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Inference on spatially unstructured flow fields using Graph Neural Networks FRANCIS OGOKE, KAZEM MEIDANI, Carnegie Mellon University, AMIRREZA HASHEMI, University of Pittsburgh, AMIR BARATI FARIMANI, Carnegie Mellon University — Experimental and computational models of fluid behavior frequently produce spatially unstructured data. However, machine learning models require data samples that have a within-sample ordered set of features. This limits the ability to form a coherent feature matrix based on a spatially unstructured dataset. Therefore, we present a data-driven model to perform inference on fields defined on an unstructured mesh, using a Graph Convolutional Neural Network framework. We demonstrate the ability of the method to predict global properties from spatially irregular measurements with high accuracy, by predicting the body forces associated with the laminar flow around airfoils from scattered velocity measurements. The network can infer from field samples at different resolutions and is invariant to the order in which the measurements within each sample are presented. The results are compared to the performance of both shallow and deep conventional machine learning methods.

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