Program of the 15th edition of

Functional Equations in LIMoges

FELIM 2026

March 30-31, April 1, 2026

Salle de Conférences du bâtiment XLIM

Organised by

Moulay Barkatou, Julie Bredoux, Cyrille Chenavier, Thomas Cluzeau, Débora Thomas, and Jacques-Arthur Weil

Sponsored by

XLIM / MATHIS, Labex SigmaLim, GDR EFI,[*] Fédération MARGAUX

[*]axe transverse au sein de trois nouveaux réseaux thématiques de l'INSMI : "Algèbre", "Géométrie Algébrique et Singularités" et "Théorie des Nombres"

FELIM 2026, Functional Equations in LIMoges

Monday, March 30

10:30 - 11:00	Registration - Coffee - Welcome
11:00 - 12:00	**Gleb Pogudin**: *Exact reduction for differential dynamical models*
12:00 - 14:30	Lunch break
14:30 - 15:10	**Louis Gaillard**: *Fast linear algebra for computing linear differential equations and recurrences*
15:15 - 15:55	**Thomas Cluzeau**: *Towards the computation of stabilizing controllers of multidimensional systems*
16:00 - 16:30	Tea break, Discussions
16:30 - 17:10	**Mickaël Matusinski**: *Transserial trajectories of planar vector fields*

FELIM 2026, Functional Equations in LIMoges

Tuesday, March 31

9:30 - 10:30	**Antonio Jiménez Pastor**: *Burchnall-Chaundy ideals: centralizers, spectral curves and symbolic computation*
10:30 - 11:00	Coffee break, Discussions
11:00 - 11:40	**Nicolas Martinez**: *Solving algebraic differential equations in the field of rank 1 Hahn series*
12:00 - 14:30	Lunch break
14:30 - 15:30	**Thomas Dreyfus**: *Classification of discrete walks in the quadrant*
15:30 - 16:00	Tea break, Discussions
20:00 -	Conference Dinner

FELIM 2026, Functional Equations in LIMoges

Wednesday, April 1

9:30 - 10:10	**Jacques-Arthur Weil**: *Representation theory results to simplify the computation of differential Galois groups via reduced forms*
10:10 - 10:40	Coffee break, Discussions
10:40 - 11:20	**Vincel Hoang-Ngoc Minh**: *On the solutions of universal differen--tial equations by noncommutative Picard-Vessiot theory* (visio in french)
11:25 - 12:05	**Sergei Abramov - Anna Ryabenko**: *Compact sets of prolongations of truncated matrices* (visio)
12:05 - 14:00	Lunch break

FELIM 2026, Functional Equations in LIMoges

Abstracts of the talks

1. **Gleb Pogudin**: *Exact reduction for differential dynamical models*

   Dynamical models defined by systems of ordinary differential equations are widely used to describe processes in the sciences and engineering. Producing a detailed and realistic model often means increasing its dimension. This complicates simulation, calibration, and mechanistic understanding of the model. The standard remedy is model order reduction: replacing model with a smaller one retaining some important features/behaviours.

   We will discuss methods for exact model reduction, meaning that the trajectories of the original model are mapped to the trajectories of the new model without any approximation error. We will start with the case when this mapping is linear which can be reformulated and solved in terms of finite-dimensional matrix algebras. Then we will discuss results for a more general case when the mapping can be nonlinear. It turns out to be fruitful to view this problem through the lens of structural identifiability/observability of the model, old notions from control theory. We will explain this link and the reduction algorithms arising from it.

2. **Louis Gaillard**: *Fast linear algebra for computing linear differential equations and recurrences*

   Linear differential equations and recurrences reveal many properties about their solutions. Therefore, these equations are well-suited for representing solutions and computing with special functions. We identify a large class of existing algorithms that compute such representations as a linear relation between the iterates of an elementary operator known as a pseudo-linear map. Algorithms of this form have been designed and used for solving various computational problems, in different contexts, including effective closure properties for linear differential or recurrence equations, the computation of a differential equation satisfied by an algebraic function, or creative telescoping. In this talk, I present a unified algorithm that exploits the common structure in the linear systems arising from these computational problems, under an explicit genericity assumption. When applied to a specific problem, this genericity assumption frequently translates into a genericity assumption on the input of the problem. In this case, the complexity of the resulting algorithm typically improves by one order of magnitude the previous best known complexity bound for the problem.

   This is joint work with Alin Bostan, Bruno Salvy and Gilles Villard.

3. **Thomas Cluzeau**: *Towards the computation of stabilizing controllers of multidimensional systems*

In this talk, we study the effective computation of stabilizing controllers of multidimensional systems. Within the algebraic analysis approach, the stabilization problem can be characterized by the fact that a certain finitely presented $\mathcal{A}$-module $\mathcal{M}$, naturally associated with the multidimensional system, is projective, where $\mathcal{A}$ denotes the ring of multivariate rational functions without poles in the closed complex unit polydisc $\overline{\mathbb{D}}^n$. This condition can be reduced to the existence of an element s of a polynomial ideal $\mathcal{I}$ which has no zero in $\overline{\mathbb{D}}^n$. According to the Polydisc Nullstellensatz, the latter condition is equivalent to the fact that no complex zero of the elements of $\mathcal{I}$ belongs to $\overline{\mathbb{D}}^n$. If this condition is satisfied, using cyclic resultants and linear programming, we then propose a method to compute such a polynomial s. Using computer algebra methods for handling elementary operations for $\mathcal{R}[s^{-1}]$-modules, where $\mathcal{R}$ denotes a polynomial ring, we finally show how to compute stabilizing controllers.

