Enabling Reflective & Refractive Depth Representation in Computer-Generated Holography

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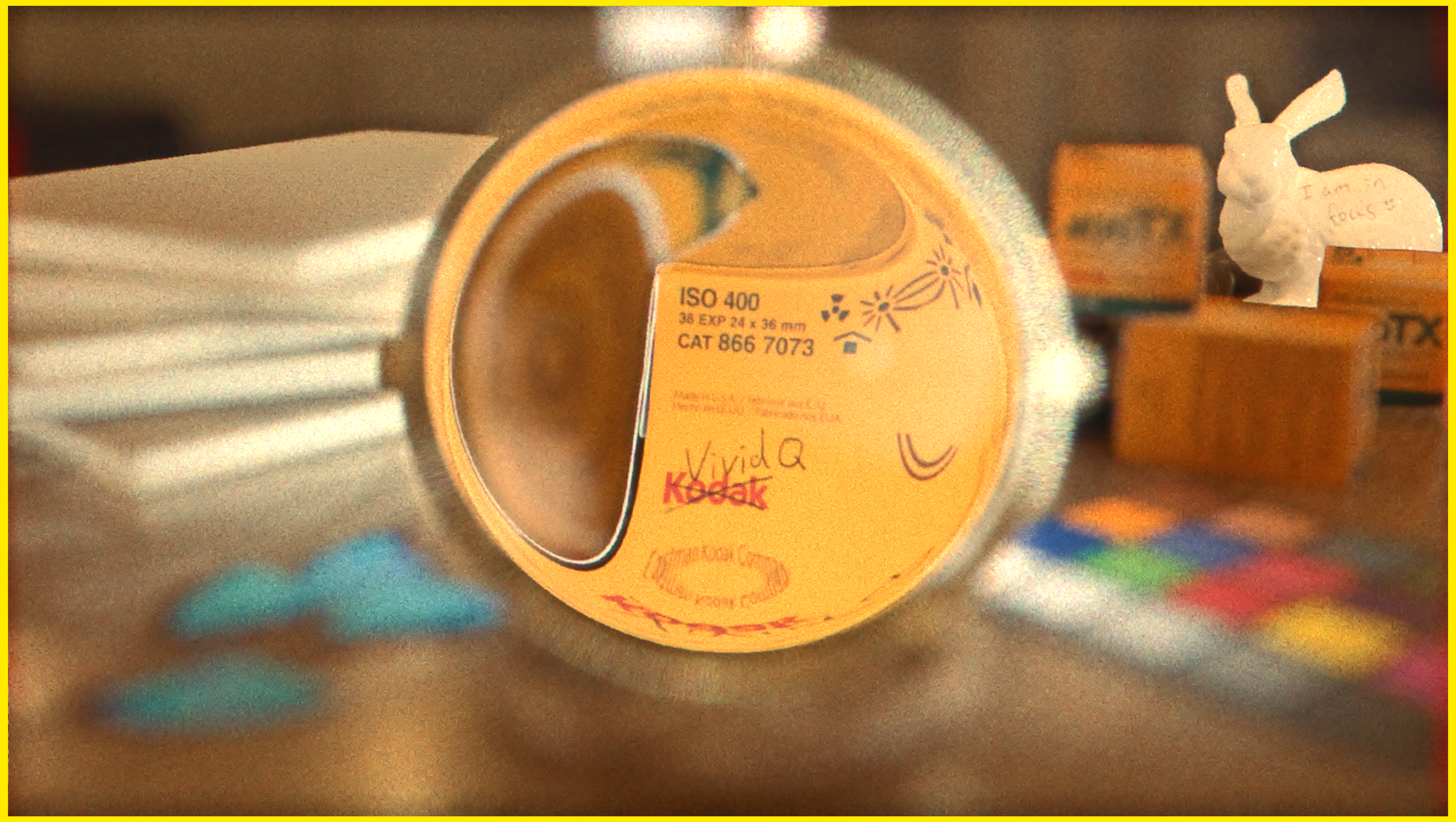
SIGGRAPH 2021

Holographic images with reflections and refractions can now be generated with physically correct focus using image renderers.



