolutionary theories. Nevertheless, it has been extremely influential in many areas of sciences and art. In this talk, I read d'Arcy Thompson and try to give him his right place in the history of sciences by identifying his true contributions to mathematics and biology. To do so, I will contrast his ideas to modern theories on morphology and morphogenesis based on my own work.

John Newell
Translational Medicine promotes the convergence of basic and clinical research disciplines and the transfer of knowledge on the benefits and risks of therapies. In an analogous fashion we proposed the concept of Translational Statistics (Newell et al, 2014) to facilitate the integration of Biostatistics within clinical research and enhance communication of research findings in an accurate manner to diverse audiences (e.g. policy makers, patients and the media). In this presentation, examples will be used to illustrate how modern web-based computing tools, incorporating the authors DynNom package for generating dynamic nomograms in R, allow the simple development of interactive tools for communicating and exploring research findings, in particular when modelling a binary or time to event response. In theory, any model appearing in a scientific publication can be accompanied by a URL directing the 'user' to the accompanying dynamic nomogram from which the results of the models are directly translational and the suitability of the model verified through automatically generated model summaries and diagnostic tools.

Newell, J., Jalali, J., Alvarez-Iglesias, A, Hinde J. (2014) Translational Statistics and Dynamic Nomograms. International Clinical Biostatistics Conference. Vienna.

Ray Ryan
We begin with some classical results on power series expansions of analytic functions, moving on to some contemporary work and finishing with a couple of open problems that are the subject of current research.

Giuseppe Zurlo
The solidification of water and metals; the growth of trees; the layered accretion of masonry and concrete structures; the accumulation of gravitational stresses in planets; the wind rolling of aluminum foils and arteries; and 3D printing. What is common to all of these natural, biological and technological processes? In this talk I will discuss a new theory that establishes a connection between the conditions during deposition of new material and the resulting geometric frustration, which is the source of residual stresses in the final body. This theory helps to understand how Nature piles up stresses during surface accretion, but also how 3D layer-by-layer technologies may be used to "design stresses" inside of printed objects.

3 Poster Session

[1] **Daher Al Baydli: "Computation of the Steenrod square operation on finite 2-groups"**
Supervisors: Graham Ellis, Emil Skoeldberg

[2] **Nisreen Alokbi: "Enhanced Mapper data analysis"**
Supervisor: Graham Ellis

[3] **Faiza Alssaedi: "Parameter robust methods for a complex-valued reaction-diffusion problem"**
Supervisor: Niall Madden

[4] **Richard Burke: "Hybrid adaptive multi-agent control"**
Supervisor: Petri Piiroinen

[5] **Hannah Conroy Broderick: "Equibiaxial Deformations of Dielectric Elastomers"**
Supervisor: Michel Destrade

[6] **Roberto Galizia: "LQR control of complex networks"**
Supervisor: Petri Piiroinen

[7] **Paul Greaney: "Membrane Thinning during Deformation"**
Supervisors: Martin Meere, Giuseppe Zurlo

[8] **Hieu Ha Van: "On the maximal Ranks of Completions of Entry Pattern Matrices"**
Supervisor: Rachel Quinlan

[9] **Olga Kalinina: "Penalized Proportional Hazards Model and Multiple Imputation"**
Supervisors: Emma Holian, John Newell

[10] **Vinh Mai: "Mathematically modelling hyaluronan degradation by Streptococcus pneumoniae hyaluronate lyase"**
Supervisor: Martin Meere

[11] **Robert Mangan: "Acoustic Wave Elastography of Arteries: Theory, Simulations, Experiments, Validation"**
Supervisor: Michel Destrade

[12] **Barbara Martinelli: "Deconvolution of genome wide epigenetic data using the expectation-maximization (EM) algorithm approach"**
Supervisors: Cathal Seoighe, Pilib Ó Broin

[13] **Ngoc Nguyen: "Analysis of Allele Specific Translation in Human"**
Supervisor: Cathal Seoighe

[14] **Cian O'Brien: "Alternating Sign Matrices"**
Supervisors: Rachel Quinlan, Kevin Jennings

[15] **Olga O'Mahony: "Edge-Minimal Graphs of Exponent 2"**
Supervisor: Rachel Quinlan

[16] **Davood Roshan: "Individualized Adaptive Range for clinical biomarkers"**
Supervisors: John Newell, Frank Sullivan, John Ferguson

[17] **Qays Shakir: "Σ-Facegraphs and Their Tightness"**
Supervisor: James Cruickshank

[18] **Eoghan Staunton: "Noise and Multistability in the Square Root Map"**
Supervisor: Petri Piiroinen

[19] **Nghia Tran: "Hochschild cohomology rings of Algebras $k[s^a, s^b]$"**
Supervisors: Emil Skoeldberg, Alexander Rahm

[20] **Michael Welby: "Genus Two Zhu Theory for Fermionic Vertex Operator Super Algebras"**
Supervisor: Michael Tuite

[21] **"Undergraduate Research"**
With contributions by Tuathlaith de Búrca, Ellen Casey, Patrick Fleming, Ailbhe Gill, Aoife Hill, Róisín Hill, Aaron Kilboy, Pierce Lawlor, Aidan Mannion, Lorna McLoughlin, Noeleen Rawle, Brian Regan, David Smyth, Szymon Urbas, and Bartlomiej Zaucha.

4 Abstracts of PhD Theses

Pathogen genomics of Methicillin resistant
Staphylococcus aureus and Leishmania
Simone Coughlan
Supervisors: Dr Tim Downing & Prof Cathal
Seoighe

Infectious diseases caused by the single-celled eukaryotic parasite Leishmania and the methicillin-resistant Staphylococcus aureus (MRSA) bacterium are major public health problems in many countries. In this thesis, I use genomics to explore the genomic plasticity of Leishmania and characterise the genomic and transcriptomic responses of MRSA treated with an antibiotic called oxacillin.

The Leishmania parasite is transmitted by sandflies and can be maintained in the wild by various animals, as well as in people. It causes leishmaniasis, which is often difficult to treat and can prove fatal. In order to understand the Leishmania spp. infecting wild animals and their relationships to human-infecting Leishmania, we assembled, annotated and analysed the genomes of three Leishmania spp. The first of these was from a rodent in Ethiopia which we identified as Leishmania adleri using a phylogenomic approach. This species is part of the Sauroleishmania subgenera, whose genomes are expected to have 36 chromosomes and can infect reptiles. We found evidence of two novel independent chromosomal fission events in L. adleri using both our genome and an unassembled L. adleri sample isolated from a lizard. This resulted in 38 chromosomes, which was a novel finding because there was no evidence of these fissions in the sole published genome from the same subgenus: L. tarentolae Parrot-TarII. Extensive gene amplifications and aneuploidy were discovered in all three Sauroleishmania samples analysed, in common with previous work on other Leishmania spp., highlighting the lack of differentiation between animal- and human- infecting species. This new L. adleri genome is a high-quality annotated draft suitable for use as a reference, is the first assembled sequence available for L. adleri, and is only the second species in the Sauroleishmania subgenus to have a published genome.

The other two Leishmania samples were isolated from dogs with leishmaniasis in Colombia and these were assembled and analysed using the same approach. A control genome was assembled using reads from the L. braziliensis genome so that we could quantify the completeness of our assemblies and identify any problems caused by our assembly approach. We classified our samples as L. naiffi and L. guyanensis, both members of the subgenus Viannia, whose members are only found in the Americas, predominately South America. This is the first report of L. naiffi in Colombia and in dogs illustrating the usefulness of genomics in disease surveillance. These genomes are also the first genomes for these two species. We compared both genomes with multiple other species from this subgenus and identified a 45 kb amplification in many Viannia spp. as well as a minichromosome in L. shawi M8408. Genes with high copy number and those unique to both species and the Viannia subgenus as a whole were also documented, which will aid development of diagnostics for this subgenus.

Multiple responses to drug treatment with oxacillin have been investigated in many MRSA lineages. In this thesis, colleagues and I examined the genomic and transcriptomic responses of a community acquired MRSA strain (USA300) in a continuous culture (chemostat) experiment as well as in growth on agar plates. MRSA can exhibit heterogeneous resistance (HeR) which occurs when most cells in a sample are susceptible to low levels of antibiotic and only a few cells are highly resistant. A highly homogenously resistant (HoR) can be selected from a HeR sample using high doses of oxacillin. We discovered a novel tandem amplification of SCCmecIV in a drug resistant sample taken from a chemostat experiment. SCCmecIV is a mobile genetic element that harbours the mecA gene which facilitates resistance to ?-lactam antibiotics, such as oxacillin. Multiple SNPs and indels at genes previously implicated in resistance were also identified. HeR isolates treated with oxacillin had low-frequency SNPs at some genes as well as numerous differentially expressed genes, whereas HoR samples had a nonsynonymous SNP at the gdpP gene, but few differentially expressed genes. This demonstrated that HeR cell populations responded to oxacillin by modifying gene expression regulation, whereas HoR ones had a genetic mutation to become resistant. We also found that purine metabolism had a role in oxacillin stress response because it was highly down-regulated at all levels of oxacillin, and SNPs and indels were discovered at two genes in this pathway (apt and guaA).

Overall, we have assembled the genomes of three Leishmania spp., discovered novel chromosomal fission events in L. adleri and documented the presence of L. naiffi in a dog in Colombia for the first time. These genomes, coupled with that of L. guyanensis have extended our understanding of genome architecture and plasticity in Leishmania and will facilitate future research by others on these species. We have found a novel amplification of SCCmecIV in response to drug treatment demonstrating the need to search for copy number variation in addition to

SNPs and indels, and found multiple responses to various levels of oxacillin, some of which had not been previously reported. These findings have important clinical implications for drug treatment of S. aureus as they demonstrate that amplification of large mobile elements can occur and that these can be maintained on the chromosome with variable copy number in response to drug pressure. Furthermore, commonly mutated genes and pathways in resistant samples show that cells converge on common solutions to survive drug treatment and these genes/pathways could serve as drug targets.

