Statistical Inference for Structured High-dimensional Models

Organised by
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Abstract. High-dimensional statistical inference is a newly emerged direction of statistical science in the 21 century. Its importance is due to the increasing dimensionality and complexity of models needed to process and understand the modern real world data. The main idea making possible meaningful inference about such models is to assume suitable lower dimensional underlying structure or low-dimensional approximations, for which the error can be reasonably controlled. Several types of such structures have been recently introduced including sparse high-dimensional regression, sparse and/or low rank matrix models, matrix completion models, dictionary learning, network models (stochastic block model, mixed membership models) and more. The workshop focused on recent developments in structured sequence and regression models, matrix and tensor estimation, robustness, statistical learning in complex settings, network data, and topic models.

Mathematics Subject Classification (2010): 62Gxx (in particular, 62G05, 62G08, 62G10).

Introduction by the Organisers

The workshop Statistical Inference for Structured High-Dimensional Models, organized by Anatoli Juditsky (Université Grenoble-Alpes), Alexandre Tsybakov (CREST, ENSAE), and Cun-Hui Zhang (Rutgers University), was held March 11th – March 17th, 2018. The workshop aimed to highlight recent achievements in high-dimensional inference for structured statistical models based on the interplay of techniques from mathematical statistics, optimization theory and high-dimensional probability, and to bring together researchers to exchange the ideas and to explore open mathematical problems. These goals were largely achieved.
The workshop was well attended by 52 participants with broad geographic representation from three continents. Twenty five talks were presented, and seven PhD students shortly presented their work in a "Young researcher's series" on Tuesday evening. The talks can be roughly categorized into the following topics, which the workshop was focused on.

**Estimation and inference in structured sequence and high-dimensional regression models:** Pierre Bellec reports recent advances on the noise-barrier and signal bias of the Lasso and other convex estimators; Emmanuel Candès presents an asymptotic theory in logistic regression in the regime where the number of data points is of the same order as the number of unknown parameters; Richard Samworth studies the least square estimation in isotonic regression in general dimensions; Bin Yu studies local identifiability analysis of dictionary learning.

**Matrix and tensor estimation:** Vladimir Koltchinskii discusses asymptotically efficient estimation of functionals of high-dimensional covariance; Zongming Ma reports recent developments in local asymptotic normality in spiked random matrix models; Vladimir Spokoiny studies large ball probability with applications to inference for spectral projectors; Martin Wahl presents relative perturbation bounds with applications to empirical covariance operators; Dong Xia studies noisy low rank tensor completion; Anru Zhang discusses singular value decomposition for high-dimensional tensor data.

**Robust inference:** Rina Foygel Barber studies robust inference with the knock-off filter; Olivier Collier presents recent work on sparse functional estimation and robust variance estimation; Arnak Dalalyan studies statistically and computationally efficient estimation of multidimensional linear functionals; Stanislav Minsker considers robust modifications of U-statistics and their applications.

**Statistical learning in complex settings and computational issues:** Chao Gao presents convergence rates of variational posteriors; Alexandre Gramfort studies hypothesis testing with Gaussian mixture models; Andrea Montanari studies feasibility in weak recovery of high-dimensional signals; Boaz Nadler develops an asymptotic theory of projection pursuit in high dimensions; Richard Nickl studies information operators and statistical inverse problems; Johannes Schmidt-Hieber presents a statistical theory for deep neural networks; Yihong Wu studies optimal estimation of Gaussian mixtures via denoised method of moments.

**Network data, topic models and other applications:** Mladen Kolar studies estimation and inference for differential networks; Jing Lei discusses nonparametric network representation and estimation using graph root distribution; Florentina Bunea presents optimal estimation of structured loading matrices with applications to overlapping clustering and topic models; Zheng Ke develops a spectral approach to optimal topic estimation.
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