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Learning equations of transport phenomena and fluid dynamics from data KAZEM MEIDANI, AMIR BARATI FARIMANI, Carnegie Mellon Univ — Partial Differential Equations (PDEs) are models that govern transport phenomena and fluid dynamics. Recent advances in data-driven techniques as well as the availability of vast volumes of data from experiments and simulations brought about attention in using machine learning (ML) methods to uncover the structure of equations. In this study, an ML method is proposed to identify particular PDEs including convection-diffusion equations and wave equations. First, useful features are extracted from spatiotemporal data samples to represent the physical behaviors of mathematical terms. Diffusion, Convection, local time-dependent change, and system energy are some potential features. Second, a data-driven model exploits these features to identify the terms that are present in the equation. Incorporating prior knowledge leads to the robustness of the extracted features compared to detected features by Convolutional Neural Networks (CNNs) provided limited amounts of data. The framework presented in this work is efficient as it does not require numerical differentiation or time-consuming network training. Furthermore, the trained model can identify 2D PDEs with time derivatives of different orders, and discover equations out of the training domain.

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