Investigation of intron coevolution and the autoimmune potential of alternative splicing
Peter Keane
Supervisors: Prof Cathal Seoighe & Prof Rhodri Ceredig

Introns are non-coding intergenic sequences that are routinely excised from nascent pre-mRNA transcripts by a process known as splicing. Although they do not contribute directly to the protein-coding sequences of genes, they are known to have a number of important functions. In this thesis, we explore some of the functional implications of the presence of introns in mammalian genomes. In the first part of this thesis, we considered the hypothesis that tissue-specific alternative pre-mRNA splicing may result in autoimmune responses against self-antigens and showed that such restricted splice isoforms are often expressed in thymic epithelial cells, contributing to the establishment of self-tolerance of T lymphocytes. In the second part, we carried out an investigation of intron length coevolution as a means to explore the functional implications of the time taken to transcribe introns for biological processes that require precise temporal co-ordination.

Immune self-tolerance of T lymphocytes is established during their development in the thymus. This process, called negative selection, involves the exposure of the developing T cells to a range of self-peptides. This includes peptides that are normally only expressed in specific tissues outside of the thymus. The expression of these tissue-restricted antigens (TRAs) is under the control of AIRE, a transcription factor that is expressed in the thymus by medullary thymic epithelial cells (mTECs). Tissue specific alternative splicing also has the potential to introduce TRAs, but the expression of tissue-specific isoforms in the thymus had yet to be investigated. Through the re-analysis of publicly available next-generation sequencing data from thymic epithelial cells, we show that mTECs ectopically express a range of tissue specific splice isoforms, and that the diversity of splice isoforms expressed in mTECs is greater than for any other tissue. This increased diversity is likely to be under the control, at least partially, of AIRE, as in the absence of AIRE there was a significant decrease in the splicing diversity and number of exons detected in mTECs.

Remarkably, mTECs are known to express almost all known protein-coding genes, providing a comprehensive coverage of the proteome to developing T cells during negative selection. In a single mTEC however, only a small portion of the total proteome is expressed, suggesting that the total breadth of expression in mTECs is due to a highly diverse cell population. To assess the diversity of alternative splicing at the single mTEC level, we analyzed published scRNA-Seq datasets from mTECs and compared them to other similar cell types. We found that while in general the increased splicing diversity of the mTEC population was also apparent to some extent in single cells, this splicing diversity was greatly enhanced by the pooling of multiple cells. At the population level, we also calculated gene expression entropy as a measure of the total transcriptome diversity in mTECs, and found that the diversity of gene expression in mTECs is greater than any other tissue. Overall, our results suggest that the diversity of the mTEC transcriptome is greater than any other cell type, in terms of both alternative splicing and gene expression. This diversity is somewhat apparent in single mTECs, but is enhanced by the pooling of multiple cells. This diversity is under the partially under the control of AIRE, and reflects the role of AIRE in establishing and maintaining T cell tolerance to self.

Precise regulation of the timing of gene expression is functionally relevant in some biological processes. This is particularly important for developmental processes, where intron delays coupled with negative feedback loops can establish oscillatory patterns of gene expression that are required for normal embryonic development. It has previously been suggested that the intron content of a set of genes involved in development is under purifying selection, suggesting that natural selection does act on intron length. In this thesis, we carried out an investigation of intron length coevolution in mammals to test the hypothesis that sets of genes that require precise coordination in the timing of their expression may be sensitive to evolutionary changes in intron length, and that such changes, when they occur, should be correlated among these sets of genes. We found strong evidence for intron length coevolution in sets of genes enriched

for biological processes related to development and the cell cycle. We also found that genes that belong to the same protein complex or which are co-expressed are more likely to show evidence of intron length co-evolution than randomly sampled genes. Overall, our results suggest that intron length may be functionally relevant in these gene sets, and that natural selection acts to maintain the relative intron length and transcriptional timing in these genes, revealing a novel aspect of intron evolution and function.

Parabolic and equal-rank subroot systems with applications to symmetric spaces and flag manifolds
M. A. Makrooni
Supervisor: Dr. John Burns

Using the algebraic structure of subroot systems in the root system of a complex simple Lie algebra, we prove a generalisation for compact homogeneous spaces with positive Euler characteristic of the "strange formula" of Freudenthal and de-Vries. We also derive formulæ for the Chern classes of flag manifolds and their defects as projective varieties.

On the Table of Marks of a Direct Product of Finite Groups
B. Masterson
Supervisor: Prof. Gotz Pfeiffer

The table of marks was first introduced by William Burnside in his book "Theory of groups of finite order" in 1955. The table of marks counts the number of fixed points one subgroup has in the action of the cosets of another. In doing this it also encodes a lot of useful information about the subgroup lattice of a group G, including the index of each of G's subgroups in both G and their normalizers, containments and what cyclic subgroups G has.

Despite their usefulness they are extremely expensive to compute (the GAP table of marks library extends only as far as S_{13}). Thus one purpose of present research is find an efficient way to compute the table of marks of a direct product of finite group.

This is more difficult than one might expect. We consider a direct product of two finite groups $G_1 \times G_2$, using Goursat's lemma we hope to use knowledge of the table of marks of G_1 and G_2 to compute the table of marks of $G_1 \times G_2$. The methods developed in the present research also gives rise to a new base change

matrix for the double Burnside algebra, $\mathbb{Q}B(G,G)$, which it will be conjectured gives a cellular basis for the algebra.

Sparse grid methods for singularly perturbed problems
Stephen Russell
Supervisor: Dr Niall Madden

This thesis is concerned with the design, analysis and implementation of *sparse grid finite element methods* applied to singularly perturbed partial differential equations, in two and three dimensions. Typically, sparse grid methods are constructed using a hierarchical grid approach. This thesis presents a two-dimensional multiscale sparse grid method that is the same, up to choice of basis, as standard hierarchical sparse grid methods. However, since the method is described as a generalisation of the two-scale sparse grid method, both the the analysis and implementation are significantly simplified. We provide an analysis for a multiscale sparse grid method applied to an elliptic partial differential equation, by first providing a concise expression for the difference between two multiscale interpolation operators at successive levels and then deriving a bound on this expression.

The solutions to the singularly perturbed problems that we study possess boundary layers. The most commonly used numerical methods for computing solutions that resolve these layers involve layer adapted meshes, and the mesh of *Shishkin* in particular. We show how to apply sparse grid methods to both reaction-diffusion, and convection-diffusion problems with exponential layers, both in two dimensions. The multiscale analysis we have developed allows us to prove robust convergence.

We then extend the methods to three dimensions. We provide the first (that we know of) complete numerical analysis of a standard Galerkin finite element method applied to a singularly perturbed reaction-diffusion problem in three dimensions. Moreover, we provide the first analysis for any sparse grid method applied to a singularly perturbed problem in three dimensions. We describe a two-scale sparse grid method in three dimensions, and provide a full numerical analysis for it applied to a singularly perturbed reaction-diffusion problem. This requires a suitable three-dimensional Shishkin mesh, solution decomposition and bounds on derivatives of its components, which are all presented in detail. As with the two-scale sparse grid method in two dimensions, an expression for the difference between the standard

trilinear interpolation operator and the two-scale interpolation operator is the key to completing the analysis.

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5 Abstracts of Masters Theses

The use of Propensity Score Matching Methods for Causal Inference in the Analysis of Observational Studies: Estimating the effect of Clostridium difficile infection on patient average length of stay in hospital

M. McCague

Supervisor: Dr. John Newell

Propensity Score Matching is an increasingly popular statistical concept used as a pre-processing step for causal inference in observational studies. The goal is to match subjects in the case and control groups as closely as possible on their given observed characteristics so as to approximate the gold standard conditions of a randomised controlled trial to better estimate the true effect of being in the case group. Once the matching process has been carried out, covariate balance is checked using graphical and numerical methods. Propensity score matching must be viewed as the first step in a two-step process and so, with an appropriate matching algorithm decided upon, in the subsequent step, regression adjustment methods are performed on the matched data to estimate the "treatment" effect.

For this particular research project, the aim is to compare the length of stay of patients diagnosed with Clostridium difficile infection, CDI, at Galway University Hospitals with the length of stay of patients who did not have a diagnosis of CDI. Clostridium difficile is a spore forming, anaerobic bacterium that is found in the gastrointestinal tracts of up to 3% of healthy adults and is the leading cause of healthcare-associated diarrhoea in industrialised countries.

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6 Research Activity from 1 Jan 2016 to 31 Dec 2016

Permanent and Contract Staff

Burns, John

Current Research Interests

My current research interests are Algebra (Lie algebras, Lie groups, Weyl groups) and Differential Geometry (Homogeneous manifolds, Symmetric spaces). Research in these areas is ongoing with various authors:

Adib Makrooni and I are studying parabolic sub-root systems and their associated flag manifolds. Applications include dimension formulae for the irreducible components of the isotropy representation, necessary for the study of the Einstein metrics that these spaces admit. In addition formulae for the defect of the corresponding projective varieties have been obtained.

Patrick Browne and I are working on graded Lie Algebras and their application to the geometry of homogeneous submanifolds of noncompact symmetric spaces. These spaces are interesting as they contain a large class of Einstein manifolds.

Publications

Most significant recent publications

[1] Burns, John M.; Makrooni, Mohammad A. Compact homogeneous spaces with positive Euler characteristic and their 'strange formulae'. Q. J. Math. 66 (2015), no. 2, 507?516.

[2] Burns, John M.; Suter, Ruedi Power sums of Coxeter exponents. Adv. Math. 231 (2012), no. 3-4, 1291?1307.

Research Activities

Invited talks: "Subroot systems, flag manifolds and numerical invariants" at the Irish Geometry Conference, T.C.D. May 2016. "Discrete tori in Weyl groups and their applications" at Groups in Galway, N.U.I.G. May 2016. //Journal submissions: Two papers submitted. //Refereeing: 1 paper. //Reviewing: 1 paper. //Conferences and workshops: Irish Geometry Conference (T.C.D.) 2016. Groups in Galway, May 2016. //Postgraduate supervision: 1 Ph.D. student. 1 prospective Ph.d student application submitted for and IRC and Hardiman Fellowship.

Cruickshank, James

Current Research Interests

[1] Geometric rigidity theory of bar-joint frameworks and related structures. Sparsity and tightness of surface graphs. Rigidity of bar-joint frameworks in 3D

[2] Multilinear algebra over local rings - classifications of forms and analogues of the classical matrix groups.

[3] Random geometric graphs.

[4] E-assessment in mathematics.

