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
- 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
- Microscopic Color Imaging And Calibration

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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

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