Séminaire de Probabilités et Statistique

Mardi 21 mars à 14h00

Salle de conférences

Xavier Pennec

Université Côte d'Azur / Inria

Geometric statistics with applications to computational anatomy: old & new

At the interface of geometry, statistics, image analysis and medicine, computational anatomy aims at analyzing and modeling the biological variability of the organs shapes and their dynamics at the population level. The goal is to model the mean anatomy, its normal variation, its motion / evolution and to discover morphological differences between normal and pathological groups. However, shapes are usually described by equivalence classes of sets of points, curves, surfaces or images under the action of a transformation group, or directly by the diffeomorphic deformation of a template in diffeomorphometry. This implies that they live in non-linear spaces, while statistics where essentially developed in a Euclidean framework. For instance, adding or subtracting curves or surfaces does not really make sense. Thus, there is a need for redefining a consistent statistical framework for objects living in manifolds and Lie groups, a field which is now called geometric statistics. The objective of this talk is to give an overview of the Riemannian computational tools and of simple statistics in these spaces, which is then extended to Lie groups with affine connection structure. The talk is motivated and illustrated by applications in medical image analysis, such as the regression of simple and efficient models of the atrophy of the brain in Alzheimer's disease using the parallel transport of image deformations, or manifold valued image processing with the example of diffusion tensors and the recent metrics proposed on spaces of correlation matrices.