Publications

Number of publications appearing in calendar year 2016: 1

Most significant recent publications

[1] Cruickshank, James; Kitson, Derek; Power, Stephen C. *The generic rigidity of triangulated spheres with blocks and holes.* J. Combin. Theory Ser. B 122 (2017), 550-577. 05C10 (52B70)

[2] Cruickshank, James; Loane, John; Ryan, Raymond A. *Positive polynomials on Riesz spaces.* Positivity. DOI 10.1007/s11117-016-0439-8 (2016).

[3] Cruickshank, James. *On spaces of infinitesimal motions and three dimensional Henneberg extensions.* Discrete Comput. Geom. 51 (2014), no. 3, 702-721. (Reviewer: Victor Alexandrov) 52C25 (05C10)

[4] Cruickshank, J.; Herman, A.; Quinlan, R.; Szechtman, F. *Unitary groups over local rings.* J. Algebra Appl. 13 (2014), no. 2, 1350093, 23 pp. (Reviewer: A. G. Earnest) 11E57 (11E39 20C15)

Research Activities

- 2 current PhD students

- 1 paper submitted and awaiting report (arXiv:1611.00824), 1 paper ready for submission and 2 in preparation (arXiv:1509.00711).

- 2 conference presentations during 2016

  [1] Geometric Rigidity and Applications, June 2016 at the ICMS in Edinburgh. Title: *Block and Hole graphs*

  [2] EAMS 2016, September 2016 at Newcastle University. Title: *UBBR: a SageMath based e-assessment system*

- 1 paper refereed

- member of IMS Bulletin editorial board

Degrijse, Dieter

Current Research Interests

Homological and geometric group theory, algebraic topology

Publications

Most significant recent publications

[1] Degrijse, Dieter. *A cohomological characterization of locally virtually cyclic groups*, Advances in Mathematics 305 (2017), 935-952.

[2] Degrijse, Dieter and Souto, Juan. *Dimension invariants of outer automorphism groups*, Groups, Geometry and Dynamics (2017), to appear

[3] Degrijse, Dieter and Leary, Ian J. *Equivariant vector bundles over classifying spaces for proper actions*, Algebraic and Geometric Topology 17 (2017) 131-156.

[4] Degrijse, Dieter and Martinez-Perez, Conchita. *Dimension invariants for groups admitting a cocompact model for proper actions*, J. Reine Angew. Math. 721 (2016), 233-249.

Research Activities

Submitted preprints in 2016:

1. Degrijse, Dieter. *Amenable groups of finite cohomological dimension and the zero divisor conjecture.*

2. Barcenas, Noe and Degrijse, Dieter and Patchkoria, Irakli. *Stable finiteness properties of infinite discrete groups.*

Destrade, Michel

Current Research Interests

I apply the principles of Continuum Mechanics to the modelling of soft matter, including soft silicones, gels, and biological tissues such as the human skin and brain matter. I am mainly working in problems and applications of elastic wave propagation, elastic stability, and experimental and computational solid mechanics. I recently started working also on modelling electroactive polymers, which are used for artificial muscles, soft robotics and energy harvesters.

Publications

Most significant recent publications

[1] P. Ciarletta, A.L. Gower, M. Destrade. On residual stresses and homeostasis: An elastic theory of functional adaptation in living matter. Scientific Reports, 6 (2016) 24390.

[2] R. Mangan, M. Destrade, G. Saccomandi. Strain energy function for isotropic non-linear elastic incompressible solids with linear finite strain response in shear and torsion. Extreme Mechanics Letters, 9 (2016) 204-206.

[3] M. Destrade, Y. Fu, A. Nobili. Edge wrinkling in elastically supported pre-stressed incompressible isotropic plates. Proceedings of the Royal Society A, 472 (2016) 20160410.

[4] G.-Y. Li, Y. Zheng, Y. Liu, M. Destrade, Y. Cao. Elastic Cherenkov effects in transversely isotropic soft materials-I: Theoretical analysis, simulations and inverse method. Journal of the Mechanics and Physics of Solids, 96 (2016) 388-410.

Research Activities

Research grants: 2 IRC postgraduate scholarships; 1 Marie Curie Fellowship; 2 Enterprise Ireland Coordinator support grants; 1 Istituto Nazionale di Alta Matematica visiting grant; 1 Visiting Grant from Suzhou university.
Graduate students: 2 (Robert Mangan, Hannah Broderick-Conroy);
Journal submissions: 5;
Research Fellow: 1 (Valentina Balbi) *Conferences/Seminars:* 8;
Outreach talks: 10;
Research Visits: 5 (Madrid, Suzhou, St James Hospital, Manchester, Glasgow);
Research Visitors: 5 (Saccomandi/Perugia, Carfagna/Turin, Su/Hanzhou);
Papers refereed: 7;
International Grant referee: 1 (Polish National Science Centre);
PhD External Examiner: 1 (Glasgow);
Editorial Board Member: 6 (Proceedings of the Royal Society A, Quarterly Journal of Mechanics and Applied Mathematics, International Journal of Applied Mechanics, International Journal of Non-Linear Mechanics, Journal of the Acoustical Society of America, SIAM Journal of Applied Mathematics);
External positions: Reviews Editor (Proceedings of the Royal Society A); Contributing Editor (International Journal of Non-Linear Mechanics); Visiting Professor of Mechanical Engineering (University College Dublin); Directeur de Recherche, Institut d'Alembert, CNRS, Paris, France (on leave); International Brain Mechanics and Trauma Lab (Oxford); Biomechanics Research Centre (NUI Galway).

Dooley, Cara

Current Research Interests

My research interests include the design and analysis of observational studies, analysis of longitudinal data and survival analysis, particularly in the context of survey data.

Publications

3 publications were published in 2016 Most significant recent publications

[1] 1. Donoghue, O, Dooley, C, Kenny, RA. Usual and dual task walking speed: implications for pedestrians crossing the road. Journal of Aging and Health. 28(5): 850-862.

[2] 2. Hypertension prevalence, awareness, treatment and control in the over 50s in Ireland: evidence from The Irish Longitudinal Study on Ageing CM Murphy, PM Kearney, EB Shelley, T Fahey, C Dooley, RA Kenny Journal of Public Health 38 (3), 450-458

Ellis, Graham

Publications

Most significant recent publications

[1] A.T. Bui and G. Ellis. Computing Bredon homology of groups. J. Homotopy Relat. Struct. 11 (2016), no. 4, 715-734.

[2] G. Ellis. Cohomological periodicities of crystallographic groups. J. Algebra 445 (2016), 537-544.

[3] E. Bayer-Fuckiger, P. Elbaz-Vincent, and G. Ellis. Oberwolfach Mini Workshop: Computations in the Cohomology of Arithmetic Groups, 2016. (https://www.mfo.de/document/1644c/preliminary_OWR_2016_52.pdf).

Research Activities

[1] Co-organized (with Philippe Elbaz-Vincent) an Oberwolfach mini-workshop on computations in the cohomology of arithemtic groups. 30/10/2016-05/11/2016.

[2] Gave a course of five lectures on 'computational cohomology' at the workshop on group theory and computational methods, ICTS Bangalore, 05/11/2016-14/11/2016.

[3] Gave a lecture on 'group theoretic structures for van Kampen theorem' at the conference part of the meeting on group theory and computational methods, ICTS Bangalore, 05/11/2016-14/11/2016.

[4] Gave a lecture on 'Computational cohomology of some arithmetic groups', Oberwolfach, 30/10/2016-05/11/2016.

[5] Gave a talk on 'computing with 2×2 matrices' at the Annual Meeting of the Irish Mathematical Society, April 2016.

[6] Gave a talk on 'applied algebraic topology' at the weekly colloquium, Dublin City University, April 2016.

[7] Co-organized a special session on 'applied and computational algebraic topology' at ACA2016, in Kassel, Germany 1-4 August 2016.

[8] Continued to supervise two PhD students.

[9] Continued editorial work for the journals: Homology, Homotopy & Applications; Journal of Homotopy and Related Structures; Applicable Algebra in Engineering, Communications and Computing.

Flannery, Dane

Current Research Interests

- Computing with finitely generated linear groups over infinite domains, in both classes of the Tits alternative.

- Algebraic design theory: e.g., determining automorphism groups of pairwise combinatorial designs; existence and classification problems for cocyclic designs.

Publications

[1] R. Egan and D. L. Flannery, Automorphisms of generalized Sylvester Hadamard matrices, Discrete Math. 340 (2017), no. 3, 516–523.

[2] A. S. Detinko, D. L. Flannery, and A. Hulpke, Zariski density and computing in arithmetic groups, Math. Comp. (19pp., in press). DOI: https://doi.org/10.1090/mcom/3236

[3] R. Egan, D. L. Flannery, and P. Ó Catháin, Classifying cocyclic Butson Hadamard matrices, in: Algebraic design theory and Hadamard matrices, 93–106, Springer Proc. Math. Stat., 133, Springer, 2015.

[4] A. S. Detinko, D. L. Flannery, and A. Hulpke, Algorithms for arithmetic groups with the congruence subgroup property, J. Algebra 421 (2015), 234–259.

Research Activities

- Co-editor, Journal of the Australian Mathematical Society, L. G. Kovács Special Issue.

- Awards: Irish Research Council New Foundations Scheme 2015; Research in Pairs, Mathematisches Forschungsinstitut Oberwolfach; Research-in-Groups, International Centre for Mathematical Sciences, Edinburgh.

- Research visits to RMIT University, Colorado State University, University of Auckland, University of St Andrews, RWTH Aachen. Talks at RMIT, CSU, Auckland, Aachen.

- Conferences: *Thin Groups and SuperApproximation*, Institute for Advanced Study, Princeton; *Computational Group Theory*, MFO Oberwolfach; The 20th Midrasha Mathematicae *60 Faces to Groups*, Israel Institute for Advanced Studies, Jerusalem.

- Member, Associate Peer Review College of the Engineering and Physical Sciences Research Council, UK.

- Reviewer, Natural Sciences and Engineering Research Council of Canada.

- Three Mathematical Reviews.

- Referee for Journal of Algebra, Journal of the Australian Mathematical Society, Australasian Journal of Combinatorics.

Hinde, John

Current Research Interests

Statistical modelling, particularly generalized linear models, under/overdispersion and random effects and mixture models; statistical computing and statistical software; applications of statistics in biological, medical and social sciences.

Publications

Number of publications appearing in calendar year 2016: Journal papers: 3; Conference Papers: 2; Software 3.

