3D RECONSTRUCTION

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19TH, FEB.

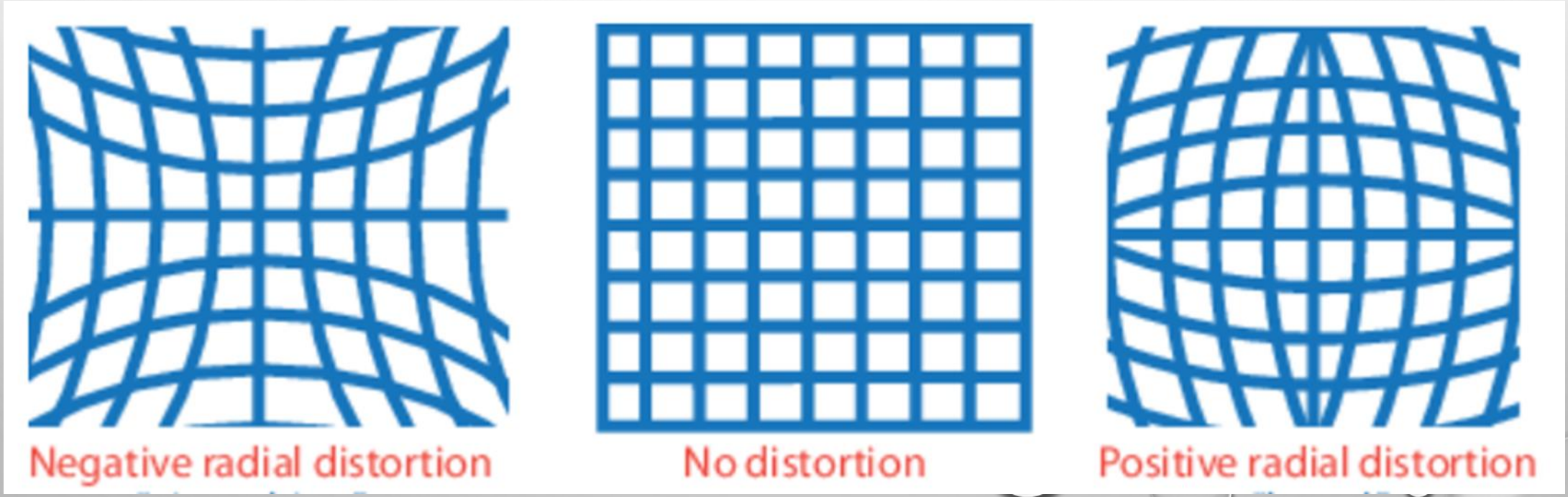
WHAT IS 3D RECONSTRUCTION

Calibration

Distortion

Reconstruction

2D image to 3D model



HTTPS://UK.MATHWORKS.COM/HELP/VISION/REF/DISPARITY.HTML

WHAT IS 3D RECONSTRUCTION

Calibration

Distortion

Chromatic dispersion

Reconstruction

2D image to 3D model

https://uk.mathworks.com/help/vision/ref/disparity.html

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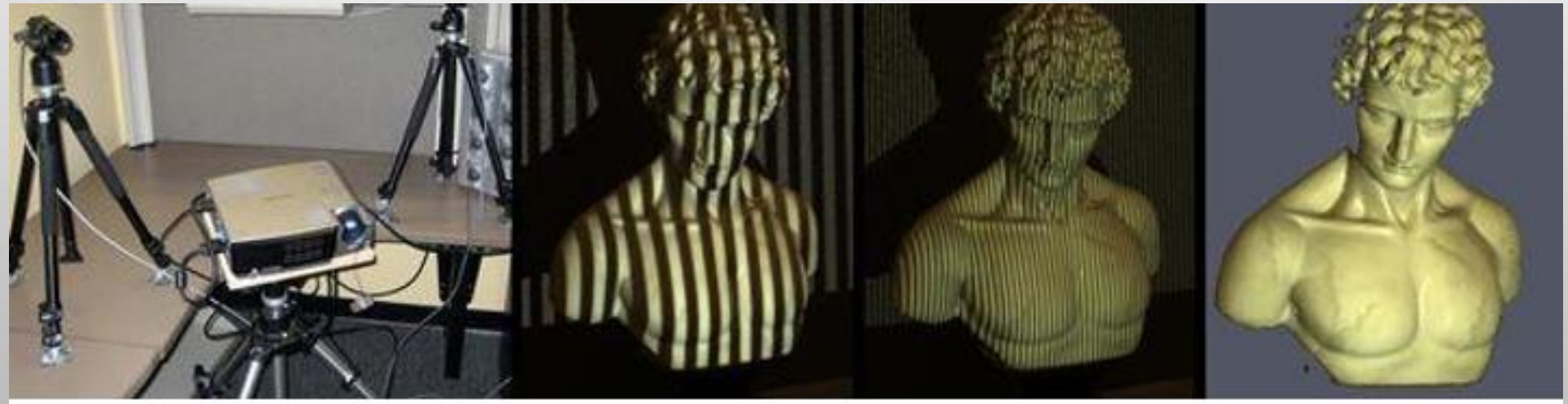
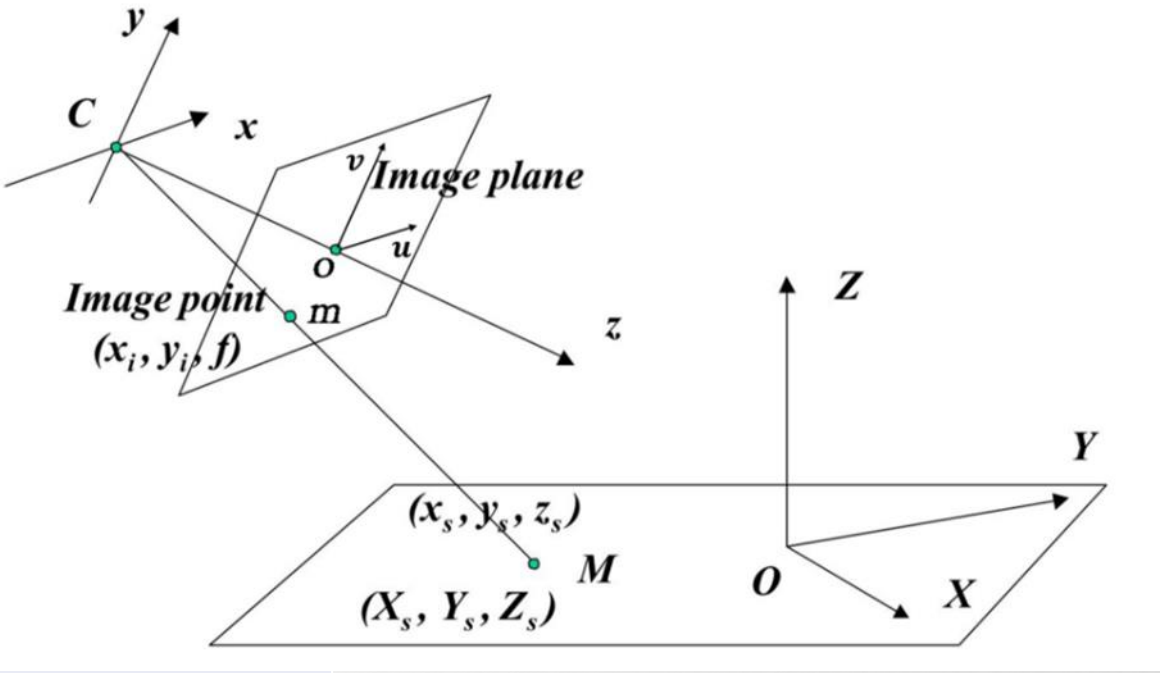


