Differential Geometry and PDEs

Overview

The behavior of many different systems in nature is governed by a system of Partial Differential Equations (PDEs). As a consequence PDEs pervasive in most Mathematical, Natural, and Engineering Sciences, and it is crucially important to understand general properties of a PDE E, like symmetries or conservation laws, as they reflect general properties of the system described by E. We usually think of a PDE in terms of coordinates, in order to prove existence of solutions or to find concrete ones. However, a PDE contains some information which is independent of the choice of coordinates. This is actually the most important information as it is independent of any external structure, artificially added to the PDE, and in this sense it is *genuine*. The most appropriate language to study coordinate-independent properties of PDEs is Differential Geometry. Even defining as important structures as *symmetries of a PDE* is only possible within a geometric language. Additionally, History of Sciences shows that adopting a more appropriate language is often crucial for the advancement of knowledge.

This course will train students to understand PDEs within Differential Geometry, and to use the geometric language to extract the relevant information from them. For the huge spectrum of applications of PDEs in Physical Sciences but also in Technology, the IIT Kanpur seems to be the right place were to undertake this initiative.

The primary goal of this course is to promote the use of the differential geometric language to define, study and treat as important objects as PDEs, developing research collaborations between pure and applied mathematicians interested in PDEs, and initiate international collaborations. Specific aims are as follows:

(i) Introducing those differential geometric structures needed to define and study PDEs in a manifestly coordinate-independent way.

(ii) Define PDEs and their symmetries within Differential Geometry.

(iii) Develop computational techniques to find symmetries and other intrinsic properties of PDEs.

(iv) Discuss explicit examples to illustrate the importance of the choice of an appropriate language.

Modules	December 4-8, 2017 (5 days): 14 hrs lecture and 6 hrs tutorials.
You Should Attend If…	You are interested in Differential Geometry and PDEs. The main targeted audience from - Interested Mathematics and Physics students at all levels (BSc/MSc/Ph.D) with some background in modern differential geometry. - Engineering students at all levels (BTech/MSc/Mtech/Ph.D) and faculty with some background in modern differential geometry, interested in PDEs. - Students with background in modern differential geometry. - Anybody with abstraction skills interested in differential geometry and PDEs.
Fees	The participation fees for taking the course is as follows: **Participants from abroad : NIL** **Industry/ Research Organizations: NIL** **Academic Institutions: NIL** The participants will be provided with accommodation on payment basis.

The Faculty

Prof. Luca Vitagliano is a Senior Researcher in Geometry at DipMat Salerno. His research reveals a combination of skills and expertise in mathematical physics, differential geometry, and commutative/homological algebra. In mathematical physics his expertise includes mathematical general relativity, geometric mechanics and classical field theories. In differential geometry his expertise includes Poisson geometry, Lie groupoids and algebroids, geometry of PDEs, graded geometry. In algebra his expertise includes Lie-Rinehart algebras, homotopy algebras, differential calculus over commutative algebras.

Dr. Ashis Mandal is an Assistant Professor of Mathematics at the Indian Institute of Technology Kanpur. His research areas include deformation theory of algebraic structures, Lie algebroids and related topics.

Course Co-ordinator

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