ADI CCD ToF Calibration – Physical Setup

Version	Edited By	Comments
V1.0	Harsh Bhatia	Initial

CONTENTS

INTRODUCTION

This document is a guideline for the physical set up for calibrating ADI ToF modules. Please read the entire document before starting assembly.

Use the diagrams as guidelines assemble the different components of the set up. Read the notes for detailed instructions for installation

The BOM contains all the parts necessary for each assembly. Hardware such as screws and washers come with specs.

This document should come with a zipfile with supplementary files.

**

Final setups must be in an environment without external IR illumination.

ASSEMBLIES

This section contains all the assemblies required for the final calibration set up.

CAMERA BASE ASSEMBLY

BOM

Part Name	Manufacturer	Part Number	Quantity
Optical Breadboard 6x6x1/2	THORLABS	MB6	1
TRA Series Post 6.0”	THORLABS	TRA6	2
¼ - 20 Stainless Steel Set Screw 3/4	THORLABS	SS25S075	2
¼ - 20 to #8-32 Threaded Adapter	THORLABS	AI25E8E	2
¼-20 Screw 20mm			2
M4 Thumbscrew			1
Camera Holder	Custom (Check 3D Model Files)	.step	1

ASSEMBLY

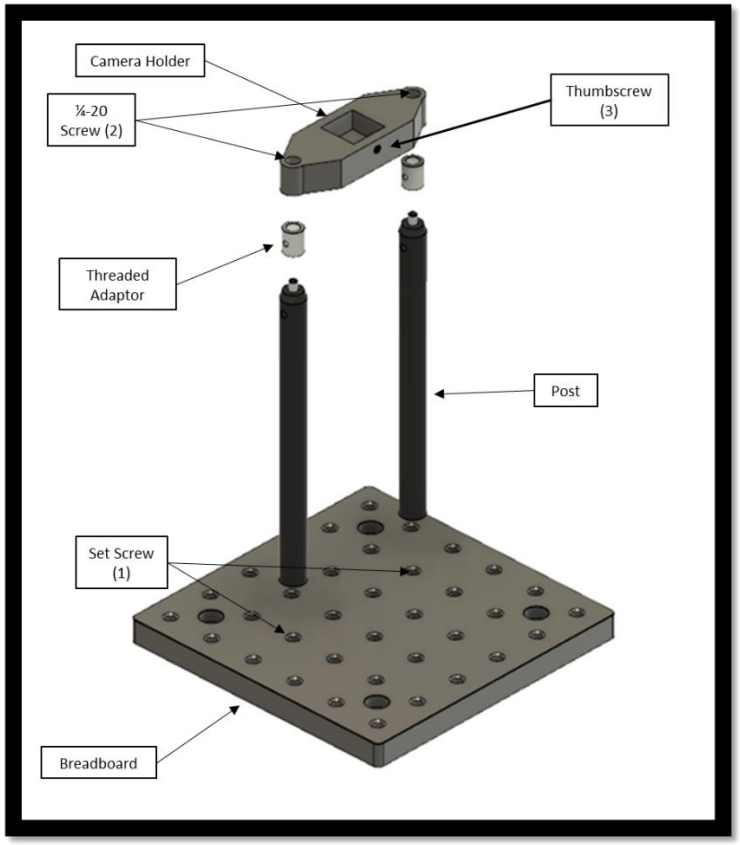

Figure 1

NOTES

1) Use a setscrew to screw the post to the optical breadboard. Use the holes where the arrows are pointing.
2) The ¼-20 screws are used to join the camera holder to the threaded adaptor.
3) The thumbscrew is used to make sure the camera base firmly in location before calibration.

TARGET ASSEMBLY

BOM

Part Name	Manufacturer	Part Number	Quantity
Optical Breadboard 6x6x1/2	THORLABS	MB6	1
Framing Extrusion T-Slotted, 10 Series – 500mm long	80/20	1010-BLACK-72	2
Joining Plate 10 Series	80/20	4108-BLACK	4
BHSCS & T-Nut, For 10S	80/20	3393-15	4
1/4 - 20 washers <1mm thick			4
¼-20 Screw 15mm			4
Elmers White Foam Board 20" x 30" - 3/8" thick			1
Double sided tape <1mm thick			

