

# Reports of Sponsored Meetings

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INFINITE DIMENSIONAL FUNCTION THEORY:  
PRESENT PROGRESS AND FUTURE PROBLEMS  
8-9 JANUARY 2015, UCD

An informal meeting on *Infinite Dimensional Function Theory: Present Progress and Future Problems* was held at UCD during 8th-9th January, 2015. The meeting received financial support from the Fulbright Commission and the IMS as well as from NUI Galway, TCD, and UCD. The meeting was organised by Chris Boyd and Michael Mackey (UCD), Richard Timoney (TCD), and Richard Aron (Kent State University).

Given that the study of Infinite Dimensional Holomorphy has been based in Ireland for many decades, it was appropriate that this meeting take place in Dublin. There were a number of foreign attendees, including five from Spain and two from the US, all of whom have strong mathematical connections with the infinite dimensional analysis group in Ireland. In addition, there were speakers from all major Irish universities.

The following list gives the 19 speakers and titles of the half-hour talks.

**José M. Ansemil:** Property LF of  $(H(U), \tau_\delta)$

**Richard M. Aron:** Fiber structure in the maximal ideal space of  $H^\infty$

**James Boland:** Operators approximable by hypercyclic operators

**Anthony Brown:** Norms of mappings between spaces of polynomials

**Gerard Buskes:** Complex vector lattices

**Sean Dineen:** Distance between Hilbertian operator spaces

**Pablo Galindo:** Group-symmetric holomorphic functions on a Banach space

**Domingo García:** The Bohr radius for Dirichlet series

**Ilja Gogic:** On derivations and elementary operators on  $C^*$  algebras

**Robin Harte:** Residual Quotients

- Finbarr Holland:** Convolution of almost periodic functions  
**Rupert Levene:** Hyperreflexivity and idempotent Schur multipliers  
**Manuel Maestre:** Banach spaces of Dirichlet series  
**Martin Mathieu:** Interplay Between Spectrally Bounded Operators and Complex Analysis  
**A. G. O'Farrell:** Boundary smoothness of holomorphic functions  
**M. Pilar Rueda:** Automatic surjectivity of isometries of weighted spaces of analytic functions  
**Raymond Ryan:** The Kantorovich Theorem for Polynomials  
**Richard Smith:** Lipschitz-free spaces and the metric approximation property  
**Milena Venkova:** Polynomials on James Tree-type spaces

Ample time was devoted to informal and fruitful discussions.

Participants availed themselves of excellent dining at the appropriately named UCD restaurant Pi as well as at the Conference Banquet at the Beaufield Mews in Stillorgan.

Report by Richard M. Aron, Kent State University  
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IRISH MATHS LEARNING SUPPORT NETWORK 9TH ANNUAL  
 WORKSHOP  
 29 MAY 2015, UNIVERSITY COLLEGE DUBLIN

The theme of the 9th Annual Workshop of the Irish Maths Learning Support Network was *Maximizing the impact of digital supports in Mathematics Learning Support in Higher Education*.

This workshop was motivated by recent calls of the National Forum for the Enhancement of Teaching and Learning in Higher Education for building digital capacity for both staff and learners across third level education in Ireland. The workshop was hosted in the Science Centre at University College Dublin (UCD) on May 29th 2015.

The day began with a Welcome Address by the Registrar and Deputy-President of UCD, Professor Mark Rogers. This was then followed by the first of the keynote speakers, Professor Chris Sangwin (then at Loughborough University now at the University of Edinburgh). Professor Sangwin gave an interactive presentation on

supporting mathematics students' problem solving skills via the free software GeoGebra. He outlined his use of the "Moore Method" when teaching the many diverse classes he has used GeoGebra with, including Maths Learning Centre (MLC) students. Following this was a short presentation by Dr Jonathan Cole of Queens University Belfast who gave a very engaging talk around the development of an app for use by second-level students studying vectors which was developed by a student at Queens University Belfast. The second keynote speaker Shazia Ahmed of the University of Glasgow then discussed an interesting study she undertook involving the use of Facebook Groups to provide academic support for first year mathematics and computer science students at Glasgow.

The next address was delivered by Nuala Curley of UCD, who spoke about the challenges of collecting useful qualitative feedback data based on the difficulties students present with at a maths support centre. The purpose of this research is to identify university students' mathematical "trouble-spots" in a maths support centre setting and to develop effective supports. The final keynote speaker was Dr Madonna Herron of Ulster University, who spoke about using the Livescribe 3 smartpen to produce pencasts which, she reported, can extend and enrich the student learning experience in mathematics and engineering programmes at her university. Dr Cormac Breen of DIT was the next speaker (describing work done in collaboration with Ciarán O Sullivan of IT Tallaght and Damien Cox of IT Blanchardstown) and he informed us about a trial of virtual mathematics drop-in support for students across the three IoTs in question. The technology used here was Wacom Intuos Tablets and the Adobe Connect software package. Dr Gerry Golding of the Open University (OU) was the final speaker of the day and he gave a very interesting presentation on the virtual mathematics support centre at OU. This is a pilot project delivered over the Moodle platform for Irish students studying (service course) mathematics with the OU.

The day concluded with a discussion session regarding various small-scale initiatives undertaken by maths support practitioners and the possibility of sharing support materials between MLCs .

A total of 39 delegates from 23 different institutions, including international visitors from the United States (Stanford University), Canada (University of British Columbia), Norway (University of

Agder), as well as keynote and invited speakers from the UK (Loughborough University, University of Glasgow, Ulster University and the Open University). There were 12 Irish Higher Education Institutions represented at the workshop encompassing five universities (DCU, MU, NUIG, UCD and UL) and seven Institutes of Technology, (Dublin IT, Dundalk IT, IT Tallaght, Limerick IT, IT Carlow, IADT and Cork IT). Companies such as Google, Folsens, KPMG and Infonalis were also represented.

