

# FIM Minicourse

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## SNF ProDoc Minicourse „Numerik“ on Numerical computations in higher dimensions: theory, algorithms, software

**May 2 - 14, 2013**

Thursday, May 02, 08:00 - 10:00

Tuesday, May 07, 08:00 - 10:00

Wednesday, May 08, 08:00 - 10:00

Tuesday, May 14, 08:00 - 10:00

HG D 16.2, ETH Zürich, Rämistrasse 101

### Abstract

The goal of this course is to give an overview of the modern state of art in the numerical methods for the solution of high-dimensional problems. First, it is interesting to see where the high-dimensional problems appear in computations: where do we actually find a 100-dimensional problem (taking into account that our „typical“ world is at most 4-dimensional). Applications of such kind include chemistry, solid state physics, uncertainty quantification, data mining and compression model reduction, latent variable models and many others.

It is remarkable that these problems are formulated in different languages, and it is not trivial to see that they share common mathematical and algorithmical properties. In the core of all numerical methods lie the low-parametric representation of multiway arrays (tensors), usually referred to as tensor decompositions. I will give an overview of the recent results on the effective representations of tensors, including the canonical and Tucker format, tensor train and Hierarchical Tucker formats, discuss their advantages and disadvantages and present the most recent results which are obtained in this area. An important point is the development of a fully functional prototype code for doing basic operations with tensors: a MATLAB Toolbox will be used as a tool to illustrate some of the basic and advanced tensor algorithms.