http://www.instructables.com/file/FMAK94OG3KYBTX1/

CALIBRATION



Pinhole Camera Model

Symbol	Meaning
C	Optical center of lens
o	Principal point
f	Focal length
M	the observed three-dimensional point
m	The image point of observed three-dimensional point
o-uv	Image coordinate
C-xyz	Image space coordinate
O-XYZ	Cartesian Coordinate System
(x_i, y_i, f)	Image point m in coordinates with respect to C, xyz in space.
(x_s, y_s, f_s)	The point M is the coordinate in space coordinate C- xyz.
(X_S, Y_S, Z_S)	The point M is in the coordinates of the object's coordinate system O-XYZ.

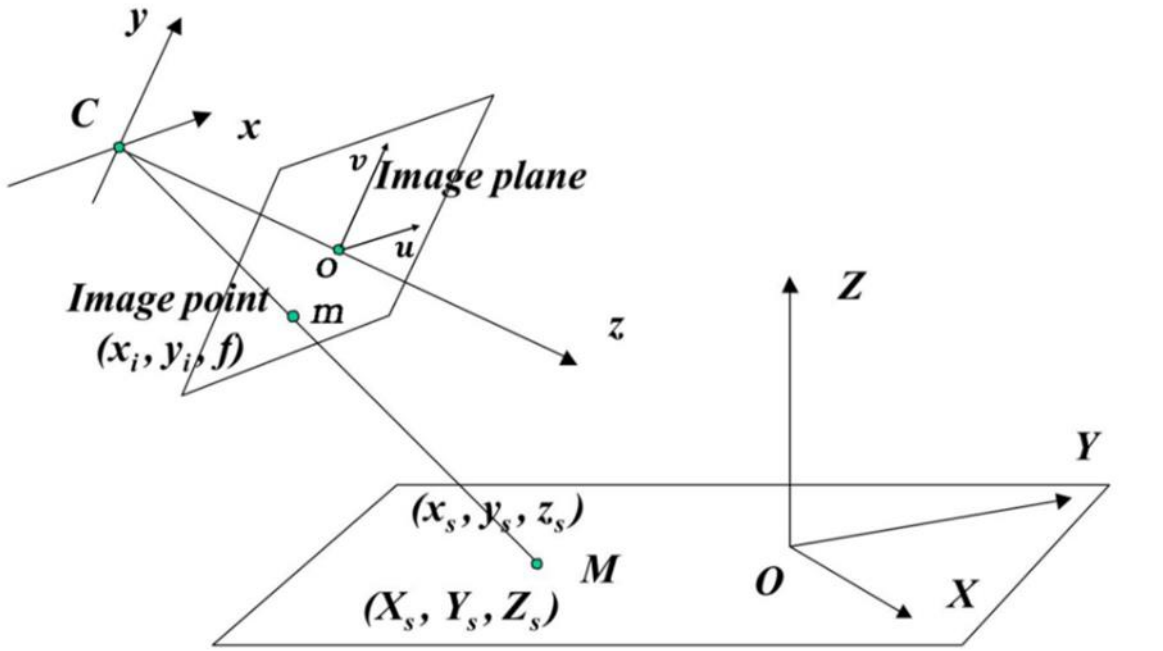
https://cn.mathworks.com/help/vision/ug/camera-calibration.html