ASSEMBLY

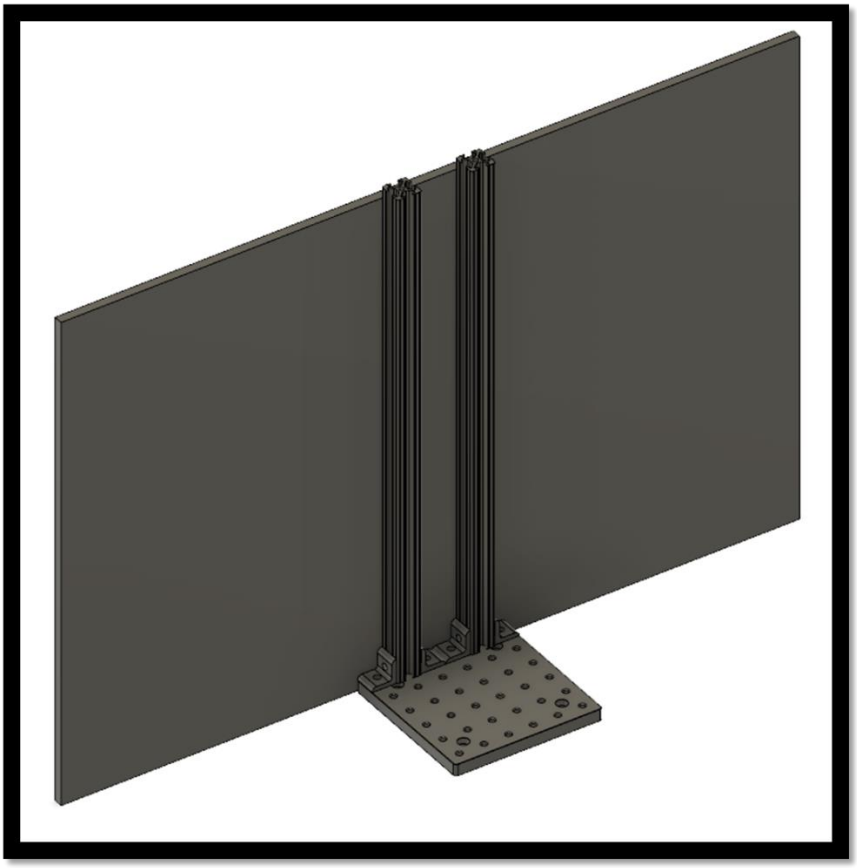

Figure 2

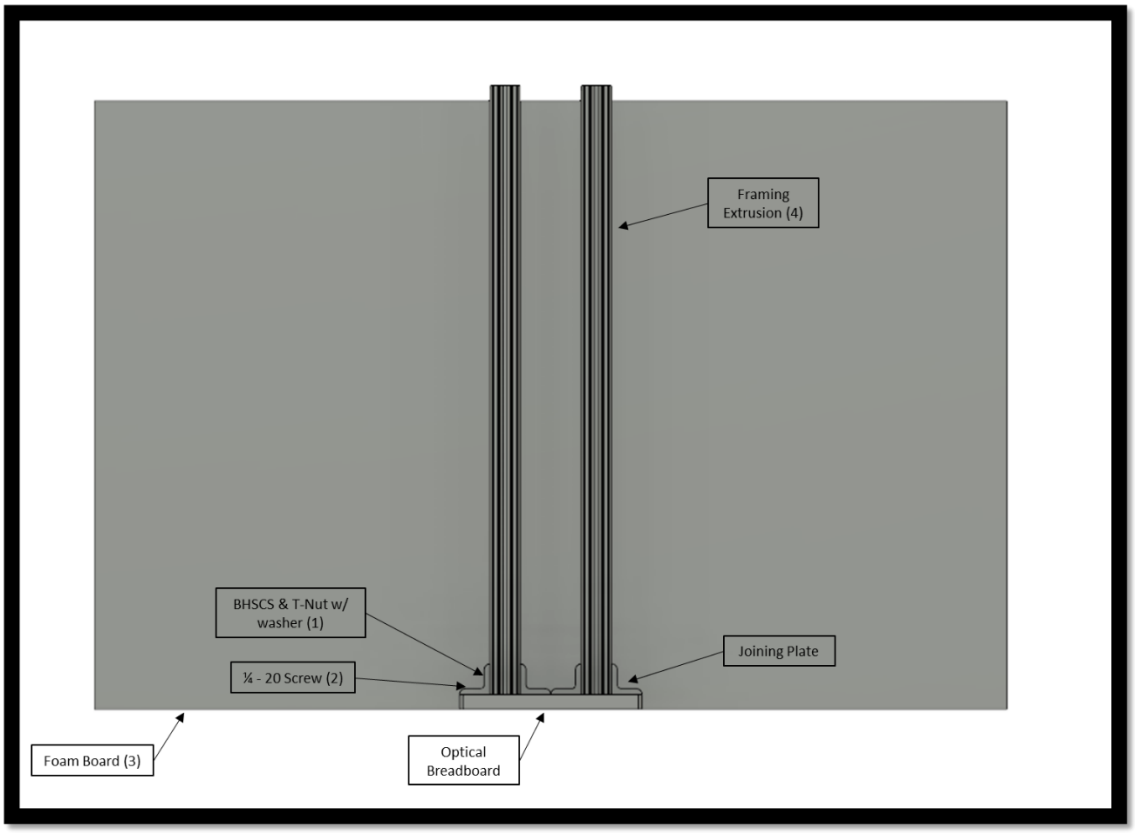

Figure 3

NOTES

1) The Button head screw and t-nut combo is used to attach the joining plate to the framing extrusion. Insert the t-nut into the t-slot of the extrusion then screw joining plate to the t-nut with a washer.
2) The ¼-20 screw is used to attach the other side of the joining plate to the optical breadboard
3) The foam board is attached to the framing extrusions using double sided tape. Run the tape down the entire length of both extrusion for maximum stability
4) When attaching the framing extrusion to the breadboard it is important that the extrusion end is entirely in contact with the breadboard, therefore the extrusion must be perfectly perpendicular to the breadboard. Recommended assembly order:
    a. Attach the joining plates to the breadboard
    b. Screw the T-nuts to the joining plate
    c. Slide the framing extrusion between the joining plates and tighten t-nut screws

LINEAR CALIBRATION ASSEMBLY MID AND NEAR MODE

The linear calibration assembly is required for calibrations that require the target to be less than ~800mm. The following diagram is an example for mid mode calibration assembly. Please follow install the target at the provided target locations for each mode.

BOM

Part Name	Manufacturer	Part Number	Quantity
Optical Breadboard 12”x36”x1/2	THORLABS	MB1236	1
Framing Extrusion T-Slotted, 10 Series – 508mm long	80/20	1010-BLACK	2
Joining Plate 10 Series	80/20	1010-BLACK	4
TRA Series Post 6.0”	THORLABS	TRA6	2
¼ - 20 Stainless Steel Set Screw 3/4	THORLABS	SS25S075	2
¼ - 20 to #8-32 Threaded Adapter	THORLABS	AI25E8E	2
M4 Thumbscrew			1
Camera Holder	Custom (zipfile)	cam_base.step	1
BHSCS & T-Nut, For 10S	80/20	3393-15	4
1/4 - 20 washers 1mm thick			4
¼-20 Screw 15mm			4
¼-20 Screw 20mm			2
Elmers White Foam Board 135mmx190mm - 3/8” thick	Elmers		1
Double sided tape <1mm thick			