PROBLEM

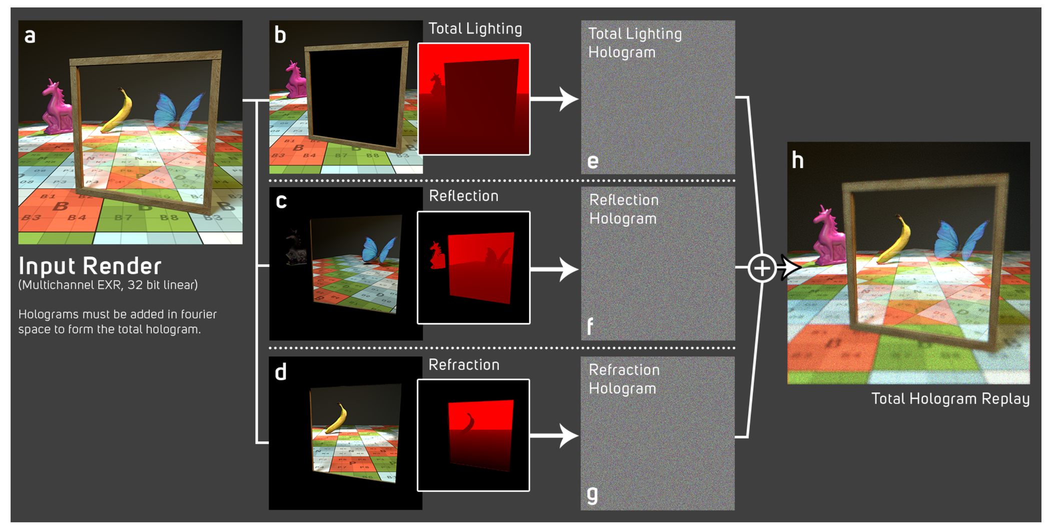
Holographic display allows for the realistic reconstruction of imagery in three dimensions, through the means of diffraction and interference of light, yet existing methods of image based holographic generation only utilise a single depth value per pixel.

A single depth value of the first hit geometry is not sufficient for realistically representing a scene, where materials will have reflective or refractive properties, and therefore multiple focal depths.

