Math Minicourses on May 24–28, 2010 (Aalto University)

There will be two minicourses in mathematics at Aalto University on May 24–28, 2010, by Shantanu Dave (Vienna) and Andrea Volpato (Berlin). The courses are for both (advanced undergraduate) students and experienced researchers, as well. The abstracts of the courses are below, and precise up-to-date information can be found on the web page `http://math.tkk.fi/conferences/minicourses_may_2010/` .

S. Dave: Introduction to the Lefschetz fixed point theorems

This is an elementary introductory mini-course on differential topology, covering the classical Lefschetz fixed point theorem.

Some of the most striking results in geometry and topology are related to the presence of symmetries in geometrical structures. A paradigm of such results is related to the Lefschetz fixed point theorems. These theorems make it possible to locally compute globally defined geometric invariants. On one hand, the classical Lefschetz fixed point theorem corresponding to the de Rham complex can be explained by elementary means to senior undergraduate students; on the other hand, the beautiful generalization of it due to Atiyah and Bott is of remarkable interest with a wide range of applications and possibilities for further research.

The course assumes familiarity with Euclidean spaces and smooth functions on them, and calculus in severable variables. Some familiarity with linear algebra would be useful. It contains the following parts:

1. Introduction to differential topology: manifolds, Sard's theorem and the de Rham cohomology.
2. Transversality and orientation.
3. Intersection theory, stability under homotopy.
4. The main statement and outline of proof of the classical Lefschetz fixed point theorem.

A. Volpato: The Cone Algebra

Pseudo-differential operators arise naturally when solving elliptic linear boundary value problems: this leads to studying pseudo-differential equations on the boundary manifold. The standard pseudo-differential calculus works for C^∞-smooth manifolds. However, often in applications, the boundary manifold may have singularities, e.g. conical points, edges or cusps.

The aim of this minicourse is to give an elementary introduction to the so called cone algebra of pseudo-differential operators. The idea is to introduce all the elements of the pseudo-differential calculus (operator-valued spaces of symbols and operators, Mellin transform and operators, ellipticity and regularity of solutions, asymptotics, ...) in a reasonable and transparent way and, in particular, in connection with the known results from the standard calculus. We can split the course in three parts.

The first part is devoted to the standard pseudo-differential calculus and the Fourier analysis, and, in particular, to fix notations and recall known results. The second part will focus on the problem of building an algebra of pseudo-differential operators on manifolds with (conical) singularities and we will then introduce the elements of the calculus analogously as we will do for the standard ones in the first part. Finally, the third part is devoted to the results in the cone algebra (like regularity of solutions, existence of parametrices) and to the introduction of the next step: the edge algebra and the case of variable asymptotics.

Practical information

Lectures: on May 24–28 each day
at 10:15–12:00 (S. Dave) and
at 13:15–15:00 (A. Volpato)
in Lecture Hall J
in the main building of Otaniemi Campus.

From each course 2 credit points can be earned by active participation.

Local organization: `ville.turunen@hut.fi`