Deep Gradient Flow Methods for Option Pricing in Diffusion Models

Jasper Rou[1]

[1] Delft University of Technology
J.G.Rou@tudelft.nl

We consider neural network solvers for differential equation-based problems based on the pioneering collocation approach introduced by Lagaris et al. Those methods are very versatile as they may not require an explicit mesh, allow for the solution of parameter identification problems, and be well-suited for high-dimensional problems. However, the training of these neural network models is generally not very robust and may require a lot of hyper parameter tuning. In particular, due to the so-called spectral bias, the training is notoriously difficult when scaling up to large computational domains as well as for multiscale problems. In this work, we give an overview of the methods from the literature and we focus later on two overlapping domain decomposition-based techniques, namely finite basis physics-informed neural networks (FBPINNs) and deep domain decomposition (Deep-DDM) methods. Whereas the former introduces the domain decomposition via a partition of unity within the classical gradient-based optimization, the latter employs a classical outer Schwarz iteration. In order to obtain scalability and robustness for multiscale problems, we consider a multi-level framework for both approaches.