

SMLTPINN-notes

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Abstract

A distillation of knowledge in this long summarize. PINNs maybe a promising way to solve physical problems via NNs.

1 What is PINNs

Physics-Informed Neural Networks (PINNs) are a scientific machine learning technique used to solve problems involving Partial Differential Equations (PDEs). It approximates the solution of PDEs by training a neural network to minimize a loss function and includes terms reflecting the initial and boundary conditions along the space-time domain's boundary and the PDE residual at collocation points, selected points in the domain.

PINNs' input is a point in integration domain and its output is an estimated solution in that point of a DE after training. And PINNs are unsupervised.

PINN is not the only NN framework utilized to solve PDEs, such as the Deep Ritz method, the Galerkin method or Petrov-Galerkin method, hp-VPINN, CPINN, PCNNS.

Advantages:

- mesh-free
- enable on-demand solution computation after a training stage
- allow solutions to be made differentiable using analytical gradients
- solve forward jointly and inverse problems using the same optimization problem

2 How PINNs were built

2.1 Neural Network's architecture

2.2 Injection of Physical laws

2.3 Model Estimation

2.4 Learning Theory