



21 октября (понедельник) 15:30, 120 (413) ауд., 14 линия В.О., 29

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«Topology and geometry, its application to (cosmological) data sets»

In the last few of decades, topology and geometry have matured from a purely theoretical field to one with strong applicability in various research domains. Combining Morse theory, Homology and Persistent homology, as well as the more familiar Minkowski functionals, this has enabled and opened up new possibilities in data analysis. From the side of topology, the central tenet is based on the identification of topological changes that occur in a manifold as a function of the excursion sets of the field. The topological changes are accounted for by tracking the creation and destruction of p -dimensional topological holes in a d -dimensional manifold ($p = 0, \dots, d$). Intuitively, in 3 spatial dimensions, these changes correspond to creation and destruction of connected components, loops/tunnels and voids. From the side of geometry, the chief exercise involves computing the Minkowski functionals for excursion sets. Important to note is that attempts to find closed form analytical expressions for the topological quantities have not been successful yet completely. The expectation values of the geometrical Minkowski functionals on the other hand have well defined analytical expressions as a function of level sets.

Towards the end, I will present an example of application of the formalism to datasets arising in Cosmology: Cosmic Microwave Background (CMB) radiation. The CMB is the earliest visible light in the universe, and studying its properties has the potential to reveal information about the physical processes occurring in the nascent stages of the Universe. The accepted model for the CMB is a homogeneous, isotropic Gaussian random field. We find that the observations depart significantly from the theoretical model.

Приглашаются все желающие!