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TEAM G

INDIVIDUAL LAB REPORT

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1.INDIVIDUAL CONTRIBUTION

1.1. ACQUIRING IMAGES FROM MULTIPLE CAMERAS

I worked on the acquisition of images from the Emergent Vision Technologies HS12000N camera. I used the Emergent Vision Technologies API to write a code which could acquire images from multiple cameras and save it on the hard drive. The calibration algorithm can then be applied to these images in order to calibrate multiple cameras from a set of images. Currently, the code can trigger the cameras using the Emergent Vision Technologies software interface and store the images for different values of exposure.

Fig. 1.1 Image of the Camera Used

1.2. NOISE CALIBRATION

The first step of calibrating the multi-sensor capture system involves calibrating the noise on the CMOS sensor. The nature of this noise can either be

1. Random noise
2. Fixed Pattern Noise

1. Random Noise:

The random noise due to the CMOS sensor can be calibrated by acquiring a large number of images which would overlap and cancel the random noise.

2.Fixed Pattern Noise

The fixed pattern noise is due to 2 factors:

1. **Dark Signal Non Uniformity (DSNU):**
   If the camera captures images in the absence of light, ideally each pixel must have zero intensity. However, some pixels can still show a positive intensity value. This intensity value must be subtracted from the values shown by the pixel to eliminate the dark signal non-uniformity. This can be represented as β.

2. **Photo Response Non Uniformity (PRNU):**
   This describes the ratio of the intensity of light falling on the pixel to the output given by the sensor. This can be also interpreted as the gain of the pixel, represented by α.

The observed pixel value (y) can be related to the true value and the actual parameters by

$$Y = \alpha X + \beta.$$

For calibrating the noise, I am currently using video files to extract multiple frames of a given scene. I am implementing a method to calibrate the fixed pattern noise in both MATLAB and OpenCV.

2.CHALLENGES

2.1. MULTIPLE CAMERA IMAGE ACQUISITION

One of the problems encountered was with the code used to make multiple cameras trigger together and take pictures. Initially, there were several bugs in the code, which were not allowing multiple cameras to operate together. These were resolved by using the proper API codes to close the cameras by using explicit API commands.

2.2. CORNER DETECTION ALGORITHM NOT WORKING

One problem which the team is encountering is that the images being captured are of very high resolution and the corner detection algorithm is unable to work on the image. This is required to compute the fixed pattern noise coefficients. However, we do not want to reduce the resolution of the image, as the calibration requirements are very tight and require a high-quality image. We are still working on the solution to this problem.

3.TEAMWORK

Our team task distribution was divided as follows:

TEAM MEMBER	CONTRIBUTION
YIQING CAI	IMAGE ACQUISITION AND NOISE CALIBRATION
HUAN-YANG CHANG	AEROTECH ARM CONTROL AND CALIBRATION TARGET DESIGN
MAN-NING CHEN	IMAGE ACQUISITION AND NOISE CALIBRATION
SAMBUDDHA SARKAR	AEROTECH ARM CONTROL
SIDDHARTH RAINA	IMAGE ACQUISITION AND NOISE CALIBRATION

4.FUTURE PLANS

After the team is able to control the AEROTECH arm, we plan to acquire images of the calibration target using a hardware trigger (currently, we are triggering cameras using the Emergent Vision Technologies software). The arm would move the calibration target in the X, Y and Z directions and trigger the cameras to capture the images. These images captured at multiple positions would be used to calibrate multiple cameras capturing the images of the target.