Physics informed spatial and functional data analysis over non-Euclidean domains

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Abstract. Recent years have seen an explosive growth in the recording of increasingly complex and high-dimensional data. Classical statistical methods are often unfit to handle such data, whose analysis calls for the definition of new methods merging ideas and approaches from statistics and applied mathematics. My talk will in particular focus on spatial and functional data defined over non-Euclidean domains, such as linear networks, two-dimensional manifolds and non-convex volumes. I will present an innovative class of methods, based on regularizing terms involving Partial Differential Equations (PDEs), defined over the complex domains being considered. These physics-informed regression methods enable the inclusion of the available problem specific information, suitably encoded in the regularizing PDE. The proposed methods make use of advanced numerical techniques, such as finite element analysis and isogeometric analisys. A challenging application to neuroimaging data will be illustrated.