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Convolutional Neural Networks for the Solution of the 2D Poisson Equation with Arbitrary Dirichlet Boundary Conditions, Mesh Sizes and Grid Spacings[1] ALI GIRAYHAN OZBAY, Department of Aeronautics, Imperial College London, PANAGIOTIS TZIRAKIS, GEORGIOS RIZOS, BJORN SCHULLER, Department of Computing, Imperial College London, SYLVAIN LAIZET, Department of Aeronautics, Imperial College London — The Poisson equation is a problem commonly encountered in engineering, including in computational fluid dynamics where it is needed to compute corrections to the pressure field. However, solving the Poisson equation numerically can be very costly, especially for large-scale problems. We propose a fully convolutional neural network (CNN) architecture to infer the solution of the Poisson equation on a Cartesian grid of arbitrary size and grid spacing, given the right hand side term, Dirichlet boundary conditions and grid parameters. Analytical test cases indicate that our CNN architecture is capable of predicting the correct solution of a Poisson equation with mean percentage errors of a few percentage points and a reduction in wall-clock time compared to traditional solvers based on finite difference methods.

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