

## Extended Depth-Of-Field In Holographic Image Reconstruction Using Deep Learning-Based Auto-Focusing And Phase-Recovery

Tech ID: 30172 / UC Case 2018-674-0

### SUMMARY

UCLA researchers in the Department of Electrical Engineering have developed a novel deep learning-based algorithm that digitally reconstructs images from holography over an extended depth of field.

### BACKGROUND

Holographic imaging has many applications in the fields of engineering, research and medicine. A holography encodes the 3D information of a sample. However, it is time-consuming and cumbersome to digitally decode the original sample image from its hologram. This process requires auto-focusing and phase recovery, which are complex, computationally heavy and specific to the imaging set-up. This leads to limitations in the depth-of-field (DOF) in image reconstruction, which in turn limits the application of this imaging modality.

### INNOVATION

A novel convolutional neural network (CNN)-based approach was developed to digitally decode holograms. It simultaneously performs auto-focusing and phase recovery to significantly extend the DOF of holographic image reconstruction. This CNN was trained to quickly reconstruct an in-focus image of a sample over an extended DOF from a single input of back-propagated hologram of a 3D sample. It improves upon the algorithm time complexity of existing methods and is non-iterative. It can also be applied to other imaging modalities to extend their DOF.

### APPLICATIONS

- ▶ Digital holography
- ▶ Other imaging modalities such as florescence imaging

### ADVANTAGES

- ▶ Fast
- ▶ Non-iterative
- ▶ Extended DOF
- ▶ Widely applicable

### PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,514,325	11/29/2022	2018-674

### ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Automated Semen Analysis Using Holographic Imaging
- ▶ Low-Cost And Portable Uv Holographic Microscope For High-Contrast Protein Crystal Imaging
- ▶ Detection and Spatial Mapping of Mercury Contamination in Water Samples Using a Smart-Phone
- ▶ Computational Cytometer Based On Magnetically-Modulated Coherent Imaging And Deep Learning
- ▶ Lensfree Tomographic Imaging
- ▶ Single Molecule Imaging and Sizing of DNA on a Cell Phone
- ▶ Cross-Modality Deep Learning Brings Bright-Field Microscopy Contrast To Holography

### CONTACT

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### INVENTORS

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### OTHER INFORMATION

#### KEYWORDS

Digital holography, Pattern Recognition, Neural networks, Convolutional neural networks (CNN), Phase retrieval, Self-focusing

#### CATEGORIZED AS

- ▶ Imaging
  - ▶ 3D/Immersive
  - ▶ Software

#### RELATED CASES

2018-674-0

- ▶ [Microscopic Color Imaging And Calibration](#)
- ▶ [Quantification Of Plant Chlorophyll Content Using Google Glass](#)
- ▶ [Rapid, Portable And Cost-Effective Yeast Cell Viability And Concentration Analysis Using Lensfree On-Chip Microscopy And Machine Learning](#)
- ▶ [Holographic Opto-Fluidic Microscopy](#)
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