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Sobolev Cubatures Strengthen the Approximation Power of Physics Informed Neural Nets

Monday 6 December 2021 11:15 (15 minutes)

In recent years, Physics Informed Neural Networks (PINNs) gained big traction in the scientific computing community. PINNs provide a neural-net-surrogate model parametrizing the solution space of a certain Partial Differential Equation (PDE) derived as the solution of a variational problem.

Thereby, the variational problem is typically formulated in terms of L^2-norms that are approximated by measuring Mean Square Errors. We will present a generalization of the analytical L^2-setup with the notion of Sobolev spaces and their corresponding norms, allowing to consistently implement weak formulations of PDEs accordingly to the classic mathematical theory. Thereby the approximation of the Sobolev norms is realized by extending classic Gauss-Legendre cubature rules.

In this presentation, we will demonstrate that the derived Sobolev Cubatures enable to replace the automatic differentiation by polynomial differential operators and reach higher accuracy for classic PINN problems than prior used MSE or L^2-loss.

Physical Presentation

I would not feel comfortable to present in front of an audience and prefer a video (call) presentation.

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Session Classification: Parallel Session