ECEN 631 – Robotic Vision

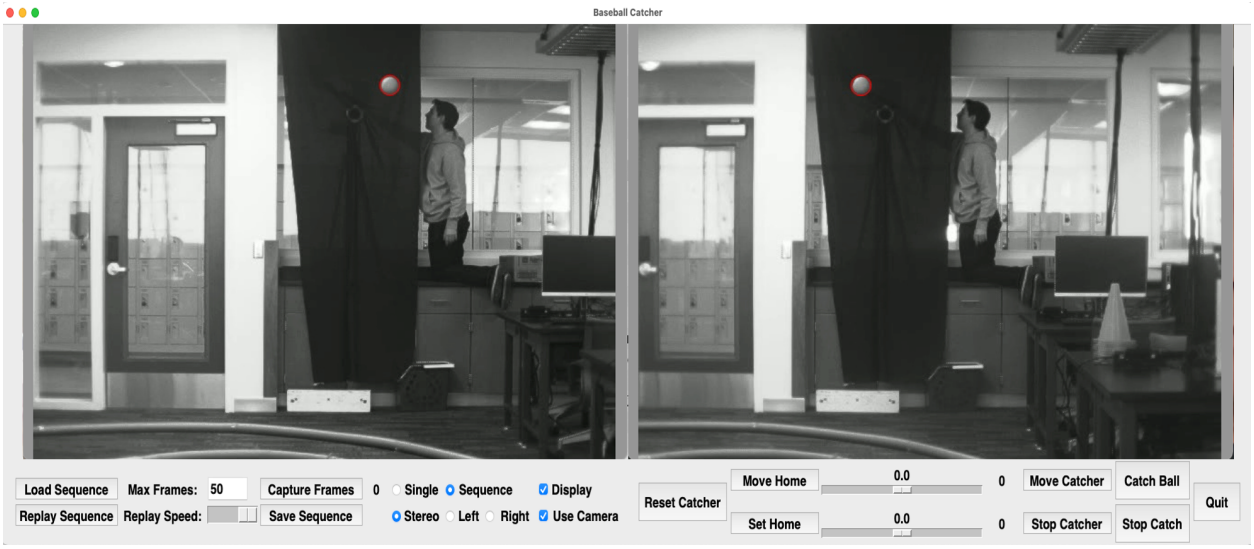
Baseball Catcher User Guide

February 12, 2022

This Python program (BaseballCatcher.py) has been developed for capturing image sequences for the Stereo Calibration and 3D Trajectory Estimation homework assignments and for Baseball Catcher team project. The two homework assignments are designed to help complete the Baseball Catcher team project.

This program can be configured to run with your own webcam or two FLIR Flea2 cameras. It can also run with the catcher machine in the lab or without it. You can download a copy of this program from Learning Suite to run it on your computer to get familiar with the image capturing functions. You will need to install all required packages on your computer.

Set WEBCAM = 1 to use your own webcam (input from one camera will be displayed in both windows) and WEBCAM = 0 to use the FLIR Flea2 cameras. Keep CATCHER = 0 when you capture image sequences. Only set CATCHER= 1 when you are ready to use the catcher.



Folder Structure and Naming of Image Frames:

- A folder named /yyyymmddhhmmss will be created automatically each time you save an image sequence.
- Two subfolders (/L and /R) will also be created.
- Images from the left camera will be stored as #.png files in the /L folder
- Images from the right camera will be stored as #.png files in the /R folder

Camera and Display:

- Check the “Use Camera” box to allow the cameras to acquire live images.
- Check the “Display” box to display live images from the cameras.

Load and Replay an Image Sequence:

- Click "Load Sequence" to show a window with the program directory to allow you to select one of the /yyyymmddhhmmss image folders (not the /L or /R subfolder) you want to load into the buffers. You need to click and open the image folder if running in Linux. You only need to choose the image folder (without opening it) if running in Mac OS.
- Click "Replay Sequence" to replay the loaded sequences if both left and right sequences are available. Otherwise, the left or right sequence that is available will be shown in both windows.
- Replay speed can be changed by dragging the slider bar left or right. The default position (right) is the fastest replay speed. Dragging it to the left will slow down replay for you to examine the images sequence.
- Replay can be performed repeatedly once the image sequences are loaded or captured into the buffers.