CALIBRATION

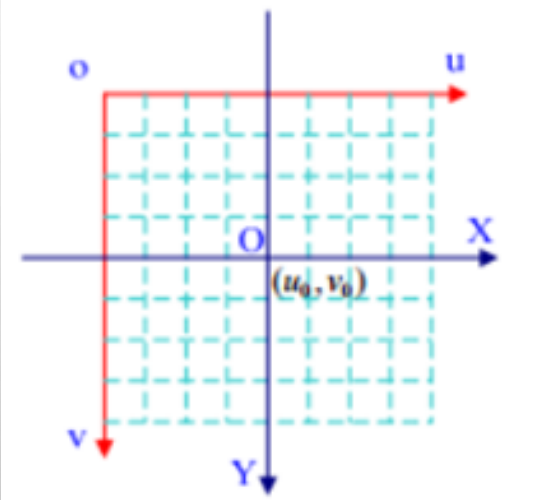
Pinhole Camera Model

World Coordinate transform to Camera Coordinate

Image Coordinate transform to Pixel Coordinate



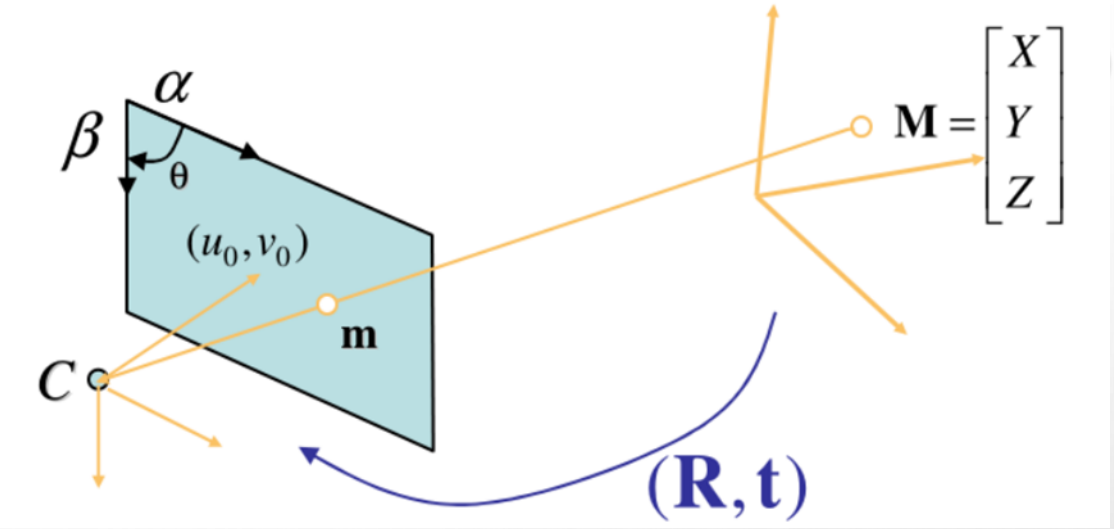
$$\begin{bmatrix} x_c \\ y_c \\ z_c \\ 1 \end{bmatrix} = \begin{bmatrix} R & t \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_w \\ y_w \\ z_w \\ 1 \end{bmatrix}$$



$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} 1/dX & 0 & u_0 \\ 0 & 1/dY & v_0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ 1 \end{bmatrix}$$

https://cn.mathworks.com/help/vision/ug/camera-calibration.html

CALIBRATION



Pinhole Camera Model

World Coordinate transform to Camera Coordinate

Image Coordinate transform to Pixel Coordinate

$$x - x_0 = -f \frac{\mathbf{R}_{11}(X - X_0) + \mathbf{R}_{21}(Y - Y_0) + \mathbf{R}_{31}(Z - Z_0)}{\mathbf{R}_{13}(X - X_0) + \mathbf{R}_{23}(Y - Y_0) + \mathbf{R}_{33}(Z - Z_0)}$$

$$y - y_0 = -f \frac{\mathbf{R}_{12}(X - X_0) + \mathbf{R}_{22}(Y - Y_0) + \mathbf{R}_{32}(Z - Z_0)}{\mathbf{R}_{13}(X - X_0) + \mathbf{R}_{23}(Y - Y_0) + \mathbf{R}_{33}(Z - Z_0)}$$

$$\tilde{m} = [u, v, 1]^T$$

$$\tilde{M} = [X, Y, Z, 1]$$

$$s\tilde{m} = A[R \;\; t]\tilde{M} \equiv P\tilde{M}$$

$$\begin{bmatrix} X - X_0 \\ Y - Y_0 \\ Z - Z_0 \end{bmatrix} = \lambda \mathbf{R} \begin{bmatrix} x \\ y \\ -f \end{bmatrix}$$

$$\mathbf{A} = \begin{bmatrix} \alpha & \gamma & u_0 \\ 0 & \beta & v_0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\mathbf{P} = \mathbf{A}[\mathbf{R} \;\; \mathbf{t}]$$

