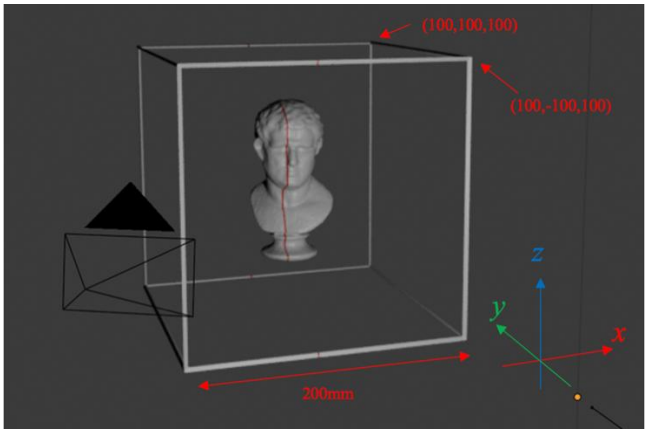
NTUST course: Computer Vision and Applications (CI5336701, 2024 Spring)

Midterm Project: Create 3D points from cast shadows on a 3D object

Date Due：2024. Apr. 19th, Friday, PM11:59 (~2.5 weeks)

Description

The midterm project is to simulate the scenario of 3D scanning device based on a known structure. In the virtual environment, there is one 3D object in a cubic frame which is 200 mm in width. We assume there is one parallel light (such as the sun) whose emitting direction is parallel to the side plane of this cube. The given images were rendering by insert one rod in front of the light. Therefore, the cast shadows will be the intersection of objects and a plane, which looks like the following figure:



1. Writing a program to retrieve the “red” shadows in all images, and try to recognize the shadows on the cubic frame. Based on this, it can be converted into a square as its actual shape in 3D space. From the perspective of a camera, we can observer the reflection shadow and convert the cast shadows on the 3D object to into a plane. By stacking all intersection profiles, 3D points of the shadows can be reconverted. (choose your tools, ex. python, C++/C, openCV, Matlab).
2. Regarding the position of each profile, you can estimate it by the relative position on the edge, and assign a reasonable Z value (which was actually *x* according to the above figure). You can do any assumption based on the known conditions, and finally please transform the coordinate by following the definition in figure (This is important to assist you for verification with ground truth). And, export your data as a list of XYZ values, then save as you_studentID.xzy. To browse the result and compare with the ground truth, you can import .xyz file and given stl file into “meshlab” software.
3. Deliverable: There are three types of data you should provide:
    1. Source code in python, Matlab, or C++/C etc. with simple comment: A program is able to import all images and output a .xyz (having correct size).
    2. Two-page report (in English) saved in PDF format: to describe how you solve it, and to compare yours with the ground truth (visually, snapshot of meshlab).

3. (Optional) Execution file (.exe) for this project, if written in C/C++, please compile into exe. For python / matlab user, you don't need to generate exe files. (Compulsory for C/C++, but Optional for python/matlab).

Please zip all your files, then, upload on moodle2 by due date.

4. Reference score

70%: Completeness: such as analyzing images and running out a 3D .xyz model.

30%: Correctness and performance: proof the accuracy, good understanding / strategy, quality organization, etc.

Hint:

Note:

1. The width of the wireframe is 3mm, if you care about the accuracy, the destination projection domain should be a bit smaller than 200 mm X 200 mm.
2. This midterm project will be 20% of final grade.

Vote the grade policy (proportion of each item)

Responses

Choice options	10%(PA)+30%(HW)+30%(MP)+30%(FP)	10%(PA)+40%(HW)+25%(MP)+25%(FP)	10%(PA)+35%(HW)+25%(MP)+30%(FP)	10%(PA)+50%(HW)+20%(MP)+20%(FP)	None of the above
Number of responses	1	8	1	20	1

3. This project was inspired by the paper entitled "A paintbrush laser range scanner." in *Computer Vision and Image Understanding* 101.2 (2006): 65-86.
4. For a project, there is no "standard answer". Please try your best to provide convincing solution / result based on your understanding.

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