SIDDHARTH RAINA

TEAM G

INDIVIDUAL LAB REPORT 03

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1.INDIVIDUAL CONTRIBUTION

1. COMPUTING THE GAIN AND OFFSET FIXED PATTERN NOISE PARAMETERS

As explained in the previous ILR, currently I am working on the sensor noise calibration for the cameras. The CMOS sensor of the camera has a response function has noise which needs to be calibrated. This noise is of two types:

1.Random Noise, which can be calibrated by acquiring a large number of images and overlapping them to cancel out the noise

2. Fixed Pattern Noise, which consists of two components, namely the gain for each pixel (each pixel responds to the same amount of illumination differently) and the offset (some charge gets stored in the CMOS sensor which outputs a non-zero pixel value for zero illumination)

FLAT-FIELD CORRECTION FOR FIXED PATTERN NOISE CALIBRATION

I used the flat field correction technique to compute the offset and gain parameters. This method involves taking multiple images from the camera sensor which is to be calibrated, which are:

1. DARK IMAGE: This is taken by closing the shutter of the camera and capturing the image.

Fig 1.1.1 Dark Image

2. WHITE IMAGE (FLAT FIELD IMAGE): This is taken by capturing the image of a uniform white, non-reflecting surface. (The noise pattern can be seen in this image).

Fig 1.1.2 White (Flat Field) Image

3. RAW IMAGE: This is the raw image of a scene captured with noise. (an example is shown below)

Fig 1.1.2 Raw Image

The Formula for flat field correction can be then applied as:

$$\frac{(R-B)\times m}{(F-B)}$$

Where,
R is the raw image
F is the flat field image
B is the dark image
and, m is the mean value of F-D
Here the Gain parameter would be m/(F-B) and the offset would be B*m/(F-B)

I am currently working on a MATLAB to compute the corrected image using the mean value of the difference between the dark and flat field image.

2. PHOTOMETRIC CALIBRATION

After correcting the fixed pattern noise, Mandy, Yiqing and I are working on the photometric calibration. We conducted a literature survey and are currently working on a code to compute the sensor response function, taking into account the irradiance image, vignette pattern and exposure time. For this, we collected high-quality images for different exposure values.

2.CHALLENGES

1. MEMORY REQUIREMENTS:

As the images captured are of very high quality, the MATLAB code for photometric calibration has very high memory requirements. For this, we are currently working on downsizing the images by a ratio which would be optimal for fast program execution and no significant loss of information.

3.TEAMWORK

Our team task distribution was divided as follows:

TEAM MEMBER	CONTRIBUTION
YIQING CAI	YIqing is working with me and Mandy on photometric calibration and the fixed pattern noise elimination algorithms.
HUAN-YANG CHANG	Peter is working on the robotic arm control with Sam.
MAN-NING CHEN	Apart from the photometric calibration part, Mandy created a code to eliminate the fixed pattern noise using median filtering (Flat field correction using the median value of F-B) (Please Refer. To the Flat Field Correction section above).
SAMBUDDHA SARKAR	Sam is working on controlling the Robotic Arm and motion planning of the arm.

4.FUTURE PLANS

I plan to complete the work on the code for photometric calibration. I am also working with Peter to start the geometric calibration for the cameras. Currently, our aim is to achieve the geometric and photometric calibration of a system of 2 cameras using the calibration target mounted on the Aerotech Robotic Arm for the fall validation experiment.