Capture and Save an Image Sequence:

- Set the maximum number of frames (default 50) you want to load, replay, capture, and save.
- Select "Single" to acquire one image frame at a time. This function is used for acquiring images for camera or stereo calibration.
- Select "Sequence" to acquire a sequence of the specified number of images. This is used for acquiring baseball image sequences.
- If "Single" is selected, every click of the "Capture Frames" button will acquire one pair of left and right images into the buffers. Once the specified number of image pairs are acquired a window will open to confirm whether to keep the sequence.
- After the images are captured into the buffers, select "Left" to save only the left image sequence, "Right" to save only the right image sequence, or "Stereo" to save both. Click "Save Sequence" to save the image sequence(s).
- A number displayed to the right of the "Capture Frames" button indicates which frame is being captured or replayed.

Catcher Operation:

- Click "Reset Catcher" when the motor controller is not responding correctly.
- Click "Move Home" to move the catcher to its X and Y home positions when power up the catcher system. The catcher will move and stop at the left and down positions. You may need to help and push it left and down to reach the home positions. Homing only needs to be done after power up or when the catcher does not move to the desired position.
- Click "Set Home" to set the encoder home positions. This must ONLY be done after the motors reach the home positions.
- The catcher is limited to move between +/-9" horizontally and +/-8" vertically.
- Slide the Horizontal (top) slider to set the X position and the Vertical (bottom) slider to set the Y position. Click "Move Catcher" to move and test the catcher.
- Click "Stop Catcher" to stop and release the motors to prevent overheating the motors.
- Uncheck "Display" before trying to catch the baseball so the system can capture images as fast as the camera framerate allows.

- Click “Catch Ball” when you are ready to have some fun.
- Click “Stop Catch” to stop and release the motors to prevent overheating the motors and return the catcher to its default state.

Using the Baseball Catcher System:

- Login the lab machine that is connected to the catcher with your CAEDM account.
- Download a copy of the whole Baseball Catcher package into your J-Drive.
- Make sure the catcher power supply is turned on and the computer is connected to the catcher through a serial cord.
- Run the BaseballCapture.py program on the lab machine (use python3 because other classes are using python2)

  $ python3 BaseballCapture.py.
- Fill in the blanks in the thread handler called `def process(self)` in BaseballCatcher.py to detect and track the baseball, calculate ball trajectory and catch it.
- Ideally, you can send as many Move commands as fast as you want, but python itself can get clogged sometimes using the serial command too fast. Also, DO NOT send dramatically different move commands, the internal PID control can sometimes slam the catcher arm against the catcher's frame.

Using the Catcher Hardware:

- The Catcher motors are very powerful. Keep a safe distance and do not touch the frame while the Catcher is in operation.
- Two Firewire cables are connected to the computer. Do not move the computer. Moving the computer could damage the Firewire connectors.
- The stereo system has been adjusted to be very close to canonical configuration. DO NOT touch the camera lenses or the camera mounting fixture.
- There are two limit switches for each axis to cut off the motor power when the catcher reaches the catcher frame. When this happens, you must click “Stop Catcher” or “Stop Catch” to release the motors and push and release the catcher from dead stop.
- DO NOT remove the metal case that protects the electronics.
- DO NOT move the catcher frame. It is aligned to the baseball pitching machine and the stereo vision system.
- Motor parameters are stored in the memory of the motor controller board. You may (and only) have to reset the motor controller board by clicking the “Reset Catcher” button if the catcher does not work properly.
- In case the motor stalls, shutdown the power supply to release the motors to avoid overheating the motors.
- You only need to home the catcher once at the beginning of your work period. To avoid the wear and tear of the machine or accidently damaging the catcher hardware, you should only do homing when the catcher does not return to the center.