This workshop was funded by the National Forum's Seminar Series, the School of Mathematical Sciences in UCD and the Irish Mathematical Society.

All abstracts, slides and videos from each presentation can be found at: <http://supportcentre.maths.nuim.ie/mathsnetwork/ucd2015>

Report by Anthony Cronin, University College Dublin  
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THIRTEENTH IRISH GEOMETRY CONFERENCE  
15-16 MAY 2015, MIC LIMERICK

The Irish Geometry Conference is a research meeting that has taken place annually since its inauguration at NUI Galway in 2003. Its 2015 edition took place at MIC Limerick and was organized by Norbert Hoffmann (MIC), Bernd Kreussler (MIC) and Clifford Nolan (UL). This conference was funded by the Research and Graduate School, MIC Limerick; the Department of Mathematics, University of Limerick; and the Irish Mathematical Society.

There were 22 participants from 12 institutions in Ireland and abroad. The speakers, titles and abstracts were as follows.

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HANS-CHRISTIAN GRAF V. BOTHMER (*Universität Hamburg*)  
**Rationality of hypersurfaces**

I will review classical and modern results about the rationality of hypersurfaces and present our results (with Christian Böhning and Pawel Sosna) regarding Kuznetsov's derived-category approach to the rationality question of cubic 4-folds.

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ULRICH DERENTHAL (*Leibniz Universität Hannover*)  
**Cox rings over nonclosed fields**

For a wide class of varieties over algebraically closed fields, Cox rings were defined and studied by Cox, Hu, Keel, Hausen, Hassett and others. We give a new definition of Cox rings for suitable varieties over arbitrary fields that is compatible with universal torsors, which were introduced by Colliot-Thélène and Sansuc. We study their existence and classification, and we make their relation to universal torsors precise. This is joint work with Marta Pieropan.

BRENDAN GUILFOYLE (*IT Tralee*)

**Flowing a classical surface by its mean radius of curvature**

In this talk I will present joint work with Wilhelm Klingenberg on the flow of a convex surface in Euclidean 3-space by its mean radius of curvature. Under this expanding flow, it is well known that the surface runs out to infinity, becoming round as it does so. In the talk I will outline our proof that the centre of this “sphere at infinity” can be computed from the spectral data of the surface. This result can be viewed in a number of ways: convergence of the normal lines of the flowing surface or a definition of a “centre” for an arbitrary convex surface which is conserved under mean radius of curvature flow.

NOBUHIRO HONDA (*Tokyo Institute of Technology*)

**Some examples of twistor spaces  
of algebraic dimension one**

It has been known that twistor spaces provide nice examples of compact complex 3-fold whose algebraic dimension takes all values from zero to three.

Most compact twistor spaces are of algebraic dimension zero, and also a lot of examples are already known of twistor spaces of algebraic dimension three. Also, twistor spaces of K3 surfaces, complex tori (and also some Hopf surfaces) form a good class of twistor spaces whose algebraic dimension is one.

In this talk, I will present twistor spaces of algebraic dimension one with a different flavour; namely I will present a series of simply connected twistor spaces of algebraic dimension one whose general fibre of the algebraic reduction is birational to an elliptic ruled

surface. In these examples, a pair of Hopf surfaces are contained as a reducible fibre of the algebraic reduction.

DANIEL HUYBRECHTS (*Universität Bonn*)

**The K3 category of a cubic fourfold**

The derived category of a smooth cubic hypersurface of dimension four determines the cubic. However, due to a result of Kuznetsov the category contains a full subcategory that behaves in many respects like the derived category of a K3 surface. In this talk, I will explain what is known about it from a purely categorical point of view but also from a more Hodge theoretic perspective.

BENJAMIN MCKAY (*University College Cork*)

**Bending metal sheets, Riemann surfaces  
and integrable systems**

When you bend a metal sheet, without stretching, it deforms through isometric immersions of a Riemannian metric. Problem: for which surfaces is the differential equation of isometric immersion an integrable system? We find the first examples. We use ideas of Darboux relating complex geometry and integrable systems. Joint work with Jeanne Clelland, Tom Ivey and Peter Vassiliou.

SERGEY MOZGOVOY (*Trinity College Dublin*)

**Counting Higgs bundles**

In this talk I will discuss a problem of counting semistable twisted Higgs bundles over a smooth projective curve defined over a finite field. I will also introduce the Donaldson-Thomas invariants for this problem and explain their relation to counting of indecomposable vector bundles over a curve. I will discuss an explicit formula for the above problem and its relation to the conjectural formula of Hausel-Rodriguez-Villegas. This is a joint project with Olivier Schiffmann.

FABIAN REEDE (*MIC Limerick*)

**Vector bundles and Arakelov geometry**

We study vector bundles on the projective line over the integers and apply concepts of Arakelov geometry to these bundles. For example we compute their arithmetic Chern classes and derive the arithmetic Hirzebruch-Riemann-Roch theorem from the arithmetic

Riemann-Roch theorem due to Gillet and Soulé. As an application we will compute the Ray Singer analytic torsion for all line bundles on the Riemann sphere.

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DAVID WRAITH (*Maynooth University*)

### Positive Ricci curvature on highly connected manifolds

This talk concerns the existence of positive Ricci curvature metrics on compact  $(2n - 2)$ -connected  $(4n - 1)$ -manifolds. The focus will be largely topological: we will describe new constructions of these objects to which existing curvature results can be applied. The constructions are based on the technique of plumbing disc bundles. This is joint work with Diarmuid Crowley.



IGC Participants

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