



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 |

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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

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