**15-463 Computational Photography (Fall 2023)**

**Assignment 6**

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**1. Implementing structured-light triangulation**

**[Per-frame shadow edge estimation & Per-pixel shadow time estimation]**

**A rainbow colored image of a map

Description automatically generated with medium confidence**

66th frame

A frog statue lying on a white surface

Description automatically generated

106th frame

**A frog statue lying on a floor

Description automatically generated**

**[Intrinsic and extrinsic calibration]**

**A screenshot of a computer

Description automatically generated**

**A graph with red and green lines

Description automatically generated**

**A graph with lines and numbers

Description automatically generated**

**A graph with red and green lines

Description automatically generated**

Green: horizontal, Red: vertical

There were some errors on 3D points projection, especially on the vertical plane. We expect that it’s because of calibration errors, which could be resolved through more accurate calibration using the dual-space geometry procedure in the original paper.

**[Reconstruction]**

A white object with numbers and lines

Description automatically generated with medium confidence

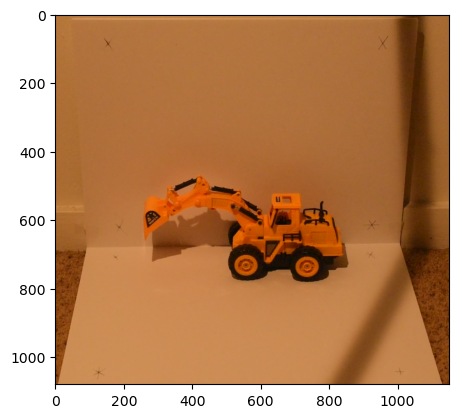
To improve our reconstruction, we set the boundary of ROI in our images only containing frog, filtered out points based on the Z-coordinate to slice out only frog.

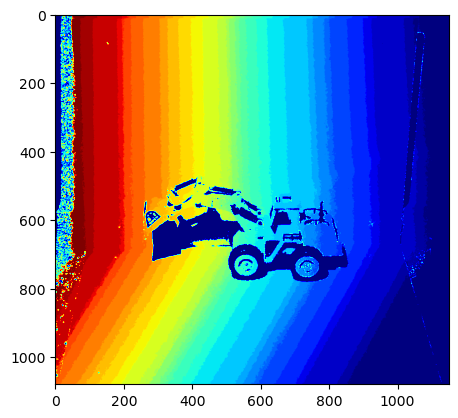
**2. Building your own 3D scanner (100 points)**

**A camera on a tripod next to a toy car

Description automatically generated**

**[Fork crane]**

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**A toy tractor on a white paper

Description automatically generated**

**A graph of a tractor

Description automatically generated with medium confidence**

**[Pill packer bottle]**

**A white bottle on a white surface

Description automatically generated**

**A rainbow colored object in a room

Description automatically generatedA white bottle on a white surface

Description automatically generated**

**A graph with lines and dots

Description automatically generatedA grid with a container in it

Description automatically generated with medium confidence**

To reduce the noise and improve the contrast of shadow’s edge, we applied bilateral filtering on the images. From the both objects, per-frame shadow edge, per-pixel shadow time estimation, and 3D points on shadow line were successfully computed with some errors. When the objects were 3D reconstructed, the results clearly showed that the object’s points are lied on the estimated 3D shadow plan, but also with its background. The first reason we expect is the Penumbra of shadow because of non-point light source, which led to the blurred and thick shadow.

A diagram of the solar system

Description automatically generated

The second reason could be the relatively small size of object in camera-projector distance scale. Because of that, shadow wasn’t bended much, which might led to estimate the background and object in the same depth.

**4 Bonus: Implement direct-indirect separation (100 points)**

A frog statue in a room

Description automatically generatedA frog statue lying on the floor

Description automatically generated

**A white bottle with a lid

Description automatically generated**

**A toy tractor with a bucket

Description automatically generatedA toy tractor and bulldozer

Description automatically generated**Instead of radiometric calibration with exposure stack, we simply applied sRGB linearization and performed direct-global separation. As a result, it produced quite satisfying results. We can see the specular reflection in direct component, otherwise subsurface scattering in global components.