Séminaire de Probabilités et Statistique

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Salle de conférences

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Limit theorems and statistical inference for quadratic variations: application to the stochastic wave equation and random fields on the sphere

For a stochastic process $(X_t)_{t\in\mathbb{R}^+}$, empirical quadratic variations, that is, variables of the form

$$\sum_{i=1}^{N}(X_{i\Delta} - X_{(i-1)\Delta})^2$$

with mesh size Δ tending to zero as $N \to \infty$, are a robust and simple to implement tool for parameter estimation. In terms of stochastic analysis, quadratic and higher power variations of a Gaussian process can be described in a practical way with multiple integrals in the sense of Wiener-Itô. The method of Malliavin-Stein provides many statements, such as the celebrated 4th Moment Theorem, to study the asymptotic behaviour of such functionals, making precise asymptotic statistical statements accessible.

In this talk, we show two applications of this method having very different flavours. One is parameter estimation for the stochastic wave equation driven by a noise that is fractional in time and white in space. We show how the interplay of space and time observations can be used to access different parameters of this equation. The other application concerns isotropic random fields on the sphere. We demonstrate how the quadratic variation method can help extract such intrinsically global information as the spectral slope of such fields from observations on a single geodesic line.