https://cn.mathworks.com/help/vision/ug/camera-calibration.html

RECONSTRUCTION

$$u_1 = f\frac{x_p}{z_p}$$

$$u_2 = f\frac{x_p - b}{z_p}$$

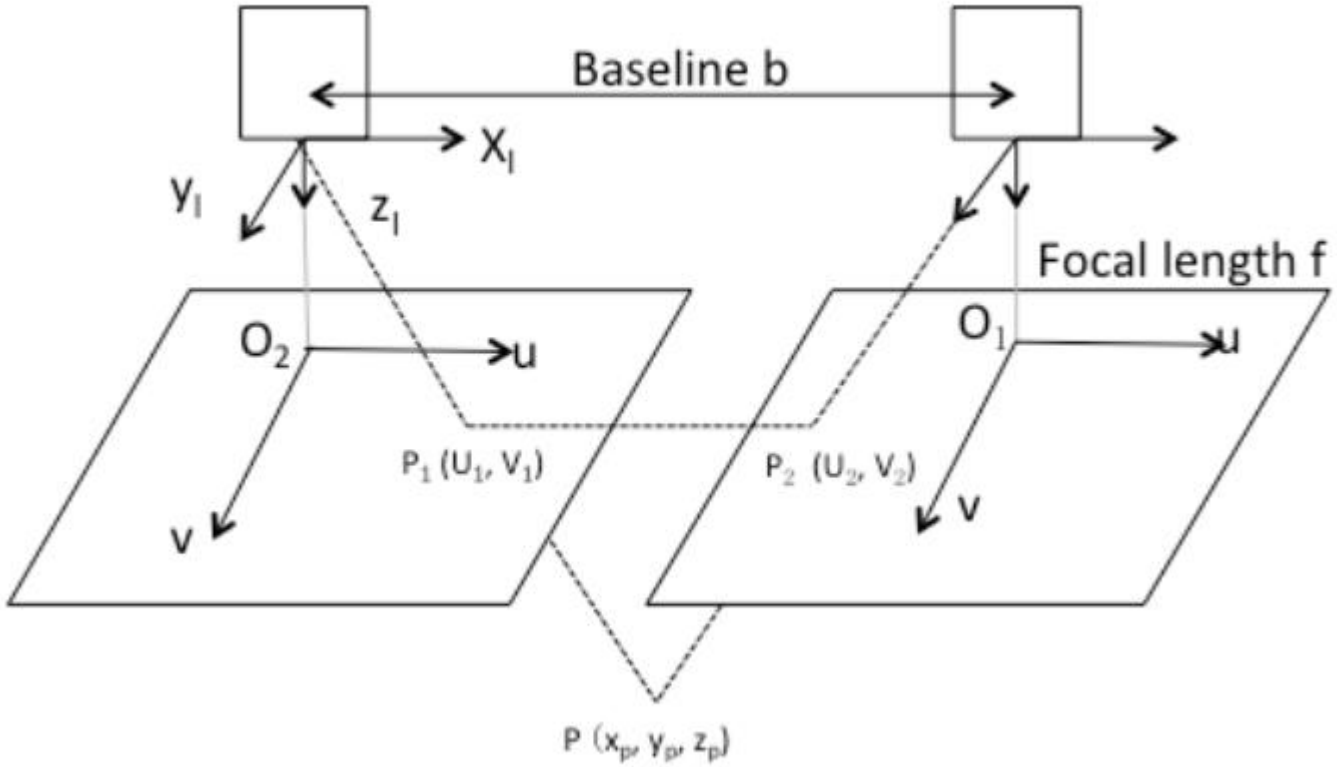
$$v_1 = v_2 = f\frac{y_p}{z_p}$$

$$x_p = \frac{bu_1}{d}$$

$$y_p = \frac{bv_1}{d}$$

$$z_p = \frac{bf}{d}$$

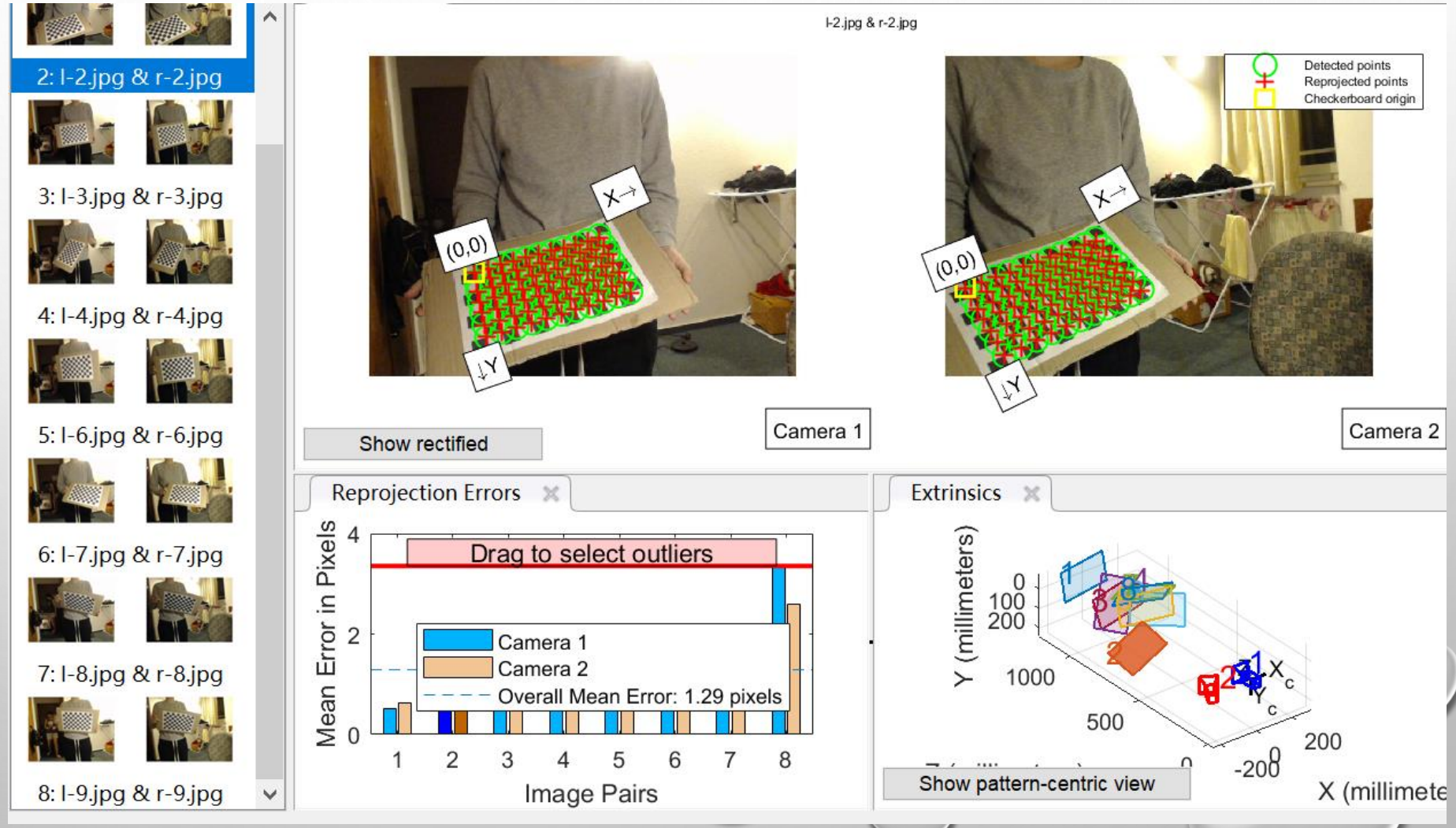
$$d = u_1 - u_2 = f\frac{b}{z_p}$$



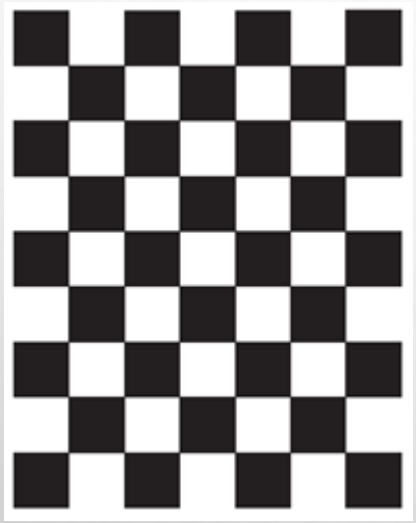
