

CUSO Graduate Colloquium 2025 – Program

WEDNESDAY, SEPTEMBER 10

THURSDAY, SEPTEMBER 11

FRIDAY, SEPTEMBER 12

	<p>10:00 Birational self-maps of del Pezzo surfaces over perfect fields</p> <p style="text-align: center;">ELIAS KURZ (Neuchâtel)</p> <p style="text-align: center;"><i>Coffee break</i></p>	<p>10:00 On the existence of harmonic maps from surfaces to metric spaces</p> <p style="text-align: center;">NOA VIKMAN (Fribourg)</p> <p style="text-align: center;"><i>Coffee break</i></p>
	<p>11:15 From Hex to Brouwer back to continuous Hex</p> <p style="text-align: center;">LOÏC GASSMANN (Fribourg)</p>	<p>11:15 An introduction to intersection theory in projective space</p> <p style="text-align: center;">ANNE SCHNATTINGER (Neuchâtel)</p>
<p>13:00 <i>Welcome</i></p>	<p>12:15 <i>Lunch break</i></p>	<p>12:15 <i>Birkhäuser prize & Conclusion</i></p>
<p>13:05 Limits of graphs and spectral measures</p> <p style="text-align: center;">GEORGII VEPREV (Geneva)</p>	<p>13:30 The Algebras of a Real-Valued Modal Logic</p> <p style="text-align: center;">NIELS VOOLJS (Bern)</p>	
<p>14:00 Exotic Rational Numbers in Diffeomorphism Groups of Manifolds</p> <p style="text-align: center;">NICOLAS GRUNDER (Neuchâtel)</p> <p style="text-align: center;"><i>Coffee break</i></p>	<p>14:30 Lie groupoid integration of $Sl(2, \mathbb{R})$ action on the punctured disk</p> <p style="text-align: center;">REA DALIPI (Geneva)</p> <p style="text-align: center;"><i>Coffee break</i></p>	
<p>15:20 A diffusion model for mosquito control trials with spillover</p> <p style="text-align: center;">LUZIA NORA FELBER (Basel)</p>	<p>16:00 Solutions of Zermelo's Navigation Problem via the Jacobi–Maupertuis Principle</p> <p style="text-align: center;">NICOLA PADDEU (Fribourg)</p>	
	<p>19:30 <i>Social Dinner at La Manufacture</i></p>	

Abstracts

Limits of graphs and spectral measures

GEORGII VEPREV (University of Geneva)

I will talk about the asymptotic and spectral properties of graphs. For a sequence of finite graphs, there is a way to define their limit as a distribution on the space of infinite rooted graphs, as proposed by Benjamini and Schramm. This convergence ensures the convergence of spectra and the empirical spectral measures and can be used to compute spectral properties of the limit. This can be applied to many cases in geometric group theory, percolation, and dynamics, depending on where the family of finite graphs comes from. For example, the famous De Bruijn graphs approximate in this sense the Diestel-Leader graph, a Cayley graph of the Lamplighter group, giving a computation of its Kesten spectral measure, which was first obtained by Grigorchuk and Żuk. In the talk, I will present several classical and recent results in this area, focusing on dynamics and geometric group theory. In the last part of the talk, I will outline some open questions and research directions.

Exotic Rational Numbers in Diffeomorphism Groups of Manifolds

NICOLAS GRUNDER (University of Neuchâtel)

In this talk, based on joint work with Baptiste Serraille, we will discuss how a variant of the Anosov–Katok construction can be used to produce exotic rational numbers \mathbb{Q} in the group of diffeomorphisms of manifolds. In a symplectic setting, this yields examples of Hamiltonian diffeomorphisms that are not autonomous but nonetheless admit roots of every order—objects whose existence was previously unknown. More generally, this approach allows one to realize \mathbb{Q} as a topological subgroup of $(\text{Diff}(M), C^0)$ with a non-standard topology.

A diffusion model for mosquito control trials with spillover

LUZIA NORA FELBER (University of Basel)

About 17% of all infectious diseases are transmitted by mosquitoes, causing more than 700,000 deaths annually. This yields the need to continuously discover and trial new vector control interventions that interfere with the mosquito life-cycle. However, the design of such trials is being complicated by mosquito movement that results in spillover/contamination. The precautionary principles generally used are very large geographical clusters with extensive buffer zones between the different trial arms. In a new approach presented here, the spillover effect caused by mosquito movement is modelled by approximating mosquito dispersion with the diffusion equation. The mathematical solution is then incorporated into power calculations for cluster randomised trials, which gives expressions for the adjusted power as well as the bias in efficacy estimates, and how those get affected by the sample size of the clusters. This then suggests that the key to obtaining powerful mosquito control trials is the inclusion of many small clusters rather than designing large clusters with buffer zones. The analytical approach gets illustrated with baseline data from an intervention trial against *Aedes aegypti* mosquitoes in Côte d’Ivoire.

