CS460 - Project

Machine Learning Based Digital Holographic Microscopy

Group – 12
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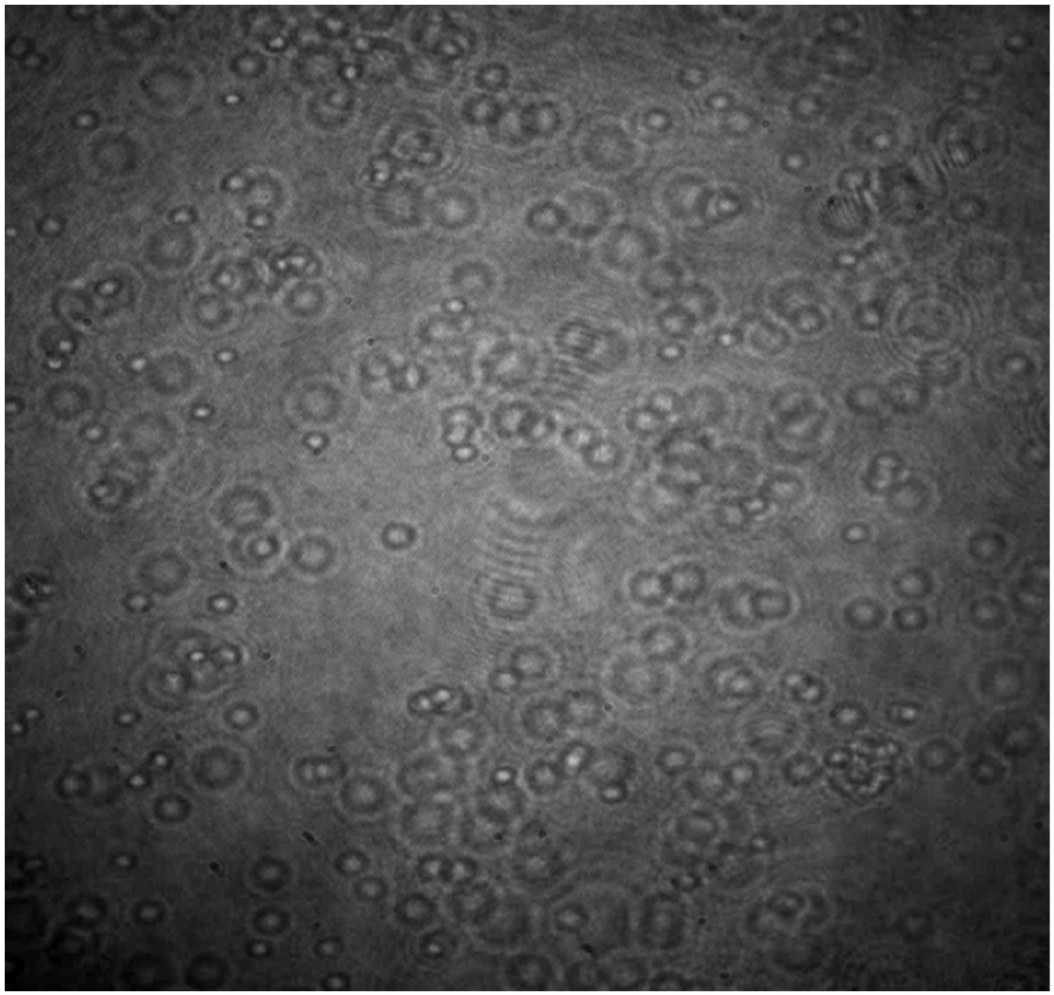
Idea : Using machine learning models to predict and track micro-particles in 3D in using the Digital Holographic Microscopy.

Targets achieved :

- ***Generated Synthetic data corresponding to experimental data***
- ***Studied and reproduced the existing works.***

Experimental Video:

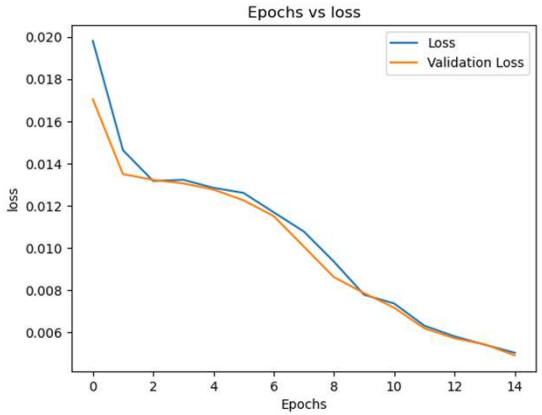


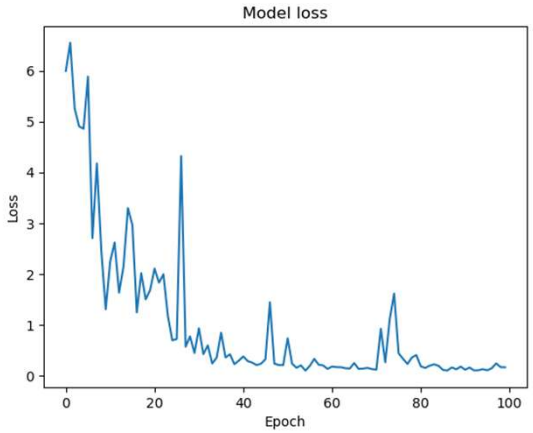
Reproduced Results:

Model used:

