Reaction Report XI:
DiffuserCam: Lensless Single-exposure 3D Imaging

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Identify one idea in the paper that you feel is a major contribution or a major limitation, explain it, and discuss why it is important

The author proposed a new method for reconstructing 3D scenes from normal 2D cameras without lenses by creating a caustic pattern to encode the 3D location of point sources, rather than projecting 3D world coordinates onto a 2D sensor. The author designed an optical system with a diffuser in front of the 2D sensor to achieve this. After calibration, during image capture, this allowed for the reconstruction of 3D voxels using compressed sensing. The ADMM algorithm was used in a forward convolutional model to solve the non-linear inverse problem with a sparsity prior. Besides the diffuser that can effectively create high spatial frequency caustics given any shifts or magnification, I believe the main contribution of this work is the dimension reduction technique, which includes cropped convolution in the forward model (not calculating H directly) and ADMM in the inverse calculation. This drastically reduces the solution spaces of the reconstruction; however, the resolution actually changes depending on the object complexity.

Describe one idea of yours that builds on the paper and expand on that idea as much as possible

In the experiments, the authors observed that the model would fail if multiple points were too close to each other, but increasing the separation could help the reconstruction by making the caustic patterns more distinguishable. I am thinking that it may be possible to place another diffuser right next to the original one. This could be designed to encode the 3D scene from another perspective, providing stereo information about the scene. However, adding another diffuser in such a narrow angle would require additional calibration and computation, as we would need to magnify the pixel response in wide angles of incidence. Nonetheless, this approach may be able to boost the reconstruction resolution even when the separation between points is small.