https://en.wikipedia.org/wiki/3D_reconstruction

CALIBRATION

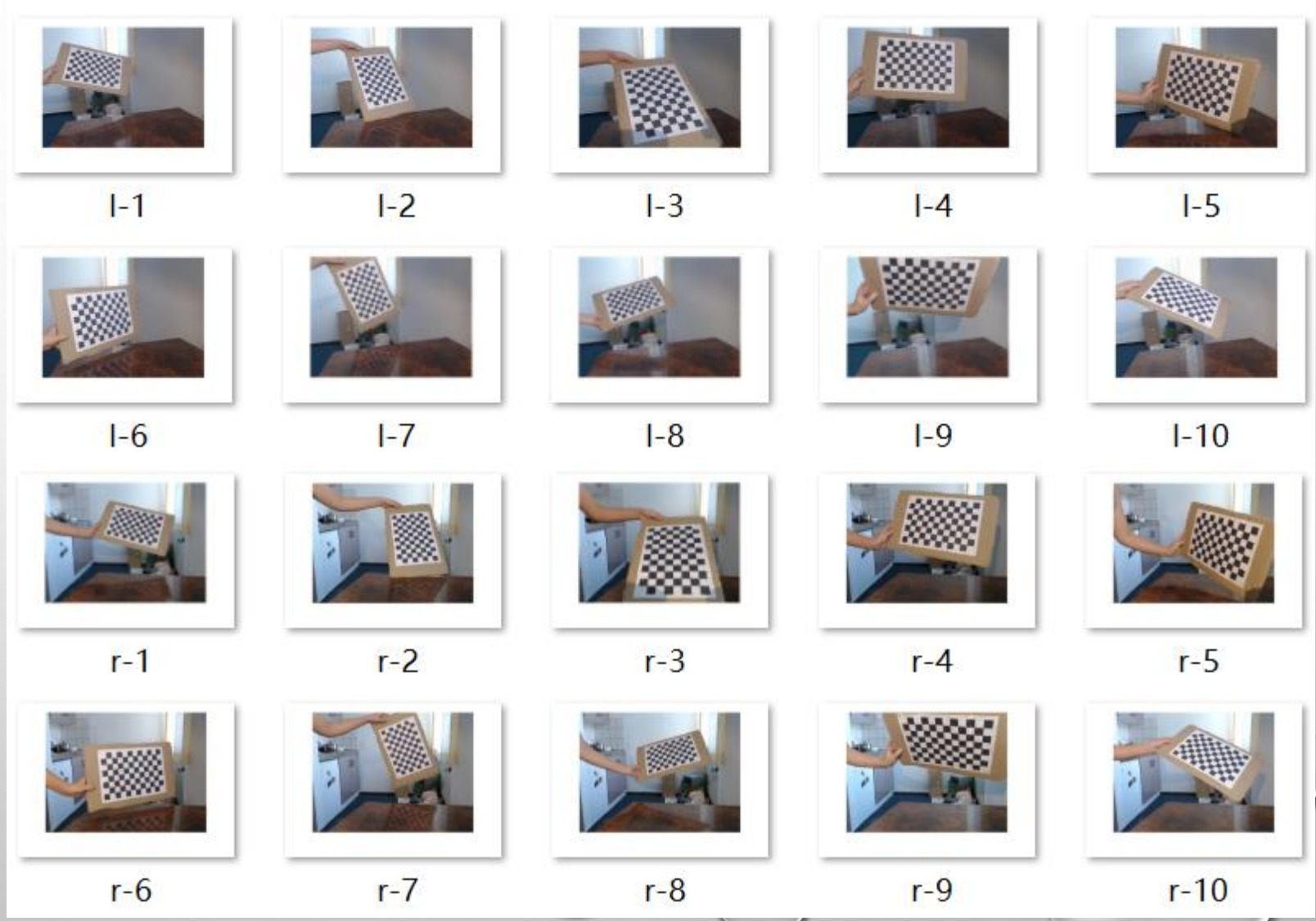
CameraParameters1&2:
[1×1 cameraParameters]
Inter-camera Geometry
Rotation of Camera2: [3×3 double]
Translation of Camera2: [194.5060 -4.8902 82.0959]
FundamentalMatrix: [3×3 double]
EssentialMatrix: [3×3 double]
Accuracy of Estimation
MeanReprojectionError: 1.2897
Calibration Settings
NumPatterns: 8
WorldPoints: [77×2 double]
WorldUnits: 'millimeters'



