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Depth from Coupled Optical Differentiation

Passive-light 3D sensor delivering longer range, higher accuracy depth maps with minimal computation.

Researchers at Purdue University have developed a low-computational, passive-lighting 3D sensing mechanism. This novel method can estimate object depth with a longer working range, better signal-to-noise ratio, and lower computational cost as compared to conventional depth-from-defocus (DfD) methods. DfD leverages spatial derivatives of images to estimate scene depths, rendering it highly sensitive to image noise, limited by depth range and accuracy, and dependent on texture and edge content. The approach developed at Purdue addresses these pitfalls by its ability to estimate the depth of objects with multiple shots by a single camera, with only 36 floating point operations per output pixel (FLOPOP). Moreover, the method can detect objects in at least double range compared with other methods and the computational algorithm can pair with a broad range of aperture codes, making this system a versatile option for combining with other artificial depth sensing systems.

Technology Validation:

Researchers built the first 3D sensor based on depth from coupled optical differentiation. The depth map generated by the sensor demonstrated more than twice the working range of previous DfD methods while using significantly lower computation.

Advantages

-More accurate depth maps

-Less computational power necessary

-Longer working range

-Better signal-to-noise ratio

-Good in low light situations

-Pairs well with broad range of aperture codes

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Category
Robotics & Automation/Perception & Sensing
Artificial Intelligence & Machine Learning/AI-Integrated Imaging Systems & Industrial Vision and Inspection

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View online

-Enables dynamic adjustments to the optical power and aperture radius

Applications

-Optical depth sensing of fixed images

-3D reconstruction

-Focus-based imaging

-Medical Imaging

1. Microscopy

2. Endoscopy

-Robotics & Automation

1. Object Detection

-Consumer Electronics

1. Smartphones & Cameras

-Remote Sensing & Drones

-Automotive & ADAS

Related Publications:

https://arxiv.org/abs/2409.10725

TRL: 4

Intellectual Property:

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Keywords: Low-computation 3D sensing,Depth estimation technology,Optical depth sensing,Computational imaging algorithms,Signal-to-noise optimized depth maps,Extended-range depth sensing,Depth-from-defocus alternative,AI-enhanced depth sensing,Medical 3D imaging,Robotics object detection,Consumer electronics imaging,Smartphone depth cameras,Autonomous vehicle sensing,Remote sensing for drones