

Educational Activities IMEIO- UPM

Title: Solvability by Quadratures of Differential Equations: Some Effective Algorithms
Responsible of the activity: Juan J. Morales-Ruiz
Lecturers: Rafael Hernández-Heredero, Juan J. Morales-Ruiz
Total number of hours: 6
Location: ETS de Edificación
Dates:

Lie Symmetries and Differential Equations. During the second half of the 20th century Lie's infinitesimal methods had a revival and they were applied to countless problems including the theory of bifurcations, special functions, numerical analysis, control theory, self-similar solutions of hydrodynamics systems and other fields of Physics and Engineering. A panoramic overview of these methods will be given, applied to the resolution of differential equations and to the characterization of integrable equations solvable by quadratures. We will start by discussing how the dimensional analysis is a particular case of this theory, and we will continue by analyzing how the traditional integration methods for ordinary differential equations are also due to the existence of Lie symmetries. To end up, a characterization/definition of integrability for differential equations from the perspective of Lie symmetries will be given.

Galois Symmetries for Linear Differential Equations. The motivation of Sophus Lie in formulating a theory, of symmetries Nature's laws, was to find a theory for differential equations similar to Galois theory of algebraic equations. We now know that the theory of Lie symmetries is not a Galois theory for differential equations. The genuine Galois theory for differential equations had its start at the end of the 19th century, simultaneously to Lie theory, and it can be considered as a certain kind of "dual" theory to the theory of Lie symmetries. Over the last forty years, Galois theory for differential (and difference) equations experienced an important revival, supported by symbolic computation algorithms and numerous applications in physics, engineering and pure mathematics. In this seminar, we will clarify the relationship between Lie and Galois symmetries for linear differential equations, connecting with the previous seminar and explaining some open research problems, which are in the current program of our research group like dynamical problems, partial differential equations with solitonic solutions, Schrödinger equations, Fokker-Planck, etc.

Would you accept that the course could be given by videoconference restricted to some doctoral students who could not attend in person?: yes