The Latent Geometry Formalism and Its Applications to Social, Technological and Biological Systems

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Prediction and control of the dynamics of complex networks is a central problem in network science. Structural and dynamical similarities of different real networks suggest that some universal laws might accurately describe the dynamics of these networks, albeit the nature and common origin of such laws remain elusive. Do these universal laws exist despite the abundance of complex systems? We do not have the answer to this question... yet. The central theme of my research is the latent geometry formalism - a general approach to complex networks. Within the formalism, real networks can be viewed as certain “discretizations” of smooth geometric spaces. Network nodes can be regarded as points in these spaces, so that links between nodes are determined by distances between corresponding points: the smaller the distance the higher the is the connection probability. Mapping the nodes of real networks to latent metric spaces allows one to study dynamic processes taking place on complex systems from a geometrical standpoint. We find that many real networks can be accurately modeled by latent spaces whose geometries are not Euclidean, but either hyperbolic or Lorentzian. This suggests that equations governing the evolution of complex networks may be similar to Einstein equations in general relativity.

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