Most significant recent publications

[1] I. A. R. de Lara, J. P. Hinde, A. C. de Castro and I. J. O. da Silva (2016) A proportional odds transition model for ordinal responses with an application to pig behaviour. *Journal of Applied Statistics*, DOI:10.1080/02664763.2016.1191623

[2] Alberto Alvarez-Iglesias, John Hinde, John Ferguson, John Newell. (2017) An alternative pruning based approach to unbiased recursive partitioning. *Computational Statistics and Data Analysis*, 106, 90-102.

[3] Alvarez-Iglesias, A., Hinde, J., Scarrott, C. and Newell, J. (2015) Summarising censored survival data using the mean residual life function. *Statistics in Medicine*, 34 (11),1965-1976

[4] Demétrio, Clarice G.B., Hinde, John and Moral, Rafael de Andrade. (2014) Modeling overdispersed discrete data in entomological experiments. Contributed chapter in *Ecological Modeling Applied to Entomology*, Godoy, W.A.; Ferreira, C.P. (Eds.)., Springer, 219-259.

Research Activities

- Graduate students: 3; Visiting: Postdoc 1; Postgrads 2.

- Journal submissions: 13; accepted 5; under review 5; under revision 3

- Conferences: Invited Speaker: 2

- Seminar talks: 4; Public Lecture: 1

- Research Visits: University of Christchurch Canterbury – Feb/April 2016.

- Research Visitors: 6; Prof. Idemauro de Lara, Professor Clarice Demétrio, Rafael Moral, Wagner Bonat, Thiago Oliveira, Naratip Jansakul.

- Conference Organisation: Organising President, IBC2016 Victoria, Canada; co-chair of Scientific Programme Committee RBras 2016, Salvador, Brasil; Invited session organiser CFE-CMC 2016, Sevile, Spain; member of Scientific Programme Committee IWSM 2017, Groeningen, The Netherlands; member of Scientific Programme Committee RBras 2017, Lavras, Brasil.

- Editorships: Statistics and Computing (Associate); Computational Statistics and Data Analysis (Associate Editor); Statistical Modelling (Advisory Board); Referee for numerous journals.

- vice-President of the International Biometric Society (2016)

- External Examining: Statistics Extern School of Maths UCD; Certificate/Diploma in Statistics, Trinity College, Dublin; PhD Warwick, UK; PhD University of Victoria, Wellington, New Zealand.

Holian, Emma

Current Research Interests

Mixture modelling to cluster longitudinal data profiles and to model the group features via generalized linear mixed models and penalized smoothing models, leading to the formulation of the Regression Cluster Model (RCM). Analysis into capability of the RCM to handle missing data within profiles or profiles measured at variable time-points. Extension of the RCM to longitudinal profiles measured on discrete or categorical scales. P-Splines and mixed effects model clustering. Applications in microarray analysis.

Prognostic models in Breast Cancer, variable selection methods in survival models for data with various missingness mechanisms.

Publications

[1] "Screening of exosomal microRNAs from colorectal cancer cells." Clancy, Cillian, Sonja Khan, Claire L. Glynn, Emma Holian, Peter Dockery, Pierce Lalor, James AL Brown, Myles R. Joyce, Michael J. Kerin, and Roisin M. Dwyer. Cancer Biomarkers Preprint (2016): 1-9.

[2] "Her-2 Breast Cancer Treatments Induced Variations in the Patterns of Survival and Metastasis in Her-2 Positive Breast Cancers" A. McGuire, O. Kalinina, E. Holian, K. Sweeney, C. Malone, R. McLaughlin, A. Lowery, J. A. L. Brown, M. J. Kerin. (2015) Conference Paper in Irish Journal of Medical Science 184:S397-S397, Sept 2015

[3] "Exosome-mediated trafficking of microRNAs by breast cancer cells. D. P. Joyce, C. L. Glynn, J. Brown, E. Holian, P. Dockery, M. J. Kerin, R. M. Dwyer (2015) Cancer Research 75 (9 Supplement): P4-07-05 May 2015

[4] "Investigation of exosome-encapsulated microRNAs as potential circulating biomarkers of breast cancer." D. P. Joyce, M. Higgins, C. L. Glynn, J. Brown, E. Holian, P. Dockery, M. J. Kerin, R. M. Dwyer (2015) British Journal of Surgery, April 2015

Research Activities

Supervision:
Ph.D student Olga Kalinina, Prognostic models in Breast Cancer, variable selection methods in survival models for data with various missingness mechanisms.

Memberships: Irish Statistical Association.
Affiliations: Staff member Biostatistics Unit. HRB Clinical Research Facility, Galway, (CRFG).
Collaborative work: Statistical Consultation, Dr. Roisin Dwyer, REMEDI, NUIG, microarray analysis in Mesenchymal Stem Cells and Breast Cancer.

Madden, Niall

Current Research Interests

I am interested in the *numerical analysis* of finite element and finite difference methods for solving partial differential equations (mainly elliptic problems in two and three dimensions). Much of my focus is on so-called *singularly perturbed* problems. Solutions to these problems feature boundary and/or interior layers, and their numerical solution requires the development of quite specialised algorithms.

Within this area, I work in two main branches: discretizations (meaning algorithms that reduce differential equations to linear systems of equations) and solvers (meaning algorithms that compute solutions to these linear systems).

Publications

I had five papers that appeared in 2016. Some significant recent publications include

[1] Adler, James; MacLachlan, Scott; Madden, Niall. *A first-order system Petrov-Galerkin discretization for a reaction-diffusion problem on a fitted mesh.* IMA J. Numer. Anal. 36 (2016), no. 3, 1281-1309.

[2] Panaseti, Pandelitsa; Zouvani, Antri; Madden, Niall; Xenophontos, Christos. *A C^1-conforming hp finite element method for fourth order singularly perturbed boundary value problems.* Appl. Numer. Math. 104 (2016), 81-97.

[3] Chadha, Naresh M.; Madden, Niall. *An optimal time-stepping algorithm for unsteady advection-diffusion problems.* J. Comput. Appl. Math. 294 (2016), 57-77.

[4] Madden, Niall; Russell, Stephen. *A multiscale sparse grid finite element method for a*

two-dimensional singularly perturbed reaction-diffusion problem. Adv. Comput. Math. 41 (2015), no. 6, 987-1014.

Research Activities

In May, I gave a research talk at the 14th European Finite Element Fair, at Universiatät Bonn. Several days later, I gave an invited seminar at FernUniversität in Hagen.

In July gave a two day graduate course at the 2016 AARMS-CRM Workshop on Numerical Analysis of Singularly Perturbed Differential Equations, Halifax, Nova Scotia. I also gave a plenary lecture later in the workshop. That trip concluded with a research visit to Memorial University of Newfoundland, to work with Scott MacLachlan on a new mixed finite element method for convection diffusion problems.

And in December, I had the pleasure of giving an invited talk at the University of Limerick SIAM Student Chapter conference.

During 2016, I worked with two graduate research students: Stephen Russell, who defended his thesis in June, and Faiza Alssaedi, who is currently working on numerical solution of some complex-valued differential equations. I also supervised the research internships of Róisín Hill, who developed finite element software in FEniCS for solving a fluid-flow problem, and Szymon Urbas, who devised a hp finite element method for fractional order differential equations.

In March I was appointed to the editorial board of Numerical Algorithms, published by Springer. I also refereed papers for several international journals during 2016, including the Journal of Computational and Applied Mathematics, Computational Methods in Applied Mathematics, Applied Numerical Mathematics, and Springer Lecture Notes in Computational Science and Engineering.

McCluskey, Aisling

Current Research Interests

My research interests reside primarily within analytic topology, with a particular fascination in how order theoretic structures mesh with topology. Other ongoing research concerns continua theory in the context of both a natural associated order (a notion of "betweenness"), and of discrete dynamical systems.

Additionally, my research interests encompass research in undergraduate mathematics education.

Specifically, I am interested in the development of and facility with proof and proving in abstract analysis-based mathematical subjects typically taken in mathematics-major degree programmes.

Publications

Number of publications appearing in calendar year 2016: 1

Most significant publications

[1] A. McCluskey and B. McMaster, "Undergraduate topology: a working textbook", Oxford University Press, 2014.

[2] S. Greenwood and A. McCluskey, "Continuous functions on Hausdorff continua", Topology Appl. 212 (2016), 142 - 165.

[3] J. L. Bruno and A. E. McCluskey, "Topologies as points within a Stone space: lattice theory meets topology", Topology Appl. 160 (2) (2013), 273 - 279.

Research Activities

Publications: 1 published; 1 in process
Graduate students: Daron Anderson PhD
Conferences: 12th Symposium on General Topology and its relations to Modern Analysis and Algebra, Praha July 2016 .
31st Summer Conference in Topology and Its Applications at University of Leicester, August 2016.
19th Galway Topology Colloquium at University of Leicester, August 2016.
Member of International Steering Committee of DELTA 2016
Research visitors: S Reviewer of papers submitted to Topology and its Applications and International Journal of Research in Undergraduate Mathematics Education.

Mc Gettrick, Michael

Current Research Interests

My main research interests are in theoretical aspects of Quantum Information and Quantum Computation. In particular I investigate properties of quantum walks and quantum games, which are the building blocks for many quantum algorithms. I am currently trying to establish a new domain ("quantum evolution") marrying ideas from quantum game theory and

ideas from the Evolutionary Computation community in theoretical Computer Science.

I have other research interests in Computer Algebra, Algorithmic Composition, Markov Chains, Game Theory and Graph Theory.