1. U-net
2. Localization and detection from Symmetries, Translations And Rotations (LodeSTAR)

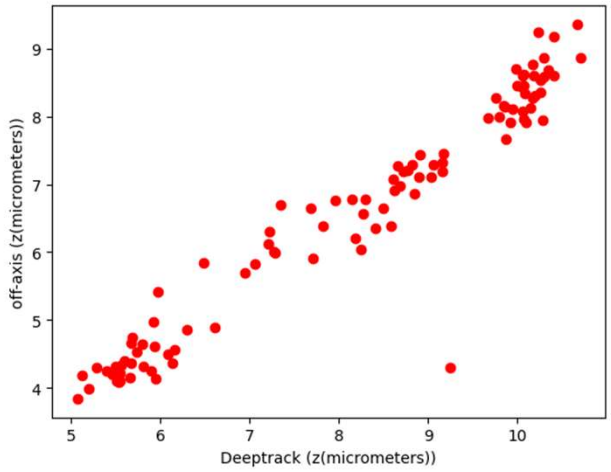
U-Net

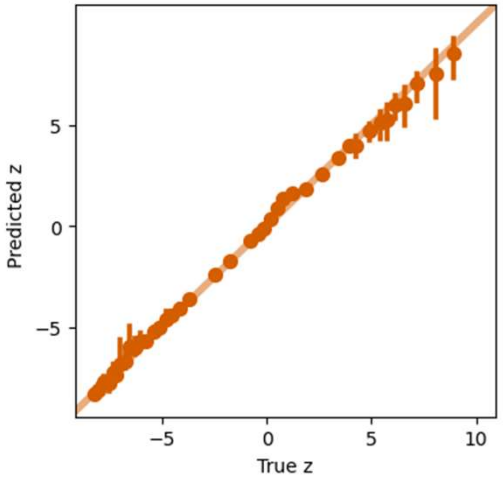




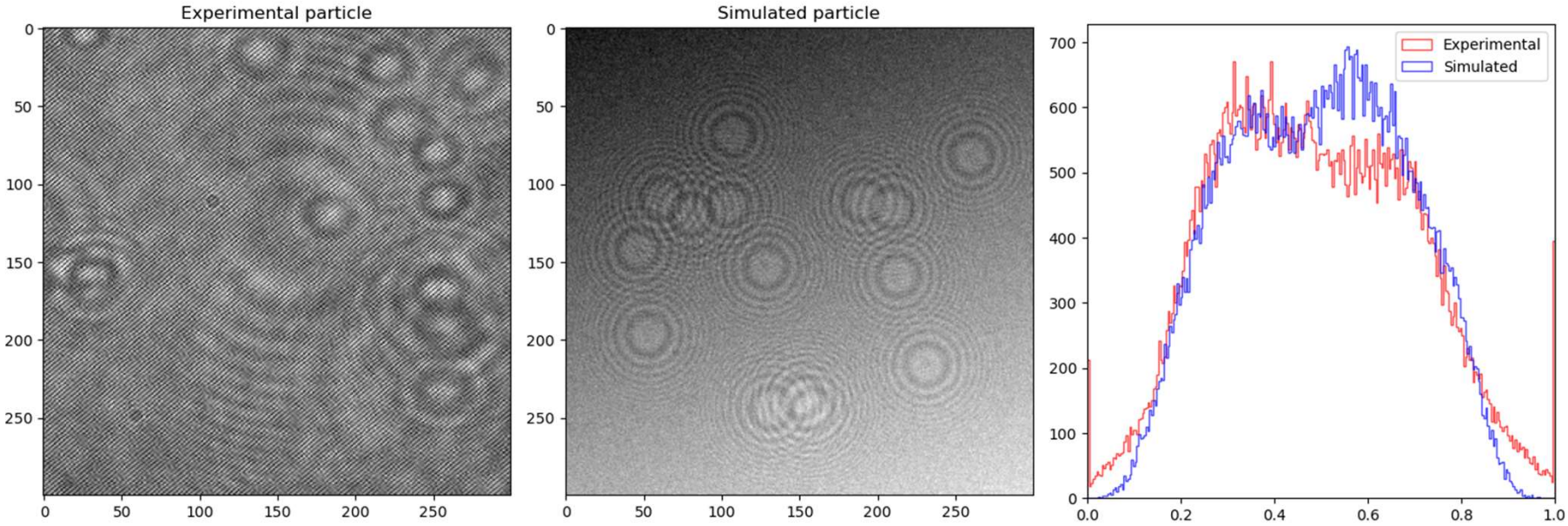
LodeSTAR

Values are predicted using existing Numerical Algorithms and Machine Learning.





Simulated Data -



Problems :

1. No. of Features in the U-Net (377)
2. Data Representation in LodeSTAR.

Main References:

- Benjamin Midtvedt, Saga Helgadottir, Aykut Argun, Jesús Pineda, Daniel Midtvedt, Giovanni Volpe. "***Quantitative Digital Microscopy with Deep Learning***." Applied Physics Reviews 8 (2021), 011310. https://doi.org/10.1063/5.0034891

- Ciraulo, B., Garcia-Guirado, J., de Miguel, I. *et al.* ***Long-range optofluidic control with plasmon heating***. *Nat. Commun.* **12**, 2001 (2021). https://doi.org/10.1038/s41467-021-22280-3

- Midtvedt, B., Pineda, J., Skärberg, F. *et al.* ***Single-shot self-supervised object detection in microscopy***. *Nat Commun* **13**, 7492 (2022). https://doi.org/10.1038/s41467-022-35004-y