RECONSTRUCTION OF CHECKERBOARD

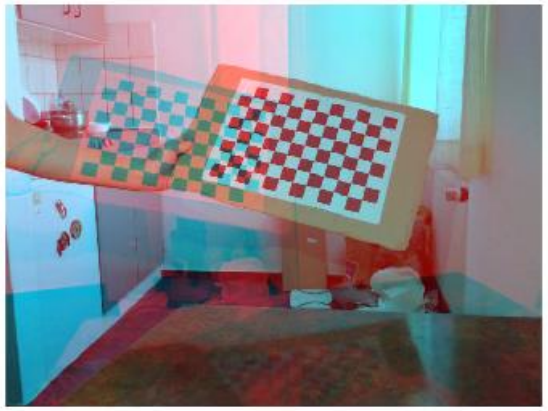


25mmX25mm



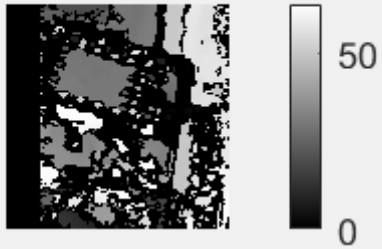
RECONSTRUCTION OF CHECKERBOARD

Before Rectification



After Rectification

Disparity Map



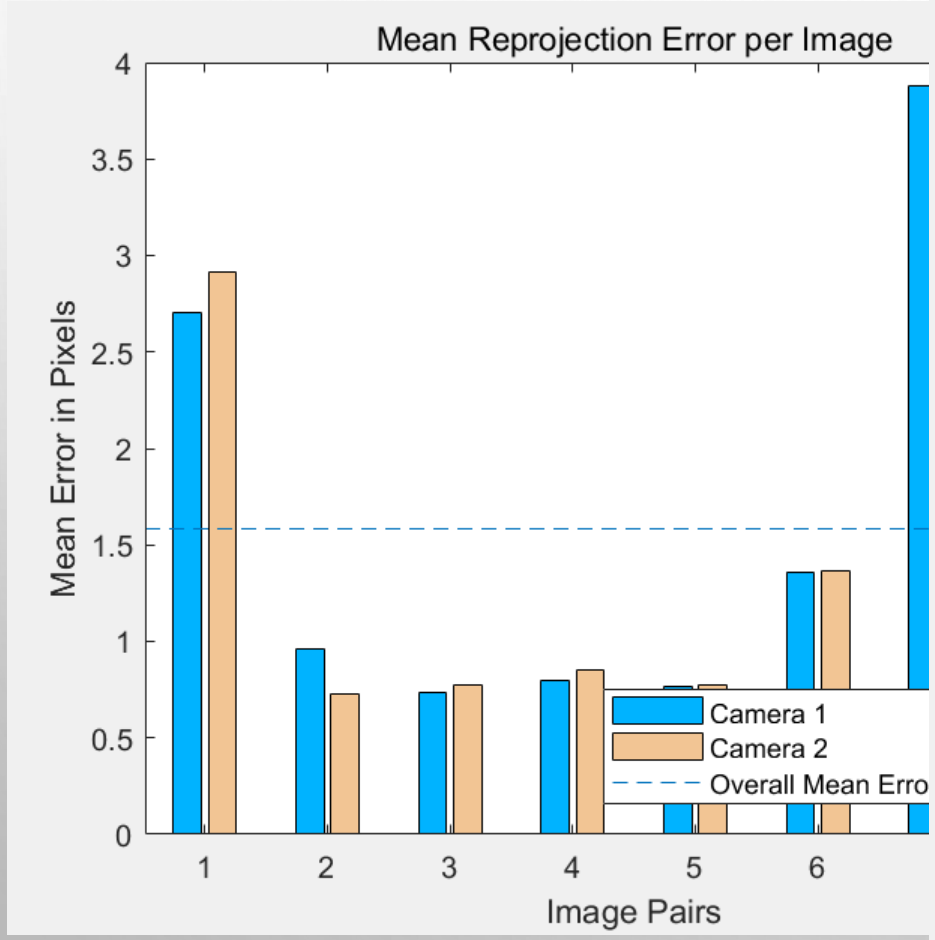
Camera 1

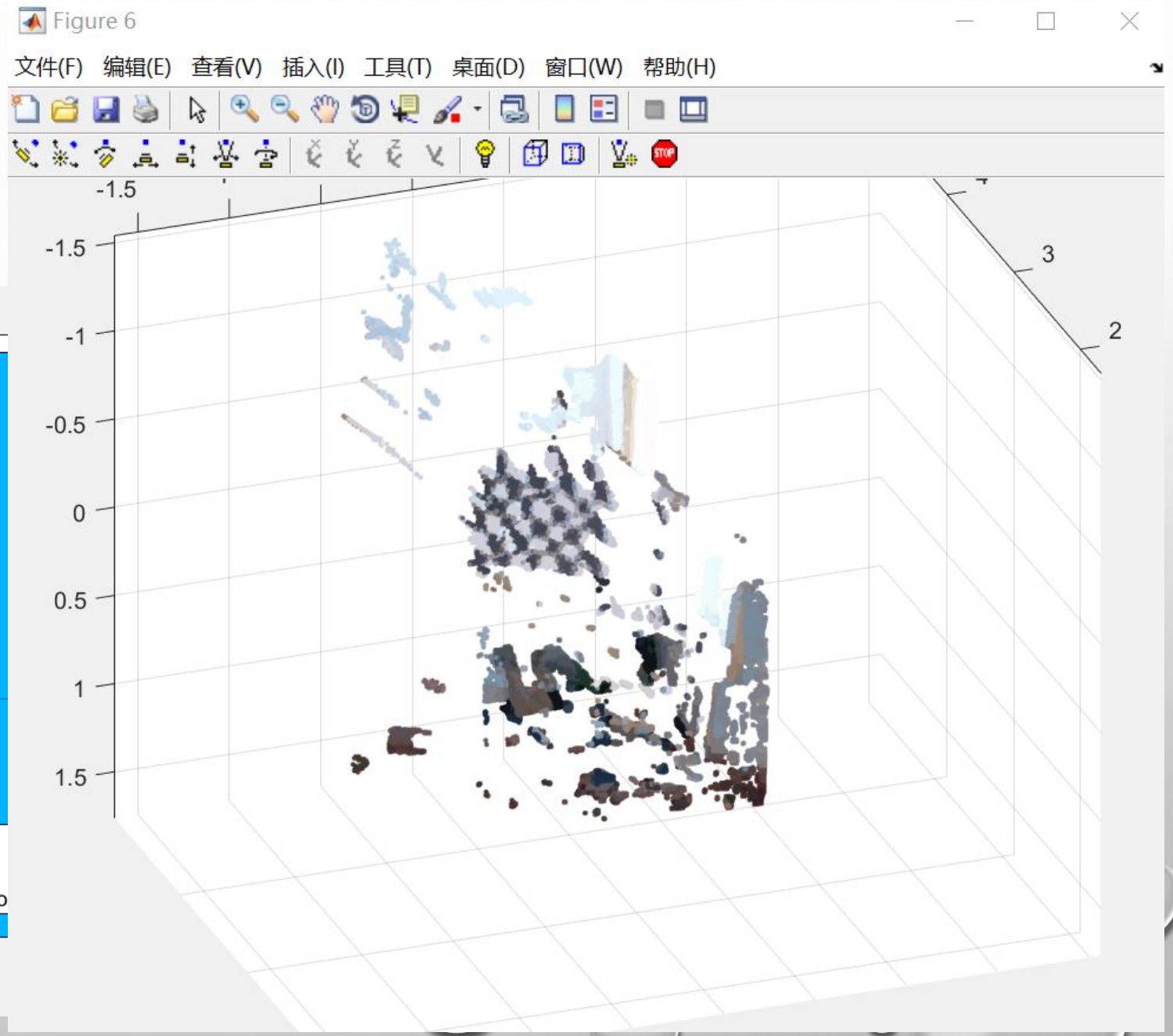







RECONSTRUCTION OF CHECKERBOARD



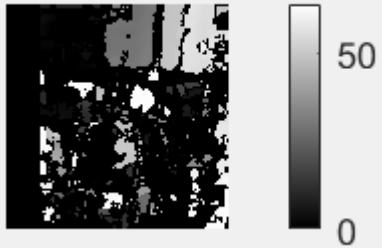


