General Mathematics Seminar (GMS)

of the University of Luxembourg

in cooperation with the Luxembourg Mathematical Society

Tuesday 7th February 2017, 4 pm Campus Kirchberg (B2)

Prof. Dr. Chris Judge (Indiana University, U.S.A.)

Chris Judge is Professor of Mathematics at Indiana University. His research interests encompass spectral analysis of Riemannian manifolds, Teichmüller theory, geodesic flows (billiards, Teichmüller, hyperbolic), automorphic forms. He has held NSF fellowships and grants, as well as a current five-years fellowship of the Simons Foundation Collaboration. He has held visiting positions at Université de Nantes (France), Université Joseph Fourier (Grenoble, France), Ecole Polytechnique Fédérale de Lausanne (Switzerland), Hausdorff Institute of Mathematics (Bonn, Germany), Université d'Orléans (France).

Virtual self-similarity, crossing avoidance, and the fragility of cusp forms

In the late 1980's, Ralph Phillips and Peter Sarnak conjectured based on basic principles of particle physics (e.g., Fermi's golden rule) that certain types of periodic solutions to a partial differential equation should exist in plenty if and only if the underlying symmetry group is "arithmetic", i.e. of interest to number theorists.

In joint work, Luc Hillairet (Université d'Orleans) and I give the first unconditional evidence for one direction of their conjecture.

I will use this opportunity to give an elementary description of the beautiful geometric context of this problem as well as to explain a physical heuristic –*crossing avoidance*– that is the basis of our proof.

Coffee and cookies: 15:45 in the first floor open space of block G of campus Kirchberg.
Time and place: 16:00 (4 p.m.) in the lecture theatre B2 of the main building on Kirchberg.
RMATH contact: Hugo Parlier, Jean-Marc Schlenker
Coordinator: Alexander D. Rahm

General Mathematics Seminar (GMS)

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Tuesday 24 October 2017, 5 pm **Maison du Savoir (MSA) 3.350**,

two 30 minutes talks in cooperation with the SnT

Dr. Susanne Claus and Dr. Pierre Kerfriden

(Cardiff University, U.K.)

Susanne Claus is a research fellow at Cardiff School of Engineering, Cardiff University, since 2015. After finishing her PhD at Cardiff School of Mathematics in the field of computational rheology, she worked as a postdoctoral research at the University of Sussex (2012) and University College London (2013-2015). Her research focuses on the development of stabilised cut finite element methods for multi-physics problems. In particular, she is developing high performance finite element solutions for moving interface problems in Newtonian/ non-Newtonian fluid mechanics as well as solid mechanics.

She received the ACME 2015 NRN Prize, an NRN Early Career Personal Research Fellowship, a Simula Research Laboratory Grant and fellowships from EPSRC, Studienstiftung des deutschen Volkes and DAAD.

CutFEM: a new generation of mesh independent finite element methods for multi-physics problems.

Traditional finite element methods rely on the discretisation of geometries with high quality meshes. However, for very complex problems such as engineering assemblies of interacting solids or unsteady multi-phase fluid flows, the construction of these high quality meshes can be prohibitively expensive and cumbersome. In this presentation, I will introduce a new cut finite element method which avoids meshing and instead uses a functional description of geometries. Such a description allows us to embed complex geometries in fixed, regular background grids with ease. I will show how a-priori finite element analysis can be used to develop cut finite element schemes (CutFEM) that are both accurate and stable. I will then present high-performance CutFEM algorithms for a range of complex multi-material problems such as unilateral contact between solids, fluid flows and laser ablation.

Coffee and cookies: 16:30 on the 6th floor of the MNO, in the kitchen corner of maximal distance to the elevator (From the elevator, you can enter only one door, and then you will pass by a small kitchen corner. Please continue until you arrive at a bigger kitchen corner).

Time and place of the talks: 17:00 (5 p.m.) in the Maison du Savoir (MSA) 3.350.

University of Luxembourg contact: Stéphane Bordas

Coordinator: Alexander D. Rahm

Please notice also the attached poster on Pierre Kerfriden's talk.

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Pierre Kerfriden is a Senior Lecturer at Cardiff University, School of Engineering. His research interests are advanced methods in computational mechanics, in particular high-performance computing, optimisation, error control and adaptivitiy, inverse problems and data-assimilation, multiscale modelling, composite materials, nonlinear fracture mechanics, structural vibrations. He received the Outstanding Paper Award of the Literati Network and was nominated at the "Rising Star" awards; two of his 19 PhD students received the Best PhD Thesis prize of the UK Association for Computational Mechanics in Engineering.

Complexity reduction in multiscale computational modelling.

In many modern engineering systems, such as micro-engineered composite structures or large-scale systems tailored for high-frequency dynamics, analysts need to predict physical phenomena over multiple scales. With ever-increasing computational capabilities, high fidelity numerical simulations are increasingly considered as a reliable way to obtain such predictions. However, the numerical cost associated with high fidelity simulations over multiple scales remains tremendous for anything but academic test cases. In this presentation, I will discuss a series of recent developments at Cardiff University in the area of automatised model reduction algorithms that give analysts control over the computational cost. In this suite of algorithms, physical features that do not contribute to engineering outputs of interests are automatically identified and removed from the computational model, thereby reducing the numerical cost by several orders of magnitude. I will present examples of applications in several areas of computational engineering, namely electrostatics, linear vibrations and nonlinear fracture mechanics and explain how such approaches may help increase the performance and reliability of modern multilevel engineering systems.

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Time and place of the talks: 17:00 (5 p.m.) in the Maison du Savoir (MSA) 3.350.

University of Luxembourg contact: Stéphane Bordas

Coordinator: Alexander D. Rahm

Please notice also the attached poster on Susanne Claus's talk.

General Mathematics Seminar (GMS)

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Tuesday 12 December 2017, 5 pm Maison du Nombre, MNO 1.050

Dr. Chiara Pagani

(Université de Louvain, Belgium)

Chiara Pagani is a post-doctoral research fellow at Université de Louvain, Belgium. Her fields of research are noncommutative geometry and quantum group theory, in particular algebraic aspects of noncommutative gauge theories.
She obtained her PhD in Mathematical Physics at International School for Advanced Studies (SISSA) in Trieste, and has worked on research positions in Goettingen, Hannover and Copenhagen.
From October 2010 to September 2012, she was Marie-Curie and FNR research fellow at University of Luxembourg. She has been for invited long-time research stays at MPIM (Bonn), IHES (Bures-sur-Yvette), and Polish Academy of Science (Warsaw).

Bundle theory: the noncommutative geometry approach

Noncommutative geometry is based on the duality between certain categories of geometric objects and corresponding categories of algebraic objects. In this colloquium I will review some basic aspects of the theory of fiber bundles from the algebraic point of view of noncommutative geometry and describe a general theory of deformation quantization of principal bundles via Drinfeld twists.

Coffee and cookies: 16:30 on the 6th floor of the MNO, in the kitchen corner of maximal distance to the elevator (From the elevator, you can enter only one door, and then you will pass by a small kitchen corner. Please continue until you arrive at a bigger kitchen corner).

Time and place of the talks: 17:00 (5 p.m.) in the Maison du Nombre, MNO 1.050.

Coordinator: Alexander D. Rahm