Publications

Most significant recent publications

[1] Dan Li, Michael Mc Gettrick, Fei Gao, Jie Xu and Qiao-Yan Wen, *Generic quantum walks with memory on regular graphs* Phys. Rev. A 93, 042323 (2016)

[2] Dan Li, Michael Mc Gettrick, Zhang Wei-Wei and Zhang Ke-Jia, *Quantum Walks on Two Kinds of Two-Dimensional Models* International Journal of Theoretical Physics 54: 2771 (2015)

[3] Dan Li, Michael Mc Gettrick, Zhang Wei-Wei and Zhang Ke-Jia, *One-dimensional lazy quantum walks and occupancy rate* Chinese Physics B, Volume 24, Number 5 (2015)

[4] Michael Mc Gettrick and Jaroslaw Adam Miszczak, *Quantum walks with memory on cycles* Physica A: Statistical Mechanics and its Applications, Vol. 399, pp. 163-170 (2014)

Research Activities

I am a member of the American Mathematical Society and the Irish Mathematical Society. In 2016 I accepted an invitation to become an EPSRC (UK - Engineering and Physical Sciences Research Council) Peer Review Associate College member, where I have since reviewed a grant application in the UK. In April 2016, I was a secondary proposer in the COST Action Proposal OC-2016-1-20381 "Quantum Walks for Algorithmic Applications" (which unfortunately was not successful). In November 2016, I was invited to attend as an expert to a Workshop on Policy Implications of Quantum Computing in Brussels, held by the Joint Research Centre of the European Commission. In December 2016 I was invited to review a research proposal for the (Polish Government) National Science Center.

I participated in the conferences

- *Irish Quantum Foundations*, May 2016, Maynooth University

- *Workshop of Quantum Simulation and Quantum Walks* November 2016, Czech Technical University (Prague).

I am a reviewer for Phys. Rev. A (American Physical Society)

Meere, Martin

Current Research Interests

Modelling polymer degradation; modelling membrane mechanics and cellular uptake; modelling diffusion in strained crystals; modelling drug delivery applications.

Publications

Two publications in peer reviewed journals in 2016.

[1] T. Vo, W. Lee, A. Peddle and M. Meere, Modelling chemistry and biology after implantation of a drug-eluting stent. Part I: Drug transport, Mathematical Biosciences and Engineering, 14(2), 491-509, 2017 / Online October 2016

[2] K. Doherty, M. Meere and P.T. Piiroinen, A mathematical model of Aurora B activity in prophase and metaphase, Mathematical Biosciences, 277, 153-165, 2016

Research Activities

I have two PhD students, one co-supervised by Dr Giuseppe Zurlo, and another co-supervised by Dr Tuoi Vo (University of Limerick). I gave two invited talks (Limerick, Glasgow). I was a mentor for a mathematical modelling workshop at the University of Glasgow (September, 2016). I attended two conferences; MEDDS 2016 (Coimbra) and BAMC 2016 (Oxford). I made two visits to the School of Mathematics, the University of Nottingham (April 2016, December 2016), and one visit to the Unversity of Glasgow (Dept. Biomedical Engineering, September 2016).

Newell, John

Current Research Interests

My primary areas of research in Biostatistics are in the theory and application of statistical methods in clinical trials of health service and population health

interventions and in the development of novel analytic approaches in Sports and Exercise Science. My research interests include statistical modelling, statistical computing, design and analysis of cluster randomised trials, smoothing techniques and derivative estimation, survival analysis, tree based classification problems and sports analytics.

Publications

7 publications appeared in calendar year 2016

Most significant recent publications

[1] Lewis, NA,Newell, J,Burden, R,Howatson, G,Pedlar, CR (2016) 'Critical Difference and Biological Variation in Biomarkers of Oxidative Stress and Nutritional Status in Athletes'. Plos One, 11

[2] O'Dea, A,Tierney, M,Danyliv, A,Glynn, LG,McGuire, BE,Carmody, LA,Newell, J,Dunne, FP (2016) 'Screening for gestational diabetes mellitus in primary versus secondary care: The clinical outcomes of a randomised controlled trial'. Diabetes Research And Clinical Practice, 117 :55-63.

[3] Alvarez-Iglesias, A., Hinde, J., Ferguson, J. and Newell, J. (2016) 'An alternative pruning based approach to unbiased recursive partitioning'. Computational Statistics & Data Analysis, 106 :90-102.

[4] Ferguson, J., Alvarez-Iglesias, A., Newell, J., Hinde, J. and O'Donell, M. (2016) 'Estimating average attributable fractions with confidence intervals for cohort and case-control studies'. Statistical Methods In Medical Research.

Research Activities

- Current research grants: PI (1), Co-PI (1), Collaborator (3)

- Number of graduate students: 5

- Journal submissions: 7

- Conferences: 2

- Visits: 1

- Invited talks: 2

- Research visits: 4

- Memberships: International Society for Clinical Biostatistics, Irish Statistical Association

- External posts: Adjunct Senior Research Fellow in the Department of Mathematics and Statistics, University of Canterbury, Christchurch, New Zealand.

Ó Broin, Pilib

Current Research Interests

My research interests are focused in two areas:

1. Biomedical Genomics

- Cancer genomics - variant discovery for recurrence risk and deconvolution of cell-type specific tumour-microenvironment interaction pathways from gene expression profiles.

- Immunology - mechanisms and sub-clinical prediction of antibody-mediated graft loss in kidney transplant patients.

- Neuroscience - population genomics for the association of non-coding variants with cognitive deficits in schizophrenia.

2. Computational methods development

- High-performance computing algorithms for the analysis of next-generation sequencing data.

- Statistical machine learning for the identification of biomarker signatures in clinical data.

Publications

Most significant recent publications

[1] Deanna Acosta, Susmita Bagchi, **Pilib Ó Broin**, Daniel Hollern, Silvia E. Racedo, Bernice Morrow, Rani S. Sellers, John M. Greally, Aaron Golden, Eran Andrechek, Teresa Wood, and Cristina Montagna 'LPA receptor activity is basal specific and coincident with early pregnancy and involution during mammary gland postnatal development'. Sci Rep. 2016; 6: 35810

[2] Tomohisa Takahashi[*], Shota Okabe[*], **Pilib Ó Broin**[*], Akira Nishi, Kenny Ye, Michael Beckert, Takeshi Izumi, Hiroaki Machida, Gina Kang, Jose L. Pena, Aaron Golden, Takefumi Kikusui, Noboru Hiroi. 'Structure and function of neonatal social communication in a genetic mouse model of autism spectrum disorders'. Mol. Psych. (2016) 21, 1208âĂŞ1214

[3] Michelle Lubetzky, **<u>Pilib Ó Broin</u>**, Yi Bao, Enver Akalin 'Molecular Significance of Microvascular Inflammation and C4d Negative Transplant Glomerulopathy'. In American Journal of Transplantation 2016 (16):224-225

Research Activities

Journal Submissions: 4
Conference Presentations: 3
Articles Refereed: 1
PhD Examiner: 2 (Internal) Graduate Students: 6 (1 PhD, 5 MSc)
Professional Memberships: ISCB, VIBE, EACR

O'Regan, Donal

Current Research Interests

Nonlinear Functional Analysis (theory, methods and applications).

Publications

41 journal papers in 2016.

Some recent publications:

[1] Agarwal, Ravi ; O'Regan, D. ; Hristova, S. Stability by Lyapunov like functions of nonlinear differential equations with non-instantaneous impulses. J. Appl. Math. Comput. 53 (2017), no. 1-2, 147–168.

[2] Agarwal, Ravi ; O'Regan, D. ; Hristova, S. Monotone iterative technique for the initial value problem for differential equations with non-instantaneous impulses. Appl. Math. Comput. 298 (2017), 45–56.

[3] Agarwal, Ravi ; O'Regan, D. ; Hristova, S. ; Cicek, M. Practical stability with respect to initial time difference for Caputo fractional differential equations. Commun. Nonlinear Sci. Numer. Simul. 42 (2017), 106–120.

[4] Bonanno, G. ; D'AguÃň, G. ; O'Regan, D. A local minimum theorem and critical nonlinearities. An. ÅďtiinÅč. Univ. "Ovidius" ConstanÅča Ser. Mat. 24 (2016), no. 2, 67–86.

[5] Mokhtari, A. ; Moussaoui, T. ; O'Regan, D. Multiplicity results for an impulsive boundary value problem of p(t) -Kirchhoff type via critical

point theory. Opuscula Math. 36 (2016), no. 5, 631–649.

[6] Agarwal, Ravi ; Hristova, S. ; O'Regan, D. Practical stability of Caputo fractional differential equations by Lyapunov functions. Differ. Equ. Appl. 8 (2016), no. 1, 53–68.

[7] Rabie, Safi S. ; Saker, S. H. ; O'Regan, D. ; Agarwal, R. P. New multiplicative higher order dynamic inequalities of Opial type. Math. Inequal. Appl. 19 (2016), no. 1, 33–49.

Pfeiffer, Götz

Current Research Interests

Computational algebra, representations of finite groups and associative algebras, combinatorics and geometry of finite Coxeter groups, Burnside rings and double Burnside rings of finite groups.

Publications

Most significant recent publications

[1] (with Alice C. Niemeyer and Cheryl E. Praeger) On the Complexity of Multiplication in the Iwahori–Hecke Algebra of the Symmetric Group.
J. Symb. Comp. **80** (2017), 817–832.

[2] (with Ivan Marin) The BMR Freeness Conjecture for the 2-Reflection Groups. *Math. Comp.* **86** (2017), no. 306, 2005–2023.

[3] (with Marcus Bishop, J. Matthew Douglass and Gerhard Röhrle) Computations for Coxeter arrangements and Solomon's descent algebra III: Groups of rank seven and eight. *J. Algebra* **423** (2015), 1213–1232.

[4] (with J. Matthew Douglass and Gerhard Röhrle) Cohomology of Coxeter Arrangements and Solomon's Descent Algebra. *Trans. Amer. Math. Soc.* **366** (2014), no. 10, 5379–5407.

Research Activities

In February 2016, Dr Brendan Masterson completed his PhD under my supervision with a thesis "On the Table of Marks of a Direct Product of Finite Groups". I gave seminar talks at the Université de Picardie Jules Verne in Amiens, France and at the University

of Southampton, UK. I also gave talks at two conferences, one in Stuttgart, Germany, and one in Oberwolfach, Germany. I wrote 6 reviews for the Mathematical Reviews and I refereed 11 research papers. With J. Burns, I submitted one research paper. I am on the Editorial Board of the Mathematical Proceedings of the Royal Irish Academy.

Pfeiffer, Kirsten

Current Research Interests

My research interests are concerned with educational interventions to enhance students' creative reasoning skills and ultimately the learning of mathematical argumentation and proof. I'm interested in task design in the teaching of mathematics at university level, in particular in students' practice of proof evaluation exercises and possible learning effects of these.

Publications

Most significant recent publications

[1] Pfeiffer, K. and Quinlan R. (2016) Proof-Evaluation as a Step towards Proof Authorship. In 'Beyond Lecture', Mathematical Association of America.

