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**Machine learning based holography for flow diagnostics**[1] KEVIN MALLERY, SIYAO SHAO, JIARONG HONG, University of Minnesota, Twin Cities — Digital inline holographic particle tracking velocimetry (DIH-PTV) is a promising single camera technique for 3D flow diagnostics due to its low cost, compact setup, versatility, and improved performance as demonstrated in the recent work by Mallery & Hong [Optics Express 27(13), 18069-18084]. However, both measurement precision and processing speed remain challenges limiting the broad adoption of DIH-PTV. We present approaches utilizing machine learning to accomplish the particle localization task with both high accuracy and speeds comparable to commercial PIV software. Our approach avoids the need for experimental ground truth measurements by utilizing existing hologram simulation and processing methods to construct a training data set to train multiple convolutional neural networks (CNNs). Our algorithm addresses issues particular to holographic imaging through a novel unification of network elements (including UNET, SWISH activation, and TV loss). We demonstrate that this network can match the results of the best conventional DIH-PTV processing on experimental data and improve speed by a factor of 100. We further demonstrate that this method increases the tracer concentration limits of holography, improving the spatial resolution of measurements.

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