USACM Workshop on Establishing Benchmarks for Data-Driven Modeling of Physical Systems
April 6-7, 2023, University of Southern California,, Los Angeles, California, USA

ERROR-IN-VARIABLES MODELLING FOR OPERATOR LEARNING BENCHMARKS

Ravi G. Patel[1], *Myoungkyu Lee*[2]

[1]*Sandia National Laboratories – Center for Computing Research*
[2]*University of Alabama - Aerospace Engineering and Mechanics*

ABSTRACT

Operator learning has emerged as a promising technique for PDE and reduced-order modeling. However, least squares (LS) estimates inferred from noisy independent variables can be heavily biased. Operator learning is particularly susceptible to this bias because it seeks mappings between functional data that often originates from signals or stochastic simulations. In this talk, I will present a method for correcting for this bias, i.e., an error-in-variables (EiV) model [1], and its integration into two operator learning frameworks, MOR-Physics [2] and DeepONet [3]. I will next demonstrate our EiV model in a synthetic benchmark problem, inferring the Burgers operator given white noise corrupted data. Finally, I will propose a new benchmark for EiV models in operator learning, inferring solution operators for compressible Euler given Direct simulation Monte Carlo data, and demonstrate the limitations of our proposed EiV model for discontinuous data.

REFERENCES

[1] R.G. Patel, I. Manickam, M. Lee, and M. Gulian, Error-in-variables modelling for operator learning, *Proceedings of Machine Learning Research*, **145**, 1-23, 2022.

[2] R.G. Patel and O. Desjardins, Nonlinear integro-differential operator regression with neural networks, arXiv:1810.08552, 2018.

[3] L. Lu, P. Jin, G.E. Karniadakis, DeepONet: Learning nonlinear operators for identifying differential equations based on the universal approximation theorem of operators, arXiv:1910.03193, 2021