ASSEMBLY

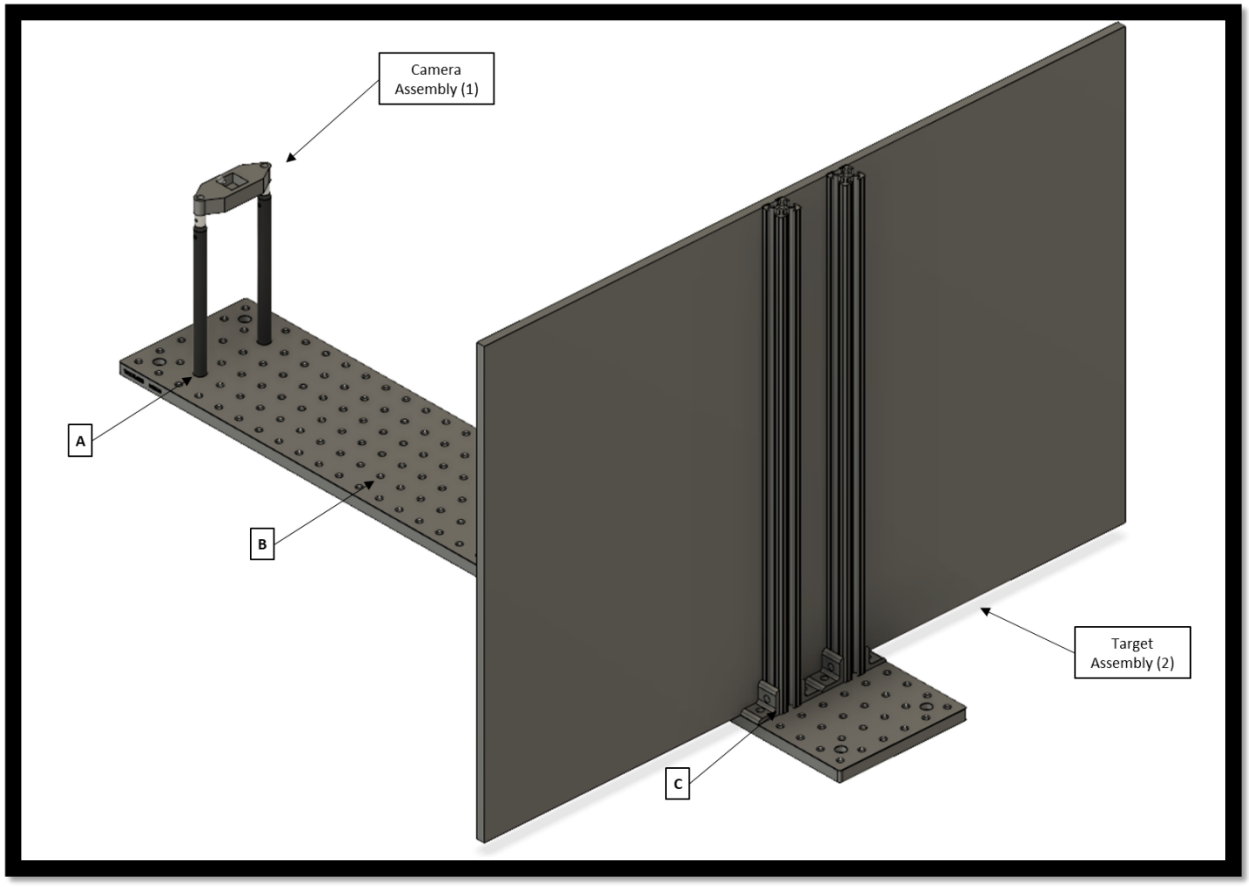

Figure 4

NOTES

1) Refer to camera assembly section for correct installation. Posts must be located at location A.
2) Refer to target assembly section for correct installation.
    a. Framing extrusions must be located at:
        i. location B for near mode station
        ii. location C for mid mode station

LINEAR CALIBRATION ASSEMBLY FAR MODE

BOM

Part Name	Manufacturer	Part Number	Quantity
Camera Base Assembly			1
Target Assembly			1
M6 Bolts			8