This is joint work with Guillaume Moroz and Alban Quadrat.

4. **Mickaël Matusinski**: *Transserial trajectories of planar vector fields*

   In the context of a 3-dimensional real analytic vector field at a singular point, Cano, Moussu and Sanz introduced and studied the notion of integral pencils of trajectories at that point in order to obtain informations on the possible real dynamical behaviours. We extend this approach on the formal side, taking advantage of the computability of transseries (in particular they are grid-based in the sense of Ecalle - van der Hoeven) when solving differential equations. More precisely, for a real formal planar vector field at 0, we introduce a notion of transserial trajectories and provide an explicit description of all the possible transserial pencils. This is meant to be a first step toward the same sort of description in dimension 3. As a motivation, we expect these transserial trajectories to reflect tameness properties of actual solutions, in a way similar to that of differentially algebraic transseries for germs in some Hardy fields (cf the recent results of Aschenbrenner-van den Dries-van der Hoeven).

   This is a joint work in progress with Daniel Panazzolo and Fernando Sanz.

5. **Antonio Jiménez Pastor**: *Burchnall-Chaundy ideals: centralizers, spectral curves and symbolic computation*

   The study of the centralizer for a linear ordinary differential operator (ODO) L is a critical part of the study of integrability since the Lax representation of this property. If P is another linear ODO that commutes with L, then there is a bivariate polynomial p(x,y) such that p(L,P) = 0. This is the so called Burchnall-Chaundy polynomial for L and P and it defines a curve in the plane called the spectral curve. In this talk, we are going to study all these objects and their properties. In particular, we will review results from Goodearl, that provides a description of the centralizer of L, and extend the concept of Burchnall-Chaundy polynomial to an ideal that defines the actual spectral curve of the operator L. We conclude the talk by discussing the relation with the Baker-Akhiezer function of L. The main point of view for all the talk is a Symbolic

Computation perspective, where everything we discussed is implemented and can be automatically computed.

6. **Nicolas Martinez**: *Solving algebraic differential equations in the field of rank* 1 *Hahn series*

   In an effort to show how Hahn series can act as formal counterparts to germs of functions in a Hardy field, one must be able to solve algebraic differential equations in a field of Hahn series. We focus on the rank 1 case, that is $\mathbb{R}((x^{\mathbb{R}}))$, endowed with the Euler derivation $x\frac{\mathrm{d}}{\mathrm{d}x}$. We show how to apply the Newton-Petrovic-Fine polygonal method to provide an algorithm solving such equations.

   This is a joint work with Mickaël Matusinski, as part of my PhD.

7. **Thomas Dreyfus**: *Classification of discrete walks in the quadrant*

   In this talk I will summarize a series of paper about the classification of the generating series of walks in the quarter plane.

   More precisely, to a set of authorized directions, we consider the corresponding discrete walks in the quarter plane. We attach to this object a generating series and ask whether the latter satisfies algebraic and/or differential relations. This particularly simple question have obtained answer in a decade by surprisingly various mathematical methods. Our goal in this talk is to explain how differential Galois theory may give a partial answer to this question in a certain framework.

   This is joint work with Charlotte Hardouin, Julien Roques, and Michael Singer.

8. **Jacques-Arthur Weil**: *Representation theory results to simplify the computation of differential Galois groups via reduced forms*

   Given a linear differential system $[A]: \ Y' = A(x)Y$, the differential Galois group is an algebraic group of matrices acting on the vector space of solutions. An algorithm of Barkatou, Cluzeau, Di Vizio, and Weil allow to compute it (for irreducible systems) by decomposing a big differential system (a tensor product of $[A]$ and its dual), thus requiring to find rational solutions of a linear differential system of size n^4. This size issue is the main bottleneck of their algorithm. We will present work in progress where, using representation theory, we show how information can be read in smaller differential modules, hence requiring rational solutions of smaller differential systems and extending the applicability of the BCDVW algorithm.

   This is joint work with Cyrille Chenavier and Thomas Cluzeau.

9. **Vincel Hoang-Ngoc Minh**: *On the solutions of universal differential equations by noncommutative Picard-Vessiot theory*

   Basing on Picard-Vessiot theory of noncommutative differential equations and algebraic combinatorics on noncommutative formal series with holomorphic coefficients, various recursive constructions of sequences of grouplike series converging to solutions of universal differential equation are proposed. Basing on monoidal factorizations, these constructions intensively use diagonal series and various pairs of bases in duality, in concatenationshuffle bialgebra and in a Loday's generalized bialgebra. As applications, the unique solution, satisfying asymptotic conditions, of universal Knizhnik-Zamolodchikov equation is provided by dévissage

10. **Sergei Abramov - Anna Ryabenko**: *Compact sets of prolongations of truncated matrices*

    Determinants of matrices with real elements having a finite number of digits after the decimal point are considered. It is shown that the set of possible digital prolongations of the original matrix elements, including infinite ones, can be considered compact in a certain metric space. This allows us to establish bounds on the possible values of the determinant. An algorithm is given for finding the numbers that serve as the endpoints of the segment filled by all these values; it is shown that such endpoints are always rational numbers.