[2] Sinead Breen, Ann O'Shea, Kirsten Pfeiffer (2016) "Students' views of example generation tasks". In: Teaching Mathematics and its Applications.

[3] Pfeiffer, K. and Quinlan R. (2016) Proof evaluation tasks as tools for teaching? In *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education (CERME 9). February 4th - 8st 2015*, Prague (Czech Republic).

Research Activities

Together with Ciaran Mac an Bhaird, Brien Nolan and Ann O'Shea I worked on a project "An analysis of the opportunities for creative reasoning in undergraduate Calculus courses" funded by *3U NStep*. The research paper 'A Study of Creative Reasoning Opportunities in Assessments in Undergraduate Calculus Courses' has been accepted for *Research in Mathematics Education Special Issue "What can summative assessment in mathematics education tell us?"*. In May 2017 I organised the 10th Annual Irish Workshop on Mathematics Learning and Support Centres in NUI Galway. The theme of this workshop was 'The key role of tutors of mathematics and statistics in Post-Secondary Education'.

Piiroinen, Petri T

Current Research Interests

My main research interests are in the area of discontinuous dynamical systems with application to rigid-body mechanics, evolving networks, population dynamics, economics, psychology and biological systems. An overarching aim of my research is to bridge the gap between mathematics and numerical analysis, on one hand, and biology, engineering and social sciences, on the other, to make mathematical theories more applicable to non-theoreticians.

Publications

Most significant recent publications

[1] Donohue, J.G. and Piiroinen, P.T., *The effects of predation on seasonally migrating populations*, Theoretical Ecology 9(4), pp. 487–499, 2016.
(DOI: 10.1007/s12080-016-0304-1)

[2] Doherty, K., Meere, M. and Piiroinen, P.T., *A Mathematical Model of Aurora B Activity in Prophase and Metaphase*, Mathematical Biosciences 277, pp. 153–165, July 2016.
(DOI: 10.1016/j.mbs.2016.04.013)

Research Activities

During 2016 I supervised 3 PhD students and 2 visiting MSc students from Naples. Both MSc students have since graduated. During the year I visited researchers in Bangalore, India and Naples, Italy. I gave conferences presentation at CRM, Barcelona, Spain and at UT Dallas, USA, and seminar presentations at UL and UCC.

Quinlan, Rachel

Current Research Interests

Linear algebra and its interactions with combinatorics, graph theory, field theory and the representation theory of finite groups. Current projects involve

(for example) completion problems for entry pattern matrices, classifications of nilpotent spaces over finite fields, and characterization of extremal graphs that are primitive of low exponent.

I also have interests in mathematics education at university level.

Publications

Most significant recent publications

[1] Hieu Ha Van and Rachel Quinlan, *On the maximum rank of completions of entry pattern matrices*, to appear in Linear Algebra and its Applications (2017).

[2] Olga O'Mahony and Rachel Quinlan, *Edge-minimal graphs of exponent 2*, to appear in Linear Algebra and its Applications (2017).

[3] K. Pfeiffer and R. Quinlan, *Proof-evaluation as a step towards proof authorship*, in *Beyond Lecture*, Mathematical Association of America, 2016 (book chapter).

[4] J. McTigue and R. Quinlan. *Partial matrices of constant rank*, Linear Algebra and its Applications, Vol. 446, 177–191 (2014).

Research Activities

I am currently supervising the research of the following PhD students:

- Olga O'Mahony

- Hieu Ha Van

- Cian O'Brien (co-supervised with Kevin Jennings)

During the calendar year 2016 I gave the following talks:

- *I almost wish I hadn't gone down that rabbit hole . . .*, Annual meeting of the Irish Mathematical Society, Trinity College Dublin, April 2016 (invited talk).

- *Adventures with nilpotent matrices, and the strange case of characteristic 2*, Western Canada Linear Algebra Meeting, Winnipeg, May 2016 (invited talk).

- *Curiosities of nilpotent spaces*, 20th ILAS Conference, Leuven, July 2016. *Partial matrices of constant rank*, Mathematics Colloquium, Maynooth University, December 2016.

I am the convenor of the weekly Linear Algebra seminar which runs throughout Semester 2, and gave two talks this year in this seminar series.

In 2016 I refereed articles for the *Journal of Algebra* and for *Linear Algebra and its Applications*, and wrote three reviews for *Mathematical Reviews.* I am a member of the Irish Mathematical Society, the American Mathematical Society, the International Linear Algebra Society and the Association for Women in Mathematics. I was elected in January 2017 to a three-year term as a member of the board of directors of the International Linear Algebra Society.

Röver, Claas

Current Research Interests

Currently I am interested in automata theoretic results concerning invertible Mealy machines. After many years of case by case investigations, new ideas have resulted in more theoretical and general results and I am keen to contribute to this development. Also the yet unknown existence of a universal group with context-free co-word problem keeps me busy from time to time. A paper on groups that are syntactic monoids of context-free languages is close to completion.

Publications

Most significant recent publications

[1] J. Burillo, S. Cleary, A. Martino and C.E. Röver, *Commensurations and Metric Properties of Houghton's Groups*, Pacific Journal of Mathematics **285** vol. 2 (2016), 289–301, DOI: 10.2140/pjm.2016.285.289

Research Activities

I was on leave until August 2016. However, jointly with Sarah Rees and Derek F. Holt, I completed the book "Groups, Languages and Automata" which is available from March 2017 in the LMS Student Texts Series published by Cambridge University Press. Together with Dieter Degrijse, I am organising *Groups in Galway 2017*, for which we have secured funding from the Registrar's Office (€3000), the Irish Mathematical Society (€200) and Science Foundation Ireland (€4750), as well as a number of high profile international speakers (see http://www.maths.nuigalway.ie/conferences/gig17/). I have also refereed two papers in 2016.

Ryan, Ray

Current Research Interests

Polynomial and holomorphic functions on real or complex Banach spaces and on Banach lattices. Currently working on:
1. Regular holomorphic functions on complex Banach lattices.
2. The existence of singular points on the boundary for power series on infinite dimensional Banach spaces.
3. The radius of analyticity for real analytic functions in infinite dimensions.

Publications

1 Journal paper. 1 minicourse given at research workshop. 2 invited talks.

[1] "Positive Polynomials on Riesz Spaces", J. Cruickshank, J. Loane, R.A. Ryan, *Positivity*, DOI 10.1007/s11117-016-0439-8 (2016).

Research Activities

- Minicourse on "Polynomial and Holomorphic Functions on Complex Riesz Spaces", 11th ILJU School of Mathematics on "Banach Spaces and Related Topics", Gyeongju, Republic of Korea, January 2016.

- "Some Recent Results for Real and Complex Analytic Functions", Dublin Analysis Seminar, UCD, October 2016.

- Invited lecture on "Power Series on Real Banach Spaces", Conference on Infinite Dimensional Analysis, Kent State University, Kent, Ohio, October 2016.

- Member of Editorial Board, Mathematical Proceedings of the Royal Irish Academy.

Seoighe, Cathal

Current Research Interests

Research interests include molecular evolution, genomics and epigenetics; in particular, the development and application of models and computational methods to analyze gene expression data and the analysis of genomic data in order to generate insights into the links between genomic and phenotypic variation.

Publications

6 journal articles appeared in 2016.

Most significant recent publications

[1] Consistency in large pharmacogenomic studies. Geeleher P, Gamazon ER, Seoighe C, Cox NJ, Huang RS. (2016) *Nature*. 540(7631):E1-E2.

[2] Intron Length Coevolution across Mammalian Genomes Keane, PA,Seoighe, C (2016) Intron Length Coevolution across Mammalian Genomes. *Molecular Biology And Evolution*, 33 :2682-2691

[3] LymAnalyzer: a tool for comprehensive analysis of next generation sequencing data of T cell receptors and immunoglobulins Yu, YX, Ceredig, R, Seoighe, C (2016) *Nucleic Acids Research*

[4] Impact of the Choice of Normalization Method on Molecular Cancer Class Discovery Using Nonnegative Matrix Factorization. Yang H, Seoighe C. *PLoS One*. 2016 Oct 14;11(10):e0164880

Research Activities

My research group consisted of four PhD students in 2016. Current research grants are from the EU (Marie Sklodowska Curie), IRC, Science Without Borders (Brazil), and SFI (H2020 Catalyst Award). Academic community service included membership of the editorial board of Briefings in Bioinformatics, review of grants for the Medical Research Council in the UK and Genome Canada, as well as refereeing for a range of journals.

Sheahan, Jerome

Publications

Five research papers

Sköldberg, Emil

Current Research Interests

My primary interest lies in the area of commutative algebra, but I am also working on problems in non-commutative algebra. I am mostly interested in questions that are of interest in algebraic combinatorics. In particular, I am interested in homological properties of monomial and binomial ideals.

Publications

The following were posted in 2016 and submitted for publication.

[1] M. Badiane, I. Burke and E. Sköldberg, *The universal Gröbner basis of a binomial edge ideal* `arXiv:1601.04575`

[2] E. Sköldberg, *The minimal resolution of a cointerval edge ideal is multiplicative*, `arXiv:1609.07356`

Research Activities

I am working with three PhD students: Daher Al-Baydli, whose main supervisor is Graham Ellis, Isaac Burke and Nghia Tran. Isaac recently submitted his thesis, with the title "Characterising bases of pure difference ideals". Nghia, who started her studies in 2016 is currently working on universal Gröbner bases.

In May 2016, I was hosting Veronica Crispin Quinoñez from Uppsala University.

Tuite, Michael

Current Research Interests

Vertex operator algebras (VOAs), conformal field theory, Riemann surfaces, elliptic, Jacobi and modular functions in number theory and combinatorics. Current projects include

- genus two Zhu theory for VOAs and partial differential equations describing genus two partition functions for various VOAs (with Tom Gilroy, UCD),

- genus two Zhu theory for super VOAs (with PhD student Mike Welby),

- VOAs on general genus Riemann surfaces in Schottky parameterization,

- quasi-Jacobi forms in VOAs (with Kathrin Bringman and Matt Krauel of University of Cologne),

- superconformal VOAs and Matheiu moonshine (with Geoff Mason UC Santa Cruz and Gaywalee Yamskulna of Illinois State University).