ASSEMBLY

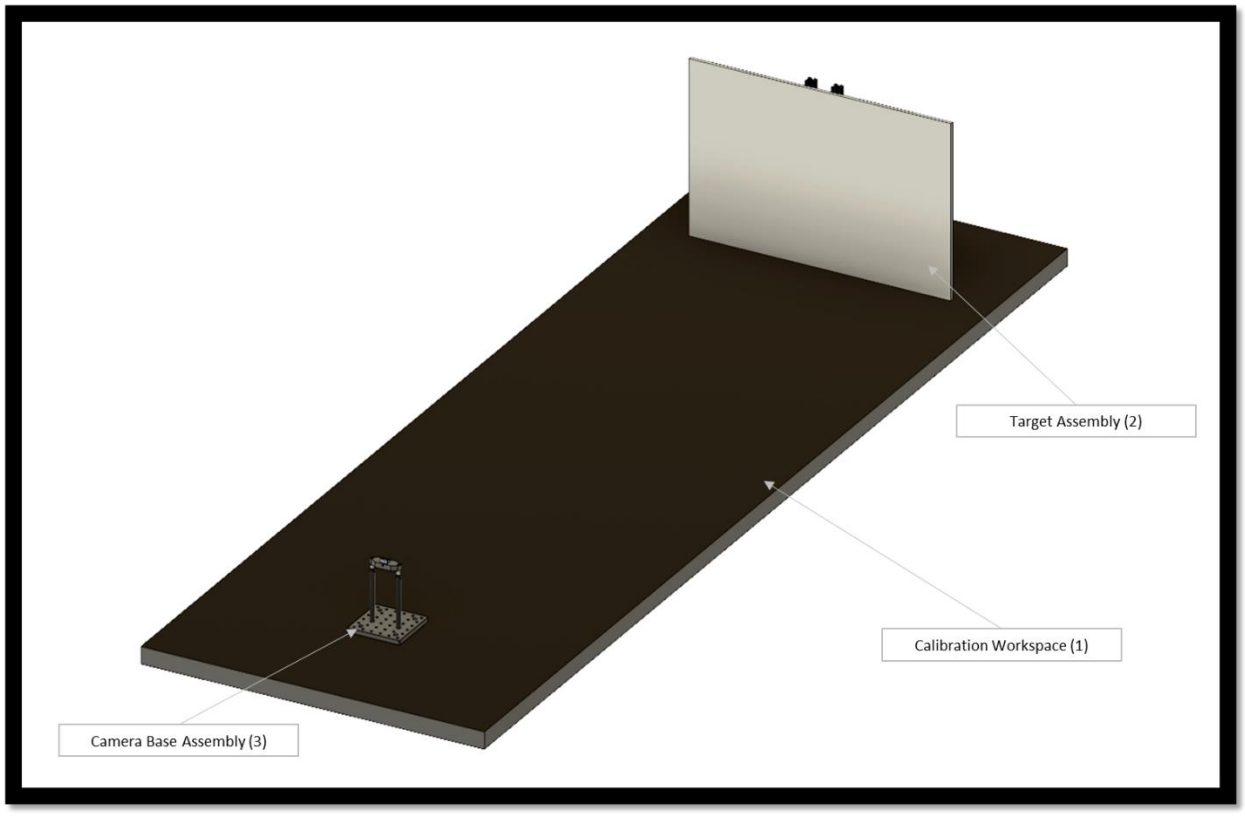

Figure 5

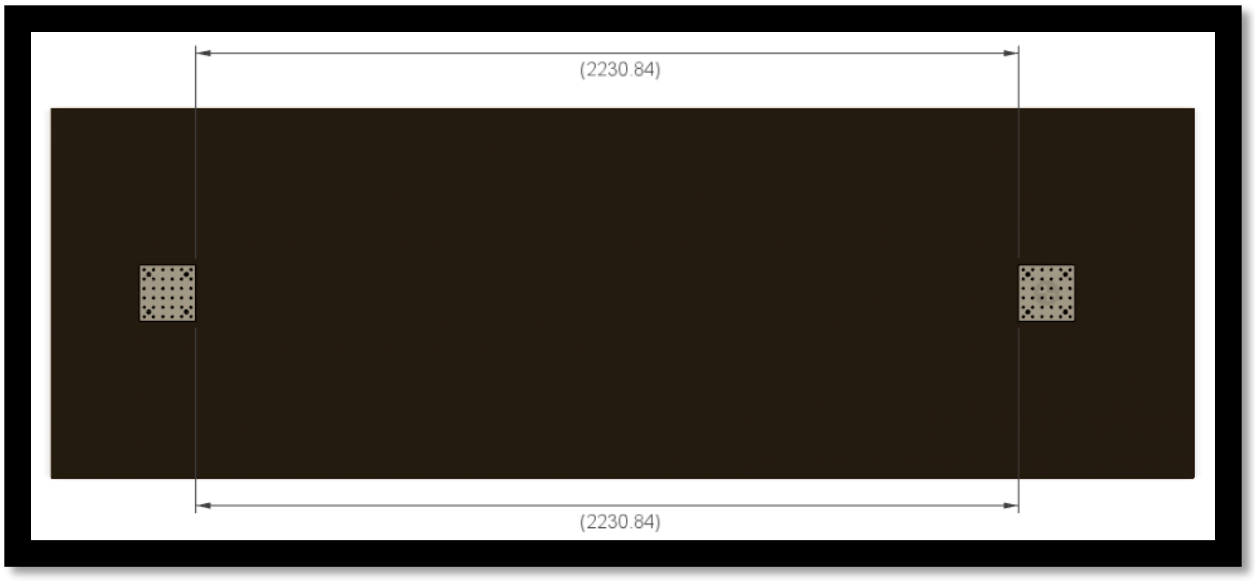

Figure 6

NOTES

1) The optical breadboards of the target, and camera base assembly **MUST** be secured to the calibration workspace. Using the recessed holes on the bread boards it is possible to bolt down them down. As shown Figure 6, verify both corners of the breadboards at the correct location. Installation procedure:
    a. Cover the workspace with black foil
    b. Bolt down breadboards
2) Refer to camera assembly section for correct installation. Posts must be located at location A.
3) Refer to target assembly section for correct installation.

INTRINSIC ASSEMBLY

BOM

Part Name	Manufacturer	Part Number	Quantity
Optical Breadboard 12”x24”x1/2	THORLABS	MB1224	1
Framing Extrusion T-Slotted, 10 Series – 275mm long	80/20	1010-BLACK	2
Framing Extrusion T-Slotted, 10 Series – 152.4mm long	80/20	1010-BLACK	2
Framing Extrusion T-Slotted, 10 Series 1020– 135mm long	80/20	1010-BLACK	2
Framing Extrusion T-Slotted, 10 Series 1020– 190mm long	80/20	1010-BLACK	2
Joining Plate 10 Series	80/20	4108-BLACK	2
Inside Corner Bracket 4 Hole	80/20	4115	6
Universal Pivot, For 10S	80/20	4195	4
TRA Series Post 6.0”	THORLABS	TRA6	2
¼ - 20 Stainless Steel Set Screw 3/4	THORLABS	SS25S075	2
¼ - 20 to #8-32 Threaded Adapter	THORLABS	AI25E8E	2
M4 Thumbscrew			1
Camera Holder	Custom (Check 3D Model Files)	.step	1
BHSCS & T-Nut, For 10S	80/20	3393-15	36
1/4 - 20 washers 1mm thick			4
¼-20 Screw 15mm			10
¼-20 Screw 20mm			2
Elmers White Foam Board 135mmx190mm - 3/8” thick	Elmers		5
Double sided tape <1mm thick			
X-Acto knife			1

