Talk 12: Bouazza Saadeddine (CACIB)

Title: Fast calibration using complex-step Sobolev training

Abstract. In [1], the authors introduced a so-called Sobolev Training procedure where neural networks would be trained to fit not only values but also sensitivities. In [4], the authors show a direct application of this approach to payoffs in order to approximate prices of derivative products. In a similar vein, the aim of our talk is to present a principled approach to construct fast pricing surrogates using neural network approximations constructed by seeking to orthogonally project simulated payoffs corresponding to randomized model and product parameters, including time-to-maturity, with these pricing surrogates then later intended to be used in model calibration routines.

The talk builds on our paper [5] where we enrich the learning task by including path-wise sensitivities of the payoffs with respect to model and product parameters. In [5], significant speed and memory footprint gains were achieved by choosing to compute the sensitivities along randomized directions at each training step, and the randomized directional derivatives were obtained using a highly accurate complex-step differentiation procedure, as opposed to approaches such as [5] which rely on full gradients.

In this talk, we go over the main results of [5] and we will discuss training stability issues and how to overcome them, as well as generalizations of the procedure. If time permits, some non-trivial implementation details will be discussed as well, from simulation to training and fast validation.

References

[1] Czarnecki, W. M., Osindero, S., Jaderberg, M., Swirszcz, G., and Pascanu, R. *Sobolev training for neural networks.* Advances in neural information processing systems 30 (2017).

[2] Glorot, X. and Bengio, Y. *Understanding the difficulty of training deep feedforward neural networks.* In Proceedings of the thirteenth international conference on artificial intelligence and statistics (2010), JMLR Workshop and Conference Proceedings, 249–256.

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[4] Huge, B. and Savine, A. *Differential machine learning.* ArXiv preprint arXiv:2005.02347 (2020).

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