پژوهشگاه دانش‌های بنیادی
پژوهشکده علوم کامپیوتر

سخنرانی علمی

Fractional Chebyshev Deep Network for Solving Differential Models

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Abstract

Differential and integral equations have been used vastly in modeling engineering and science problems. Various methods for approximating these problems have been proposed and one of the recent is scientific machine learning methods. Scientific machine learning combines differentiable programming, scientific simulation (differential equations, nonlinear solvers, etc.), and machine learning (deep learning) in order to impose physical constraints on machine learning and automatically learn biological models.

In this talk, first I will introduce some of the latest techniques in scientific machine learning such as physics-informed neural networks as a deep learning framework for solving and discovering nonlinear partial differential equations and then present a new scientific machine learning algorithm (fractional Chebyshev deep neural network) for solving a wide category of fractional models. Fractional differential equations are obtained by replacing integer-order derivatives of differential equations with fractional-order derivatives. The algorithm is a combination of deep neural network (as a machine learning technique), Chebyshev spectral method (as a numerical method) and power of fractional calculus. Chebyshev orthogonal polynomials as the basic functions in spectral methods, are used as activation functions in this network. The marching in time technique and the Gaussian method are applied in the fractional operations to simplify the calculations.

Biography

Fatemeh Baharifard is a postdoc researcher at Institute for Research in Fundamental Sciences (IPM). She received her PhD in Computer Science from the School of Computer Science, IPM in 2018. Her research interests focus on learning methods for scientific computing, approximation algorithms and algorithmic graph theory.

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