Birational self-maps of del Pezzo surfaces over perfect fields

ELIAS KURZ (University of Neuchâtel)

I will present some tools used to study del Pezzo surfaces over perfect fields and give some results on their group of birational self-maps.

From Hex to Brouwer back to continuous Hex

LOÏC GASSMANN (University of Fribourg)

The Hex game is a two-player game where players take turns placing pieces on a hexagonal board. Each player is assigned two opposite sides of the board. The first player to connect their two sides wins the game. The Hex theorem is a very intuitive (almost obvious) result stating that a Hex game cannot end in a draw. In other words, it is impossible for the players to fill the board without one of them making a connection between their two sides.

In this talk, we will show how the Hex theorem can be used to prove the Brouwer fixed-point theorem. In the second part, we will do the converse by showing how to use the Brouwer fixed-point theorem to prove a continuous generalisation of the Hex theorem. This generalisation shows that connectivity is preserved if hexagons are replaced by points forming sets with appropriate topological properties.

We will conclude with an application of the continuous Hex theorem, which concerns the connectivity of the set of points in the plane equidistant from two connected sets.

No prior knowledge is required, except for basic topology.

The Algebras of a Real-Valued Modal Logic

NIELS VOOIJS (University of Bern)

Classical logic is 2-valued: any statement is either true (1) or false (0). When we replace this set of truth values by the real line, truth of statements becomes quantitative: a statement can be *very true* (a large positive number), *very false*, and one statement can be *more true* than another. The usual logical connectives can be defined on the real numbers, for example conjunction becomes the binary minimum function, and negation the unary negative function. Adding additionally a *plus* or *addition* connective, we obtain Abelian logic.

Modal logics are logics where we add a unary connective, which can be used to express (among other things) necessity, provability, obligation, or truth in the future. We study a fragment of Abelian modal logic, for which we provide, using linear algebra, an equivalent algebraic semantics. In particular, this provides an axiomatization for this logic.

Solutions of Zermelo's Navigation Problem via the Jacobi–Maupertuis Principle

NICOLA PADDEU (University of Fribourg)

We first present a brief introduction to the Jacobi–Maupertuis principle. We then use the principle to show that the optimal solutions of Zermelo's navigation problem can be characterized as solutions of a suitable isoperimetric problem.

Lie groupoid integration of $Sl(2, \mathbb{R})$ action on the punctured disk

REA DALIPI (University of Geneva)

We consider singular vector fields acting on a disk with an excess angle $(2\pi n)$ conic singularity, corresponding to $Sl(2, \mathbb{R})$ actions. These actions naturally define action Lie algebroids. To understand these structures globally, we explain a step-by-step construction of a family of Lie groupoids

and prove that they integrate the associated Lie algebroids. Finally, we analyze the structure of the source fibers, recovering a $\mathbb{P}\mathrm{SU}(1, 1)^n$ action on the boundary circle.

On the existence of harmonic maps from surfaces to metric spaces

NOA VIKMAN (University of Fribourg)

As part of the rich study of harmonic maps from surfaces, we may ask, under what conditions is it possible to find a harmonic map in a given homotopy class? In this talk, I will formulate this existence question for a wide class of metric spaces and describe some key ideas that allow us to answer it. This is based on joint work with Damaris Meier and Stefan Wenger.

An introduction to intersection theory in projective space

ANNE SCHNATTINGER (University of Neuchâtel)

A classical theorem in algebraic geometry states that the number of zeros of n polynomials in n variables is (almost always) the product of the degrees of the polynomials. A geometric formulation of this so-called Bézout's theorem describes the number of intersection points of two curves in the plane. This talk will give an introduction to intersection theory in the projective space. We will explain some basics about hyperplanes, divisors and their intersection numbers in order to understand the key concepts behind the proof of Bézout's theorem. Time permitting, we will also give an idea of how the theory of divisors and their intersections can be applied to current research topics in birational geometry.