Deep Jump Gaussian Processes for Surrogate Modeling of High-Dimensional Piecewise Continuous Function

BIOGRAPHY

Yang Xu is a Ph.D. student in Industrial & Systems Engineering at the University of Washington. He received an M.S. in Statistics from the University of Chicago. His research lies at the intersection of statistics and machine learning, with interests in surrogate modeling, statistical machine learning, design of experiments, uncertainty quantification, and digital twin applications. His work focuses on developing data-efficient and uncertainty-aware methods for modeling, analysis, and decision-making in complex engineering systems.

ABSTRACT

Many scientific and engineering systems exhibit piecewise continuous behavior, where small changes in the inputs can lead to abrupt changes in the response. This structure poses challenges for conventional Gaussian process surrogate models, which typically rely on smoothness assumptions and often struggle in high-dimensional settings. In this talk, I will present Deep Jump Gaussian Processes (DJGP), a framework for surrogate modeling of high-dimensional piecewise continuous functions. The key idea is to combine local Jump Gaussian Process modeling with location-dependent linear projections that map high-dimensional inputs into a lower-dimensional latent space. A Gaussian process prior is placed on these projection matrices to regularize their variation across the input space, and a scalable variational inference procedure is used to jointly learn the latent projections and local model parameters. I will discuss the intuition behind the method, its theoretical properties, and empirical results on synthetic and benchmark datasets. Overall, DJGP achieves improved predictive accuracy and more reliable uncertainty quantification for complex, high-dimensional systems.