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**A unifying framework of solving forward and inverse problems in fluid mechanics via deep learning**[1] HAN GAO, JIAN-XUN WANG, University of Notre Dame — Numerical simulation has been playing an increasingly important role in understanding and predicting fluid phenomena. The traditional paradigm focuses on forward solutions with given modeling conditions (e.g., flow boundaries or mechanical parameters), some of which, however, are often unknown in many practical scenarios. On the other hand, indirect, sparse, and possibly noisy observations are usually available, which can be leveraged to estimate these unknowns, enabling modeling in an inverse fashion. Nonetheless, existing finite volume or finite element based numerical solvers have difficulties in assimilating data and solving such inverse problems because of considerable computational overhead for most nontrivial cases. In this work, we present a novel deep learning framework that enables us to solve forward and inverse problems in a unified manner, where sparse data can be naturally assimilated based discrete learning. The proposed method is demonstrated effective and efficient in simulating a number of flow transport problems with partially known boundary conditions.

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