Publications

Most significant recent publications

[1] G. Mason and M.P. Tuite, Free bosonic vertex operator algebras on genus two Riemann surfaces II. âĂIJConformal Field Theory, Automorphic Forms and Related TopicsâĂİ, Contributions in Mathematical and Computational Sciences **8** 183-225, (Springer Verlag), (2014).

[2] M.P. Tuite and Hoang Dinh Van, On exceptional vertex operator (super) algebras, "Developments and Retrospectives in Lie TheoryâĂİ, Developments in Mathematics Volume **38** 351-384 (Springer Verlag) (2014).

Research Activities

[1] Invited talks at University of Tokyo, Nagoya University and Tsukuba University, Japan, and the Korean Institute for Advanced Studies Seoul.

[2] 1 PhD student with IRC funding

[3] 5 journal submissions in progress

[4] Awarded American Institute of Mathematics SQuaREs funding 2017-2019 for joint project with Geoff Mason, UC Santa Cruz; Matt Krauel California State Univeristy, Sacramento and Gaywalee Yamskulna, Illinois State University.

Yang, Haixuan

Current Research Interests

My focus is in Bioinformatics & Statistical Modelling, especially of network data such as protein-protein interactions, co-expression, and functional similarity. A bio-molecular network can be viewed as a collection of nodes, representing the bio-molecules, connected by links, representing relations between the

bio-molecules. I am working on inferring valuable information from bio-molecular networks.

Publications

Most significant recent publications

[1] H Yang and C Seoighe. Impact of the Choice of Normalization Method on Molecular Cancer Class Discovery Using Nonnegative Matrix Factorizatio. Plos ONE, 2016.

[2] Y Jiang *et al.* An expanded evaluation of protein function prediction methods shows an improvement in accuracy. Genome biology, 2016.

Research Activities

Refereed papers for "IEEE Transactions on Neural Networks and Learning Systems" and "Gene".

Zurlo, Giuseppe

Current Research Interests

I am currently interested in surface instability phenomena in thin films, related to the role of elasticity towards capillarity, electrostatics, surface swelling and growth. In the special case of electroelasticity, I have recently started a fruitful collaboration with my colleague Michel Destrade of my same School, together with a group of researchers in Xi'an Jiaotong University, Xi'an in China. I am also interested in the mechanics of surface growth, with special emphasis on the modelling of additive layered manufacturing or "3D printing", a project in collaboration with Lev Truskinovsky, based in Paris. Finally I have interests in the modelling of biological membranes, with special emphasis on the process of endocytosis; this is a PhD thesis that I am currently supervising, together with my colleague Martin Meere of my same School.

Publications

Most significant recent publications

[1] Zurlo G., Destrade M., DeTommasi D., Puglisi G., Catastrophic Thinning of Dielectric Elastomers, Physical Review Letters 118(7):078001 (2017)

[2] Colonnelli S., Saccomandi G., Zurlo G., The role of material behavior in the performances of

electroactive polymer energy harvesters, Journal of Polymer Science Part B Polymer Physics 53(18) (2015)

[3] DeTommasi D., Puglisi G., Zurlo G., Failure modes in electroactive polymer thin films with elastic electrodes, Journal of Physics D Applied Physics 47(6):065502 (2015)

[4] Colonnelli S., Saccomandi G., Zurlo G., Damage induced dissipation in electroactive polymer harvesters, Applied Physics Letters 105 (16), 163904

Research Activities

I am currently supervising 1 PhD student; During 2016 I have taken part in the EMI Conference in Metz; I was invited to give talks in the Universities of Brunel (London-UK) and Trento (Italy); I have peer-reviewed 5 papers.

Visitors

Balbi, Valentina

Dates of visit: 12 November 2015-12 January 2016
Dr. Balbi is a Post-doctoral fellow at the Université Pierre et Marie Curie. She visited Professor Michel Destrade to prepare a grant proposal, with support from Enterprise Ireland.

Research Output

A complete proposal submitted to the European Commission for a Marie Curie Initial Training Network.

Bonat, Wagner

Dates of visit: July 2016 – Augusr 2016

Research Interests

Visiting postgraduate researcher from University of Southern Denmark, Odense and Paraná Federal University Curitiba, Brazil, working with Professor John Hinde on *Extended Poisson-Tweedie models for count data*. During visit presented two talks and submitted a joint paper with Professor Hinde.

Carfagna, Melania

Dates of visit: 15 November 2015-15 February 2016
Ms Carfagna is a PhD Student in Mathematica Engineering at Politecnico di Torino. She visited Professor Michel Destrade to work on the the stability of soft solids, with support from her university.

Research Output

A complete treatment of the problem of oblique wrinkles for half-spaces and layered substrates, published in *Philosophical Transactions A*, 2017.

de Lara, Idemauro Antonio Rodrigues

Dates of visit: August 2015 – December 2016

Research Interests

Visiting postdoctoral researcher from ESALQ/USP, Brazil, (funded by FAPESP, Brazil, grant number 2015/02628 - 2.) working with Professor John Hinde on *The analysis of longitudinal categorized data: a focus on Markov transition models.*. During visit gave several presentations to the Statistics Reading Group and 3 external conference presentations. Submitted 4 joint papers (1 published and 3 under revision) with Professor Hinde on transition modelling of longitudinal ordinal data.

Del Piero, Gianpetro

Dates of visit: 13-19 April 2016

Research Interests

Prof. Del Piero (Università di Ferrara) has broad interests in the field of Elasticity, with special regards to non-convex energies, unilateral constraints, viscoelasticity, fracture, damage. During his stay in Galway, he delivered two talks: the first, a joint seminar with the School of Engineering, on the variational approach to fracture; the second on the history of dome structures. He interacted with Dr Zurlo on the role of incompatibility in linear elasticity, a project that will be developed during 2017.

Demétrio, Clarice

Dates of visit: 26th September – 6th October 2017

Research Interests

Professor of Statistics from ESALQ/USP, Brazil. Visit to Professor John Hinde to interact with other Brazilian visitors and take part in general research activities, including the ***Statistics Mini-Symposium*** on 30th September where she presented a talk on *Formulating mixed models for experiments, including longitudinal experiments.*

Also discussions on ongoing research projects relating to over- and under-dispersion in generalized linear models.

Feldman, Arnold

Franklin & Marshal College, USA.
Dates of visit: September 2016-July 2017

Research Interests

During his visit to Galway he is carrying out research in group theory with Dr Rex Dark.

Hitchman, Michael

Linfield College, USA.
Dates of visit: September 2016-December 2016

Research Interests

During his visit to Galway he carried out research in low-dimensional topology with Prof Graham Ellis.

Marzocchi, Alfredo

Dates of visit: 15-17 June 2016 Professor Marzocchi is the President of the Università Cattolica del Sacro Cuore in Brescia, Italy. He visited Professor Michel Destrade to discuss common interests in applied mathematics.

Research Interests

A talk at the School's seminar, and participation in the Stokes Modelling Workshop.

McCormick, C.

McGinty, S.

McKee, S.

Dates of visit: 22nd to the 26th of February

Dr. McCormick (Strathclyde), Dr. McGinty (Glasgow) and Prof. McKee (Strathclyde) visited as part of an on-going collaboration with Dr M Meere concerning the mathematical modelling of drug eluting stents. During the visit, the focus of the work was on modelling drug release from polymer-free stents.

Moral, Rafael

Dates of visit: January 2016 – January 2017

Research Interests

Visiting PhD student from ESALQ/USP, Brazil, (funded by FAPESP proc. no. 2014/12903-8) working with Professor John Hinde on *Statistical modelling of data from insect studies*. During visit gave several presentations to the Statistics Reading Group, 3 external conference presentations and an invited seminar at the University of Kent in Canterbury, UK. Submitted 3 joint papers (2 already accepted and 1 under revision) with Professor Hinde and 3 R packages.

Ní Annaidh, Aisling

Dates of visit: 29-30 September 2016 Dr Ní Annaidh is Lecturer in Mechanical Engineering at University College Dublin. She visited Professor Michel Destrade to discuss common interests in mechanics.

Research Interests

A complete treatment of Non-invasive evaluation of skin tension lines with elastic waves. Published in *Skin Research and Technology* (2017).

Rubin, Miles

Dates of visit: 22-23 September 2016 Professor Miles Rubin is the Gerard Swope Chair in Mechanics at Technion, Israel Institute of Technology in Haifa. He visited Professor Michel Destrade to discuss common interests in mechanics.

Research Interests

A talk at the School's seminar, jointly organised with the School of Engineering.

Saccomandi, Giuseppe

Dates of visit: 19-22 April 2016 Professore Saccomandi is Professor in Mechanical Engineering at the Universita di Perugia and Adjunct Professor in the School of Mathematics, Statistics and Applied Mathematics. He visited Professor Michel Destrade to work on the mechanical behaviour of rubbers and to deliver a talk at the School's Research Day.

Research Interests

A complete treatment of the problem of Methodical Fitting for Mathematical Models of Rubber-like Materials, published in *Proceedings of the Royal Society A* (2017), and another of the problem of Strain energy function for isotropic non-linear elastic incompressible solids with linear finite strain response in shear and torsion, published in *Extreme Mechanics Letters* (2016).

Su, Yipin

Dates of visit: 01 November 2015-02 April 2016 Mr Su is a PhD Student in Mechanical Engineering at Zhejiang University. He visited Professor Michel Destrade to work on the mechanical behaviour of electro-active soft solids, with support from his university.

Research Interests

A complete treatment of the problem of Stability soft dielectrics for half-spaces and plates, two articles in preparation. An application for IRC postdoctoral fellowship, under review.

Szechtman, Fernando

University of Regina, Canada
Dates of visit: October 17-24 2016

Research Interests

Collaboration with James Cruickshank and Rachel Quinlan on problems involving the classification of hermitian and skew-hermitian bilinear forms over local rings, and related analogues of classical groups.

Thiago de Oliviera, J.

Dates of visit: August 2015 – December 2016

Research Interests

Visiting postdoctoral researcher (funded by FAPESP, Brazil, grant number 2015/02628 - 2.) working with Professor John Hinde on *The analysis of longitudinal categorized data: a focus on Markov transition models.*. During visit gave several presentations to the Statistics Reading Group and 3 external conference presentations. Submitted 4 joint papers (1 published and 3 under revision) with Professor Hinde on transition modelling of longitudinal ordinal data.

