Master School on Data Science and Geometry

INSTITUT DE MATHEMATIQUES DE TOULOUSE

2-26 july 2019

Third week PROGRAM 15-19 july

	Monday	Tuesday	Wednesday	Thursday	Friday
9h00-10h30 room	**Optimal Transport** MIP	**Statistics** MIP		**Statistics** MIP	
11h00-12h30 room	**Optimal Transport** MIP	**Statistics** MIP		**Statistics** MIP	
14h00-15h30 room	**Statistics** MIP	**Optimal Transport** MIP		**Optimal Transport** MIP	**Statistics** MIP**14h-15h00**
16h00-17h30 room	**Statistics** MIP			**Optimal Transport** MIP**16h-18h**	**Optimal Transport** MIP**15h30-17h30**

Lectures of the week

GEOMETRY (10h) : Wasserstein geometry and optimal transport

Max FAHTI

Lecture 1 Introduction to the optimal transport problem on Euclidean space. Formulations of Monge and Kantorovitch, history, applications. Explicit solution in dimension one. Existence of solutions to the Kantorovitch problem.

Lecture 2 Kantorovitch duality, existence of a transport map solving the Monge problem. Connection with the Monge-Ampere PDE. Extension to Riemannian manifolds.

Lecture 3 Transport cost as a distance on the space of probability measures, and applications in statistics.

Lecture 4 The geometry of optimal transport: Benamou-Brenier formula and Riemannian structure of the space of probability measures. Application: gradient flow structure of the heat equation.

Lecture 5 Long-time behavior of stochastic processes, and applications to numerical schemes.

STATISTICS (10h): Information Geometry

Alice LE BRIGANT

Lecture 1 Statistical models, parametric estimation, sufficient statistics.

Lecture 2 Fisher information, Kullback-Leibler divergence, search for the best estimator.

Lecture 3 Fisher geometry of parametric statistical models, Fisher vs Wasserstein geometry of univariate Gaussian distributions, computing barycenters of probability distributions.

Lecture 4 Dual connections, dual geometry of exponential families, divergences.

Lecture 5 Dual connections, dual geometry of exponential families, divergences.

References: Shun-ichi Amari and Hiroshi Nagaoka, Methods of Information Geometry, American Mathematical Society, 2007.