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Deformations of Gaussian random fields: study based on the mean Euler characteristic of excursion sets

Joint with Anne Estrade

We denote by X a stationary and isotropic Gaussian random field defined on $\mathbb{R}^2$ and taking real values, such that almost every realization of X is of class $\mathcal{C}^2$. If $\theta : \mathbb{R}^2 \to \mathbb{R}^2$ is a diffeomorphism of class $\mathcal{C}^2$, we consider the deformed field defined by $X_\theta(x) = X(\theta(x))$. We assume that we know the Euler characteristic of excursion sets of X_θ above different levels and over rectangular sets and segments in $\mathbb{R}^2$. Supposing no precise knowledge about the law of X, this allows us to get some information on the deformation θ. Adding the assumption that θ belongs to certain groups of deformations, we may get more information. We introduce the notion of "star-isotropic deformations". A star-isotropic deformation θ is characterized by the invariance of the mean Euler characteristic of any excursion set of X_θ over any rectangle T under orthogonal transformations of T.