

Physics-Informed Neural Networks (PINNs) in Fluid Mechanics and Heat Transfer

George Em Karniadakis

Brown University
george_karniadakis@brown.edu

Abstract

Can we solve ill-posed problems in fluid mechanics and heat transfer? For example, infer the velocity and pressure fields from dye visualizations only or infer the temperature fields from heated surfaces in convective heat transfer without knowing the thermal boundary conditions. We will present a deep learning approach based on neural networks (NNs) that can solve such practical but ill-posed problems. We will also introduce new NNs that learn functionals and nonlinear operators from functions and corresponding responses for system identification. Unlike other approaches that rely on big data, here we “learn” from small data by exploiting the information provided by the physical conservation laws, which are used to obtain informative priors or regularize the neural networks.