

Level-set Approximation of Noisy Functions

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Abstract

In this talk, we consider the problem of numerically approximating the level set of a noisy multivariate function which is only accessible via pointwise sampling. A key application is the estimation of failure probability regions: given a random PDE that depends on a set of deterministic parameters and a failure criterion, determine the parameter region where the probability of failure exceeds a given safety threshold.

We present a level-set estimation algorithm for Lipschitz-continuous functions which is adaptive in terms of both parameter-space approximation and sampling, and automatically increases accuracy close to the level set. This algorithm is compatible with general Monte Carlo estimators and achieves improved cost complexity rates with respect to non-adaptive approximations. We provide numerical experiments based on random PDEs and computer vision in support of our theoretical findings.

References

- [1] M. Croci, A.-L. Haji-Ali, and I. C. J. Powell. An adaptive sampling algorithm for level-set approximation. *Preprint*, 2025. <https://arxiv.org/abs/2509.14896>