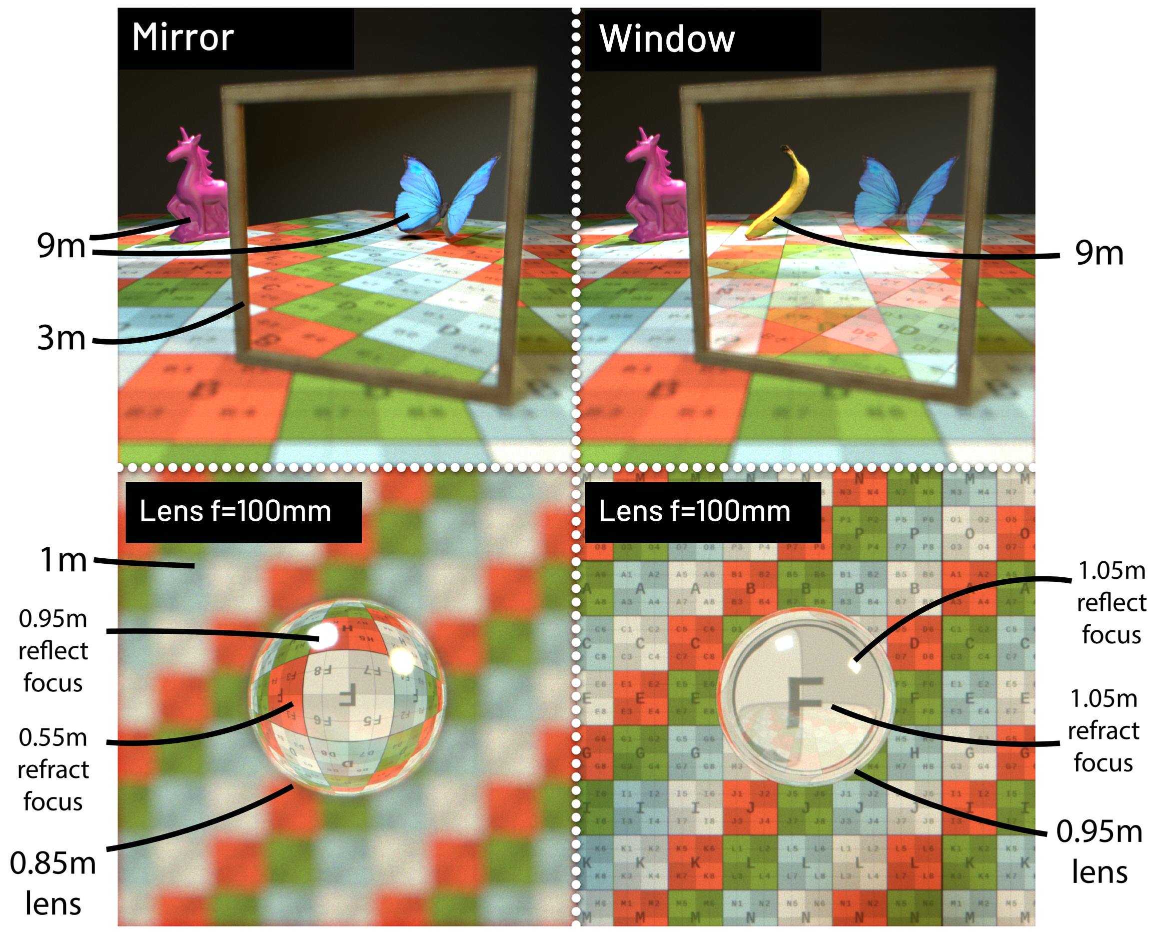
We introduce a method to allow for additional depth data for holographic image generation - allowing the viewer to correctly focus on, for example, objects in a mirror or through a window.

METHOD

By calculating the correct focus distance for separate render passes (such as reflections and refractions), we can gain the correct depth data required for realistic focus. Renderers may likely already store this value. We can then take each render pass and it's associated depth, and holographically composite them.



RESULTS



OUR APPROACH

Presents a novel method for allowing existing renderers to provide more data to a holographic generation engine for significantly more realistic holographic images.

Introduces the concept of holographic compositing - where render layers are first generated into holograms and then composited in fourier space to get back to the total image.

Can be utilised for both offline and realtime rendering, with applications for holographic display including AR/MR/VR, car HUDs and larger displays.

RELATED WORK

Image/layer based holography [1], allows the use of existing renderers to create images for holographic display, but this is typically RGBZ data as input, which is not sufficient for realism. Applications of holography include Extended Reality [2], Head-Up Displays, and larger display devices [3].

Recent work in holography, such as Peng et al. [4] and Shi et al. [5] has began utilising neural networks to decrease computational time, but has still only supported an RGB image with a single Z depth channel as input.

Our method differs in that we generate a hologram for each render pass (combined with their associated depth channels), such as total lighting, reflection, refraction, utilising numerous depth channels. Allowing physically correct depths in image based holograms for the first time.

REFERENCES

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[3] AN, J., WON, K., KIM, Y., et al. 2020. Slim-panel holographic video display. Nat Commun 11: 5568

[4] PENG, Y., SUYEON, C., PADMANABAN, N., et al. 2020. Neural Holography. SIGGRAPH '20: ACM SIGGRAPH 2020 Emerging Technologies, Article 8

[5] SHI, L., LI, B., KIM, C., et al. 2021. Towards real-time photorealistic 3D holography with deep neural networks. Nature 591: 234-239

ACKNOWLEDGEMENTS

This work has been supported by grant funding of the Centre for Digital Entertainment by the Engineering and Physical Sciences Research Council (EPSRC) with grant EP/L016540/1, and by VividQ Ltd.

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