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A Deep Learning Framework for Computational Fluid Dynamics on Irregular Geometries[1] ALI KASHEFI, Department of Civil and Environmental Engineering, Stanford University, DAVIS REMPE, LEONIDAS GUIBAS, Department of Computer Science, Stanford University — We present a novel deep learning framework for the prediction of flow fields in irregular domains. Grid vertices in a CFD domain are viewed as a point cloud and used as input to a neural network based on the PointNet architecture that learns an end-to-end mapping between spatial positions and CFD quantities. Using our approach, (i) the network inherits the feature of unstructured meshes (e.g., fine points near the object surface and coarse points in far field); hence the training cost is optimized; (ii) object geometry is accurately represented through vertices located on the object boundaries with no artificial affect; and (iii) no data interpolation is employed for creating training data; thus the accuracy of CFD data is preserved. None of these features are achievable by extant methods based on projecting scattered CFD data into Cartesian grids and then using regular convolutional neural networks. To evaluate the network, flow past a cylinder with different shapes for its cross section is considered. The mass and momentum of predicted fields are conserved. For the first time, our network predicts flow fields around multiple objects and airfoils, while it has only seen one object per object class and has never seen airfoils during the training process.

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