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Exploiting low-dimensional structures in machine learning and PDE simulations

Many data in real-world applications are in a high-dimensional space but exhibit low-dimensional structures. In mathematics, these data can be modeled as random samples on a low-dimensional manifold. I will talk about machine learning tasks like regression and classification, as well as PDE simulations. We consider deep learning as a tool to solve these problems. When data are sampled on a low-dimensional manifold, the sample complexity crucially depends on the intrinsic dimension of the manifold instead of the ambient dimension of the data. Our results demonstrate that deep neural networks can utilize low-dimensional geometric structures of data in machine learning and PDE simulations.