Vergori, Luigi

Dates of visit: 19-22 April 2016 Dr Vergori is Lecturer in Applied Mathematics at the University of Glasgow. He visited Professor Michel Destrade to work on mechanical instability of soft matter.

Research Interests

A complete treatment of the problem of wrinkling under bending is proposed.

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7   Postgraduate Research Students

- Daher Al-Baydli daher.mathematics@gmail.com
- Nisreen Alokbi nisreen.alokbi@gmail.com
- Faiza Alssaedi F.ALSSAEDI1@nuigalway.ie
- Daron Anderson d.anderson2@nuigalway.ie
- Issac Burke i.burke1@nuigalway.ie
- Richard Burke richardburke8@gmail.com
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- Eoghan Staunton e.staunton2@nuigalway.ie
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- Michael Welby m.welby5@nuigalway.ie
- Yaxuan Yu yuyaxuan0@gmail.com

8 NUI Galway SIAM student chapter activities

The NUI Galway Student Chapter of the Society for Industrial and Applied Mathematics was founded in 2014. It bringing together students and researchers from across campus to generate interest in applied mathematics, share ideas, and develop leadership skills.

Members include undergraduate and postgraduate students from pure and applied mathematics, information technology, physics and engineering.

The events we hosted in 2016 included

- Dr Seshu Tirupathi, from IBM Research -Dublin Lab, gave a seminar in February on a shock-capturing algorithm used to model dam-breaks, and other catastrophes.

- In March, the Chapter co-organised a seminar by Peter Lynch (UCD) on *the Emergence of Numerical Weather Prediction.*

- A *Research Blitz* for Undergraduate Students, April 12, featuring short talks from staff and research students aimed at undergraduates who might be interested in a research degree.

- The 3rd Annual Stokes Modelling Workshop for Undergraduate Students, June 13-16 (co-organised with the Stokes Cluster).

- October 27: our best-attended event was an evening on *Careers in Mathematical Science.* Over 60 students, mostly undergraduates, came looking for answers to the question: "what do mathematicians in industry do all day?". James McTigue (PhD in Mathematics; Valeo), Peter White (BSc in Applied Mathematics; Cisco), Noel Lawless (BSc in Financial Mathematics and Economics; Vhi), Stefanie Carr (BSc in Mathematics and Physical Education; St Joseph's College), Barry Hurley (PhD Mathematics; Avaya), and Ananda Geluk (BA in Communications; NUI Galway Career Development Centre).

  Attendees heard about designing car vision systems, building communications and network software, harnessing big data in insurance, developing software that tries to not to keep people on hold for too long and, of course, the challenges and rewards of educating the next generation of mathematicians.

We are now busy preparing to host the 6th "National" Student Chapter Conference of the UK and Ireland Section of SIAM, in May. Successful funding applications have been made to SIAM, Science Foundation Ireland, and the Irish Mathematical Society.

The Chapter officers during 2016 were

President: Richard Burke, succeeded by Paul Greaney in June;

Vice President: Christine Marshall;

Secretary: Paul Greaney, succeeded by Eoghan Staunton;

Treasurer: Robert Mangan (new post).

Niall Madden is the faculty advisor.

9   Seminars

[1] <u>Brendan Masterson</u>, NUIG. **On the table of marks of a direct product of finite groups**, 14/01/2016. (Host: Götz Pfeiffer)

[2] <u>Ioannis Dassios</u>, University of Limerick. **Singular linear systems of fractional nabla difference equations**, 18/02/2016. (Host: Petri Piiroinen)

[3] <u>Pádraig Ó Catháin</u>, Aalto University, Finland. **Compressed sensing and combinatorial designs**, 25/02/2016. (Host: Rachel Quinlan)

[4] <u>Seshu Tirupathi</u>, IBM Research, Dublin. **Shock capturing data assimilation algorithm for 1D shallow water equations**, 29/02/2016. (Host: NUIG SIAM student chapter)

[5] <u>Peter Lynch</u>, University College Dublin. **The Emergence of Numerical Weather Prediction: Fulfilment of a Dream & Realization of a Fantasy**, 03/03/2016. (Host: NUIG SIAM student chapter)

[6] <u>Colm Mulcahy</u>, Spelman College, Atlanta, Georgia, USA. **The Annals of Irish Mathematics and Mathematicians**, 10/03/2016. (Host: Ted Hurley)

[7] <u>KongFatt Wong-Lin</u>, Ulster University. **Understanding brain functions through mathematical modelling and analysis** , 06/04/2016. (Host: Petri Piiroinen)

[8] <u>Matthew Krauel</u>, University of Cologne, Germany. **Vector-valued modular forms, intertwining operators, and the minimal models**, 07/04/2016. (Host: Michael Tuite)

[9] <u>Gianpietro Del Piero</u>, Università di Ferrara, Italy. **History of Dome Structures**, 14/04/2016. (Host: Giuseppe Zurlo)

[10] <u>Veronica Crispin</u>, Uppsala University, Sweden. **The generalized algorithm for the Ratliff-Rush operation**, 28/04/2016. (Host: Emil Skoeldberg)

[11] <u>Eugene Kashdan</u>, University College Dublin. **Mathematical and computational modelling of chemo- thermotherapy and analysis of its side-effects** , 03/05/2016. (Host: Niall Madden)

[12] <u>Clifford Gilmore</u>, University of Helsinki, Finland. **Linear Dynamics and Derivations** , 05/05/2016. (Host: Ray Ryan)

[13] <u>Antonio Hermes Marques da Silva Júnior</u>, Federal University of Rio Grande do Norte, Brazil. **Gradient test for generalised linear models with random effects** , 10/05/2016. (Host: John Hinde)

[14] <u>Rod Gow</u>, University College Dublin. **Colloquium talk about George Salmon** , 23/05/2016. (Host: Graham Ellis)

[15] <u>Alfredo Marzocchi</u>, Università Cattolica del Sacro Cuore, Brescia, Italy. **Some good reasons to study second-gradient fluids** , 15/06/2016. (Host: Michel Destrade)

[16] <u>Miles Rubin</u>, Technion, Israel Institute of Technology. **A unified theoretical structure for modeling interstitial growth and muscle activation in soft tissues**, 22/09/2016. (Host: Michel Destrade)

[17] <u>Cora Stack</u>, Institute of Technology, Tallaght, Dublin. **Eggert's conjecture and a structure theorem**, 13/10/2016. (Host: Goetz Pfeiffer)

[18] <u>Victoria Lebed</u>, Trinity College, Dublin. **How forgetting group laws leads to a universal knot invariant**, 29/09/2016. (Host: Graham Ellis)

[19] <u>Ray Ryan</u>, NUIG. **Complex Analysis: the Real story**, 06/10/2016. (Host: Haixuan Yang)

[20] <u>Philippe Elbaz-Vincent</u>, Université Grenoble Alpes, France. **Grokking the cohomology of modular groups: from geometry to number theory**, 19/10/2016. (Host: Graham Ellis)

[21] <u>Michael Tuite</u>, NUIG. **Rogers-Ramanujan functions and vertex algebras**, 27/10/2016. (Host: Michael Mc Gettrick)

[22] <u>Lukasz Huminiecki</u>, Uppsala University, Sweden. **Can we predict gene expression by understanding proximal promoter architecture?**, 03/11/2016. (Host: Cathal Seoighe)

[23] <u>Arny Feldman</u>, Franklin and Marshall College, Lancaster, PA, USA. **Pronormality**, 10/11/2016. (Host: Rex Dark)

[24] <u>Brendan Murphy</u>, University College Dublin. **Latent Space Stochastic Block Model for Social Networks**, 17/11/2016. (Host: John Hinde)

[25] Dieter Degrijse, NUIG. **The Banach-Tarski paradox and amenable groups**, 24/11/2016. (Host: Haixuan Yang)

[26] Gianpietro Del Piero, Università di Ferrara, Italy. **History of Dome Structures**, 14/04/2016. (Host: Giuseppe Zurlo)

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10 Specialist seminar series

[1] Weekly Bioinformatics Seminar Series/Journal Club.

[2] Weekly Seminar Series/Reading Group on "Profinite Groups" (Semester I of 2016/2017).

[3] Weekly meetings/seminars of the Modelling Group (Applied Mathematics).

[4] Dynamical Systems Reading Group, meeting roughly every second week.

[5] Weekly Statistics Reading Group.

[6] Weekly Linear Algebra Seminar Series.

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11 Conferences and Workshops

- Groups in Galway

  Dates: 20–21 May 2016

  Invited speakers: Collin Bleak (University of St Andrews) John Burns (NUI Galway) Francesco de Giovanni (University of Naples) Ellen Henke (University of Aberdeen) Mark Lawson (Heriot-Watt University) Nadia Mazza (Lancaster University) Bob Oliver (Universitàľ Paris 13) Shane O'Rourke (Cork Institute of Technology) Said Sidki (Universidade de Brasilia) Peter Symonds (University of Manchester)

  Organisers: Ted Hurley & Sejong Park

- 10th. Annual Workshop of the Irish Mathematics Learning Support Network (IMLSN)

  Dates: 27 May 2016

  Conference Theme: The key role of tutors of mathematics and statistics in Post-Secondary Education.

Keynote Speakers: Michael Grove (University of Birmingham), Ciáran O'Sullivan (Institute of Technology, Tallaght, Dublin)

Locak Organiser: Kirsten Pfeiffer

- Stokes Modelling Workshop

  Dates: 13–16 June 2016

  Organisers and mentors: Richard Burke, Michel Destrade, Paul Greaney, Niall Madden, Robert Mangan, Petri Piiroinen, Eoghan Staunton, Michael Welby, Giuseppe Zurlo

  Eighteen undergraduate students from various Irish universities came to Galway for a week to study techniques in modelling, and to solve problems in elasticity, the spread of infectious diseases, design of hurley sticks and the spread of wildfires. They were mentored by staff and students of the Stokes Cluster for Applied Mathematics.

- NUIG Statistics Mini-Symposium

  Date: 30 September 2016

  Speakers: Idemauro de Lara, Clarice Demétrio, Thiago de Paula Oliveira, Lida Fallah, John Hinde, Amir Jalali, Olga Kalinina, Shirin Moghaddam, Rafael Moral, Davood Roshansangachin,

  Organizer: John Hinde