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Learning tensor networks with parameter dependencies for Fourier-based option pricing

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The fast solution of option pricing is a critical issue in quantitative finance. In the case of multiple assets, the computational cost of numerical simulations increases with the number of assets. Recent research has shown the potential for speeding up Fourier-based option pricing [1] using a tensor network learning algorithm, namely, tensor cross interpolation [2]. Another advantage of the tensor network is its ability to compress functions, including their parameter dependencies. In this study, we propose a scheme that utilizes the tensor train embedding parameter dependencies, thereby enabling the rapid calculation of option prices for various parameter changes. To benchmark the proposed method, we focus on scenarios involving fluctuations in volatility (σ). We demonstrate through numerical analysis that the resulting error of option pricing stays within the statistical error margin of a Monte Carlo simulation with 10^5 samples. Asl, we would like to discuss the speed advantage of the proposed method against the Monte Carlo approach.

[1] M. Kastoryano et al., arXiv:2203.02804 (2022).
[2] I. V. Oseledets, Linear Algebra and Its Applications 80 653 (2009).

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