Abstract

Symbolic computation tools for solving and simplifying differential equations are becoming increasingly more common and powerful. The aim of this course is to understand their algebraic foundations such that one is prepared to get the maximum benefit from existing computer algebra commands and packages. In particular we will have a close look at the Maple package `DifferentialAlgebra`.

- Title: Fundamentals of Differential Algebra

- Basic Details:

  - Core Audience: PhD Students of Pure and Applied Mathematics
  - Course Format: LTCC Advanced Course

- Course Description:

  - Keywords: Differential algebra, algebra, differential equations, elimination theory, symbolic computation, computer algebra.
  - Syllabus

    1. Introduction: Differential rings and ideals
    2. Systems of nonlinear differential equations
    3. Isolating singular solutions from the general solution
    4. First encounter with differential algebra software
    5. The basic theorems of differential algebra
    6. Differential elimination and triangulation
    7. Utilizing differential algebra packages
    8. Outlook and advanced topics

  - Recommended reading:

    * Joseph Fels Ritt, *Differential Algebra*, Dover Publications, New York, 1966.
    * Ellis Kolchin, *Differential Algebra and Algebraic Groups*, Academic Press, New York, 1973.
    * Andy Magid, Lectures on Differential Galois Theory, second edition, American Mathematical Society, 1994.
    * Irving Kaplansky, An Introduction to Differential Algebra, Hermann, Paris, 1957.
    * Kolchin Seminar in Differential Algebra, `http://www.sci.ccny.cuny.edu/~ksda`.

  - Prerequisites: Basic algebra (commutative rings and fields) and basic differential equations (ordinary and ideally also partial ones)

- Format:

  - No of discussion/problem sheets: 4
  - Electronic lecture notes: Will be provided
  - Necessary support facilities: Computer with data projector
  - Necessary software requirements for computing facilities: Students should have access to Maple for the hands-on tutorial sessions for the `DifferentialAlgebra` package.
  - Location: University of Kent since the tutorial sessions would be in computer labs with Maple access.
  - Proposed timing: Two days at five hours each
  - Lecture/computer session/tutorial/discussion split (hours of each): 7 hours lecture plus 3 hours computer tutorial

- Lecturer Details:

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