ASSEMBLY

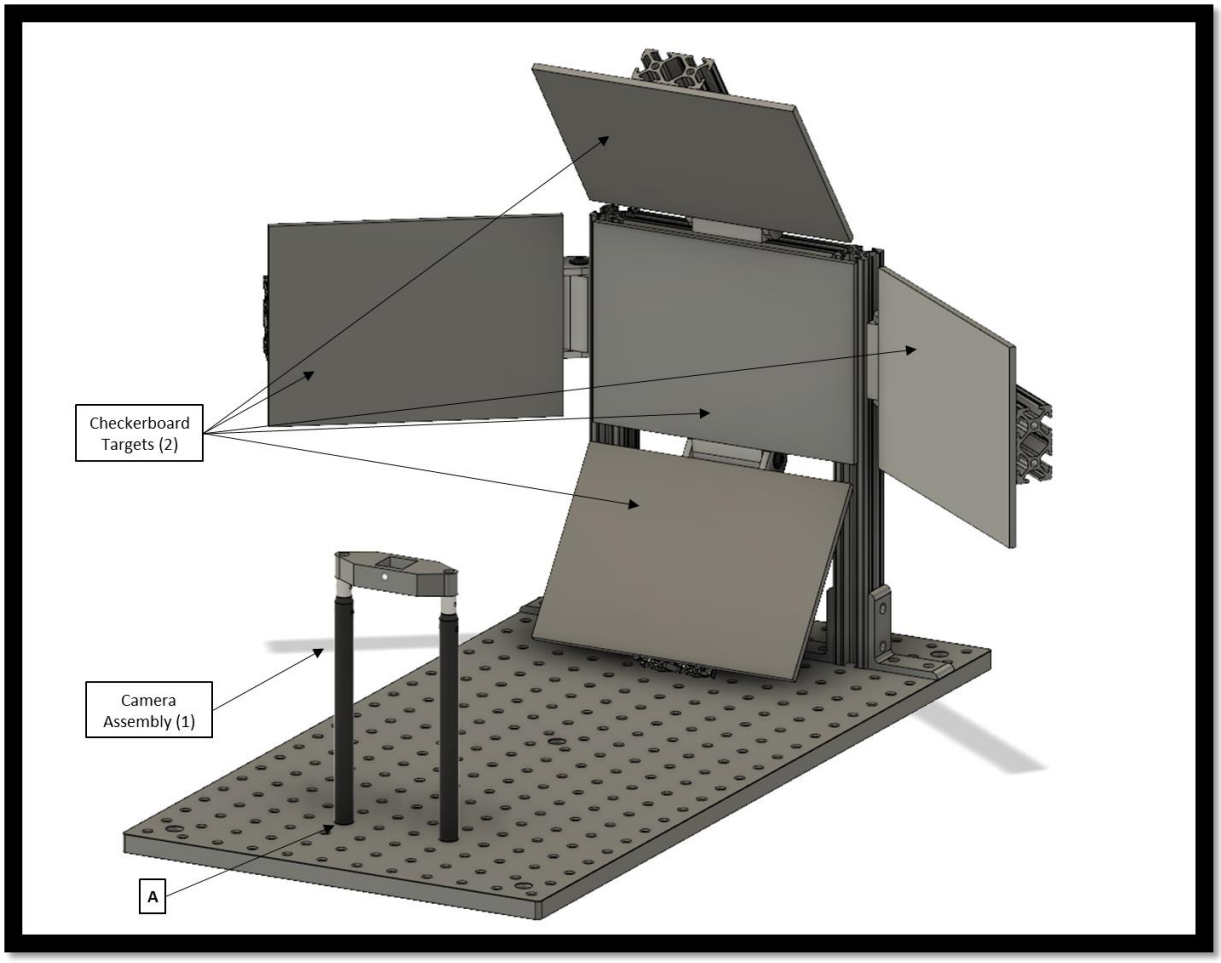

Figure 7

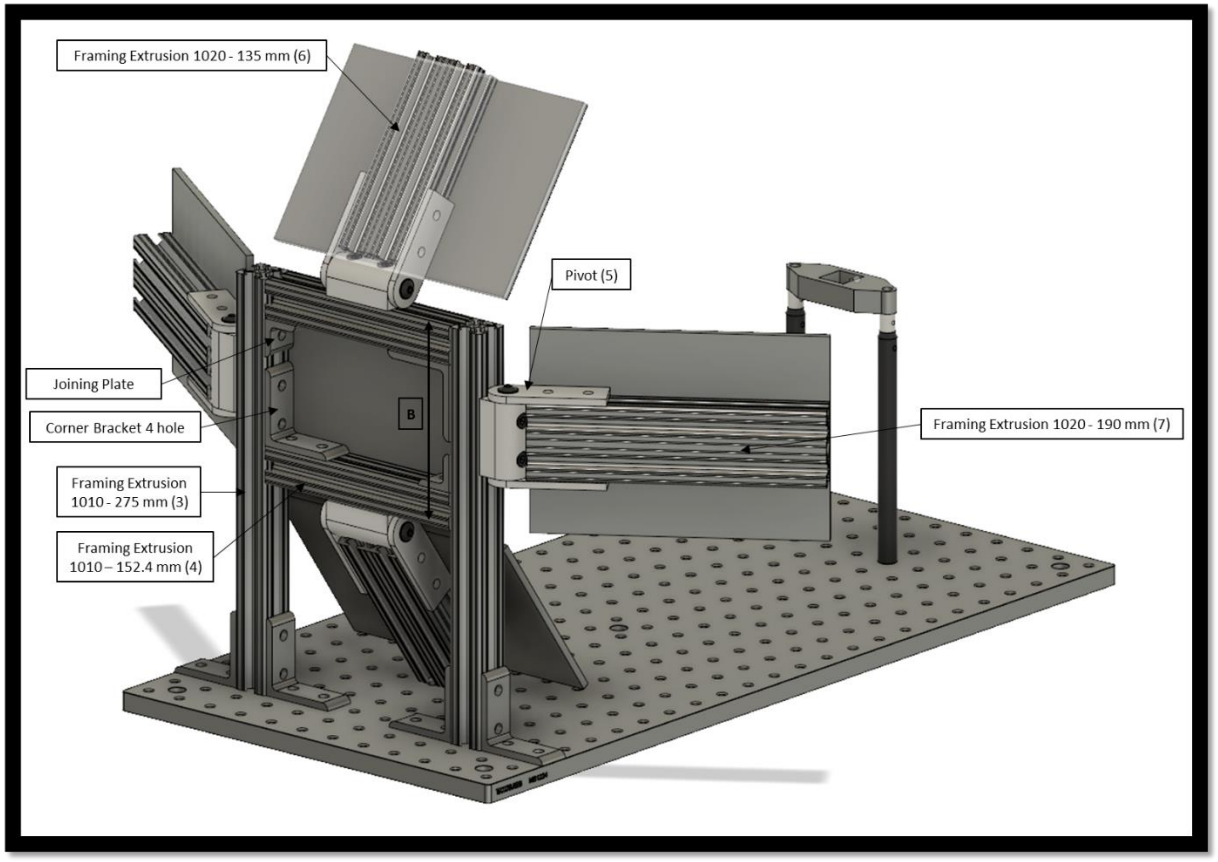

Figure 8

NOTES

1) Refer to camera assembly section for correct installation. Posts must be located at location A.
2) To create checkerboard targets:
    a. Cut Elmers Foam board to 5 pieces (135mmx190mm) using X-Acto knife
        i. Board sections must be straight, with no major damage
    b. Print 5 checkerboard.png, and cut out extra white borders
    c. Stick one checkerboard flat onto each foam board
        i. To guarantee flatness it is recommended to start from one side and put pressure evenly across the checkerboard as it is sticking to the foam board
    d. Stick the foam boards to the framing extrusions using double sided tape as shown in Figure 9
3) This framing extrusion is used as the base for the intrinsic target. The sides connecting to the breadboard are joined using a 4 hole inside corner bracket. Use T-Nuts to affix the joining plates to the framing extrusion. Use 15mm ¼-20 screws to affix the bracket to the breadboard.
4) This extrusion is used as a cross beam to support the frame and targets. **USE THE DIAGRAM AS REFERENCE**
    a. Attach the pivots to both framing extrusions.
    b. Place the first extrusion in between and at the top of the extrusions connected to the base.
    c. Place the second extrusion 135mm away as shown by **B.**
    d. Use joining plates and corner brackets with t-nuts to secure the extrusions. (T-nuts for Joining plates might require washers)

5) Pivots are connected to framing extrusions using T-Nuts.
    a. Use the 1020 190mm extrusions for the left and right side.
    b. Use the 1020 135mm extrusions for the top and bottom.
    c. Final location of pivots might require adjustment using software

FINAL CALIBRATION SETUPS

Currently only has one setup.

