# IMAGING RED BLOOD CELLS USING A PHASE EXTRACTION NEURAL NETWORK (PHENN)

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## ABSTRACT

Phase extraction neural network (PhENN) [1] is a deep learning architecture that can be used to recover an unknown phase object given the intensity measurement obtained some distance away. Here, we apply PhENN to image red blood cells (RBCs), which are almost transparent under visible light. Specifically, we build up an optical microscope and place a CMOS camera in a defocused plane to capture the diffracted intensity patterns. Moreover, we insert a spatial light modulator (SLM) right at the conjugate plane of the sample plane to generate training objects. We find that while PhENN is trained on examples drawn exclusively from the ImageNet [2] database, which consists of natural images, it performs well on recovering RBC samples. This result demonstrates the generalizability of PhENN, indicating that our version of PhENN has learned at the very least a generalizable mapping of low-level textures between the phase objects and their respective intensity images.

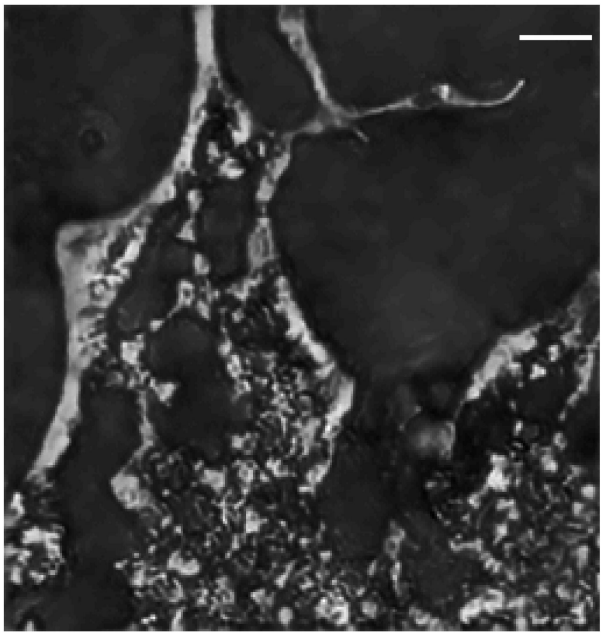

Figure 1: Recovered phase map of a RBC sample by PhENN. Scale bar :50um

**References:**

[1] Sinha, A., Lee, J., Li, S., & Barbastathis, G., "Lensless computational imaging through deep learning," *Optica*, 4(9), 1117-1125 (2017).

[2] Deng, J., Dong, W., Socher, R., Li, L. J., Li, K., & Fei-Fei, L. (2009, June), "ImageNet: A large-scale hierarchical image database," in *IEEE Conference on Computer Vision and Pattern Recognition*, 2009*, CVPR 2009*. (pp. 248-255). IEEE.