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A Generative Model to Solve Steady Navier-Stokes Equations with Reduced Training SHEN WANG, JOSHUA AGAR, YALING LIU, Lehigh University — Traditional computational fluid dynamics (CFD) seeks high-performance computational resources to reduce computational time. Recently, machine learning has been deployed to create data-driven surrogate models for CFD that improve computational efficiency. A majority of these approaches rely on labeled CFD datasets which are computationally intractable to obtain at a scale necessary to build data-driven models. Weakly-supervised learning, as an alternative approach, has shown the ability for solving Laplaces equation with costless training data by building up a generative model with the physics-driven loss function according to the finite-difference method. Here we extend such an approach and train a model that instantly generates the steady solutions of the Navier-Stokes equations with various boundary conditions. We improved the model to handle the computational domains with internal obstacles. The trained model produces accurate steady solutions facilitated by warm-up initializations given during training. We expect that the model can be generalized to speed up the boundary-value CFD problems with minimal requirement of training data.

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