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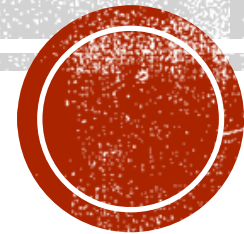## (THE SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS)

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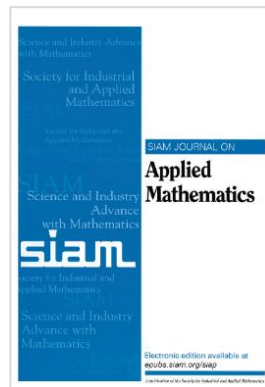# SIAM (THE SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS)

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Lu Lu (ID), **Xuhui Meng, Zhiping Mao**, and **George Em Karniadakis** (ID)

https://doi.org/10.1137/19M1274067

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Abstract

Deep learning has achieved remarkable success in diverse applications; however, its use in solving partial differential equations has emerged only recently. Here, we present an overview of physics-informed neural networks (PINNs), which embed a PDE into the loss of the neural network u... ...Es, including integro-dif... ...PINNs solve inverse problem... ...improve the training efficiency of... ...also present a Python libr... ...m as well as a research tool for... ...blems given initial and boundary... ...metry domains based on the technique of constructive solid geometry and enables the user code to be compact, resembling closely the mathematical formulation. We introduce the usage of DeepXDE and its customizability, and we also demonstrate the capability of PINNs and the user-friendliness of DeepXDE for five different examples. More broadly, DeepXDE contributes to the more rapid development of the emerging scientific machine learning field.

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SIAM Review
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ARTICLE
Research Spotlights

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Misha E. Kilmer

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Print	, 2022
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Abstract
The first Research Spotlights article in this issue is concerned with filtering, a task of paramount

RESEARCH SPOTLIGHTS

The first Research Spotlights article in this issue is concerned with filtering, a task of paramount importance in a great many applications such as numerical weather prediction and geophysical data assimilation. Authors Alessio Spantini, Ricardo Baptista, and Youssef M. Marzouk, in their article "Coupling Techniques for Nonlinear Ensemble Filtering," describe discrete-time filtering as the act of characterizing the sequence of conditional distributions of the latent field at observation times, given all currently available measurements. Despite the existing literature on filtering, issues such as high-dimensional state spaces and sparse (in both space and time) observations still prove formidable in practice. The traditional approach of ensemble-based data assimilation is the ensemble Kalman filter (EnKF), involving a prediction (forecasting) step followed by an analysis step. However, linearity of the transformation, the analysis step, which limits Gaussian generalizations of the filters—using nonlinear transfo distribution and the filtering di "can be estimated efficiently . . . easy to 'localize' in high dimens increasingly challenging as the v comprehensive description of t ically the superiority of their st subsequent discussion offers th

Recovery of a sparse solution to a large-scale optimization problem is another ubiquitous problem arising in many applications such as image reconstruction, signal processing, and machine learning. The cost functional typically includes a regularization term in the form of an ℓ_1 norm term on the solution and/or regularized solution to enforce sparsity. Designing suitable algorithms for such recovery problems is the subject of our second Research Spotlights article. In "Sparse Approximations with Interior Point Methods," authors Valentina De Simone, Daniela di Serafino, Jacek Gondzio, Spyridon Pougkaklotis, and Marco Viola set out to correct the misconception that first-order methods are to be preferred over second-order methods out of hand. Through case studies, they offer evidence that interior point methods (IPMs) which are constructed to "exploit special features of the problems in the linear algebra of IPMs" and which are designed "to take advantage of the expected sparsity of the optimal solution" can in fact be the method of choice for solving this class of optimization problems. The

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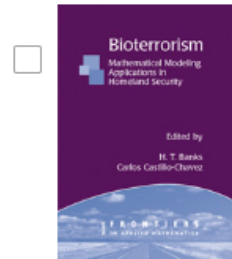REFINE SEARCH ⌄   RESULTS PER PAGE: 20 50 100   ↑↓ SORT BY: RELEVANCE ⌄

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SIAM Journal on Mathematical Analysis • Vol. 50, No. 3, pp. 2362–2388 • 2018

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