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Deep Learning Fluid Mechanics AMIR BARATI FARIMANI, JOSEPH GOMES, VIJAY PANDE, Stanford University — We have developed a new data-driven model paradigm for the rapid inference and solution of the constitutive equations of fluid mechanic by deep learning models. Using generative adversarial networks (GAN), we train models for the direct generation of solutions to steady state heat conduction and incompressible fluid flow without knowledge of the underlying governing equations. Rather than using artificial neural networks to approximate the solution of the constitutive equations, GANs can directly generate the solutions to these equations conditional upon an arbitrary set of boundary conditions. Both models predict temperature, velocity and pressure fields with great test accuracy (>99.5%). The application of our framework for inferring and generating the solutions of partial differential equations can be applied to any physical phenomena and can be used to learn directly from experiments where the underlying physical model is complex or unknown. We also have shown that our framework can be used to couple multiple physics simultaneously, making it amenable to tackle multi-physics problems.

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