SETUP 1

BOM

Part Name	Manufacturer	Part Number	Quantity
Intrinsic Assembly			1
Linear Calibration Assembly - Near			1
Linear Calibration Assembly – Mid			1
Linear Calibration Assembly – Far			1
Plywood 1000x580x12.7 mm			8
Matte Black Aluminum Foil, .002 x 12" x 50'	THORLABS	BKF12	4

ASSEMBLY

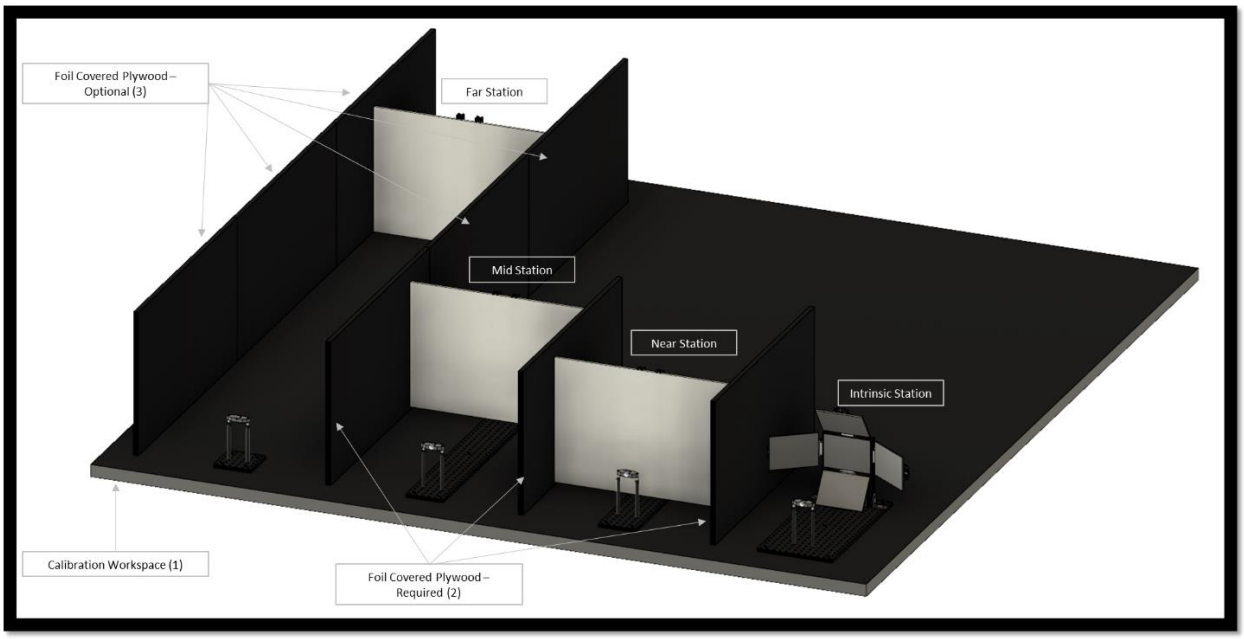

Figure 9

Figure 10

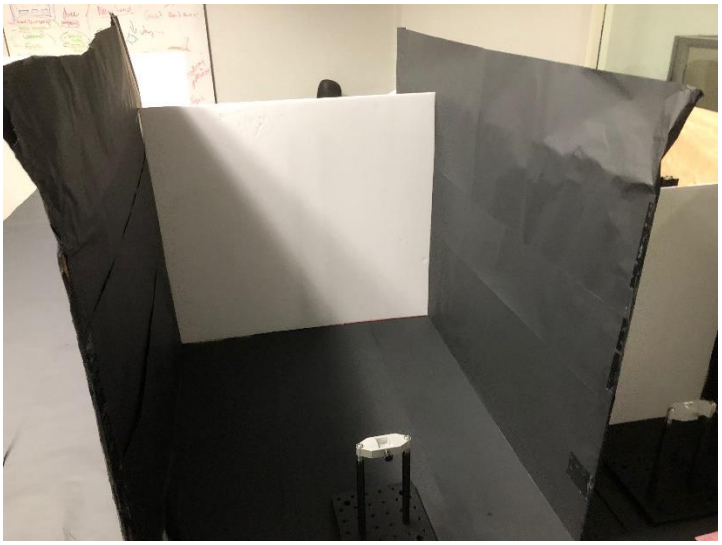

Figure 11

NOTES

1) The calibration workspace must to be at least 2.7m long and 3.2m wide. After all the stations are set on the workspace, cover all the workspace between the target and camera base with foil (Foil also covers the breadboards). Figure 10 and Figure 11 show a previous version of this setup, where the workspace is covered in black foil.
2) Black foil covered plywood is required in these locations for optimal calibration. See figure 11.
    a. Foil can be pasted onto plywood and bolted down on to the workspace
3) Foil covered plywood may not be required in these locations if the workspace is greater than 5m wide.