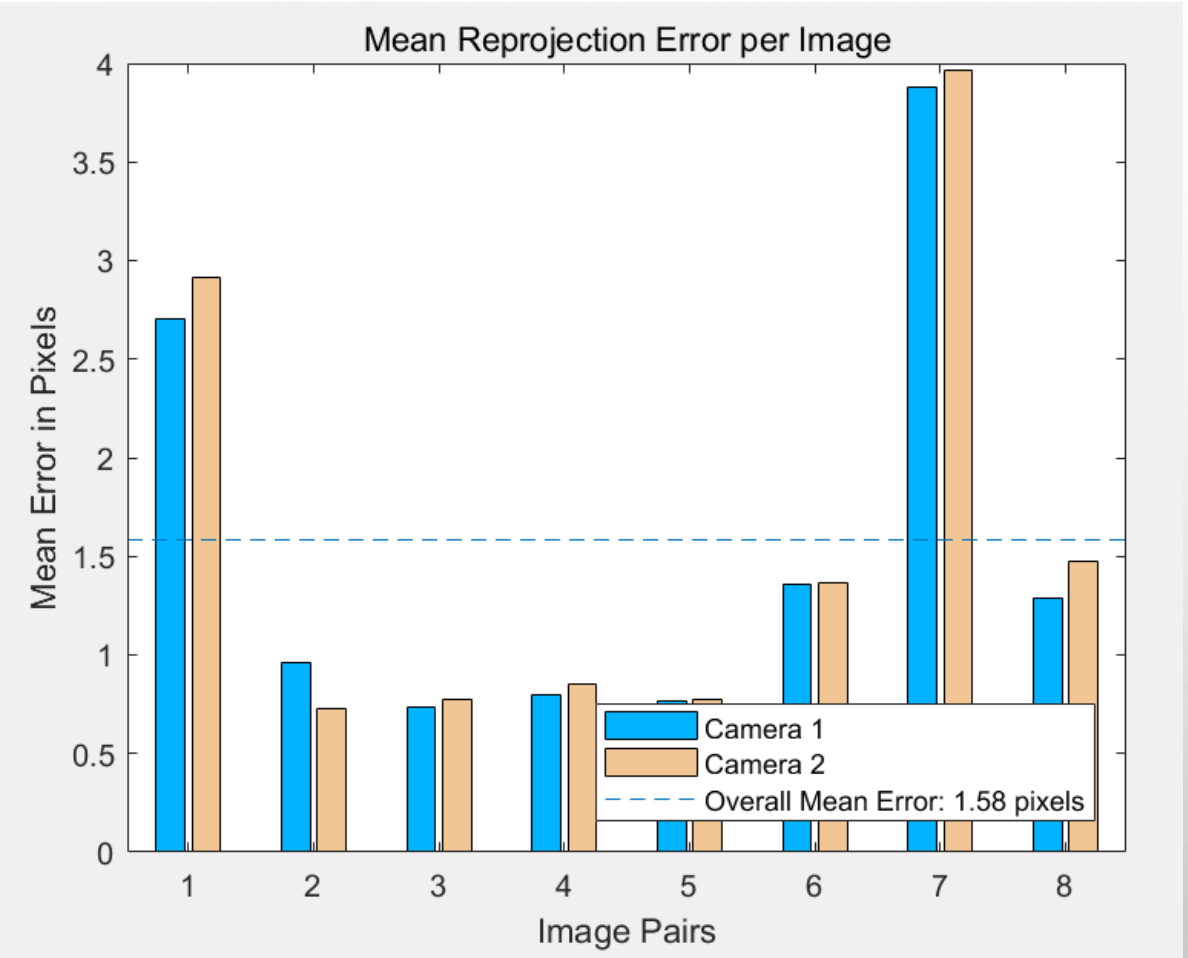
RECONSTRUCTION OF OBJECT

Before Rectification

After Rectification

Disparity Map





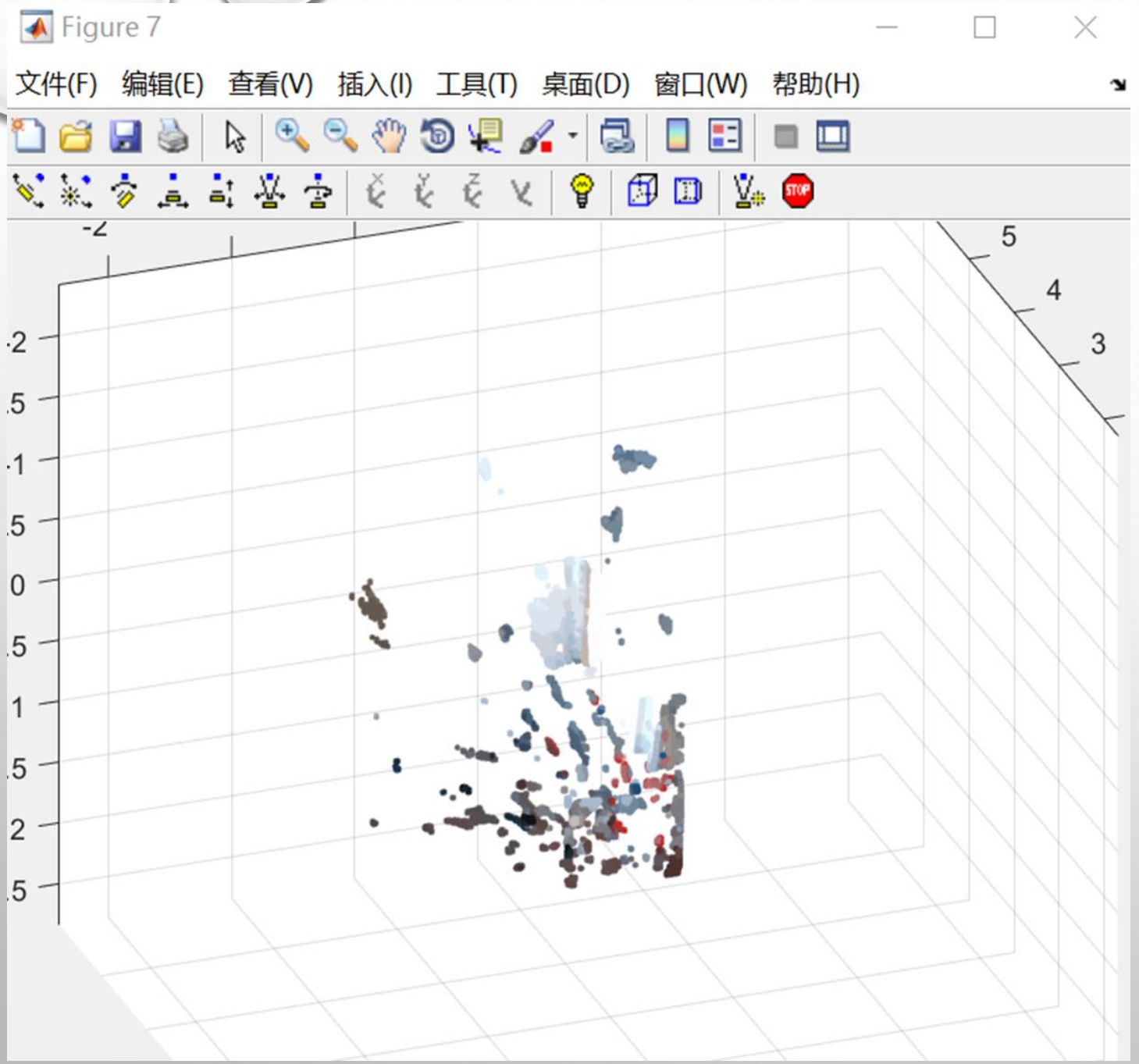
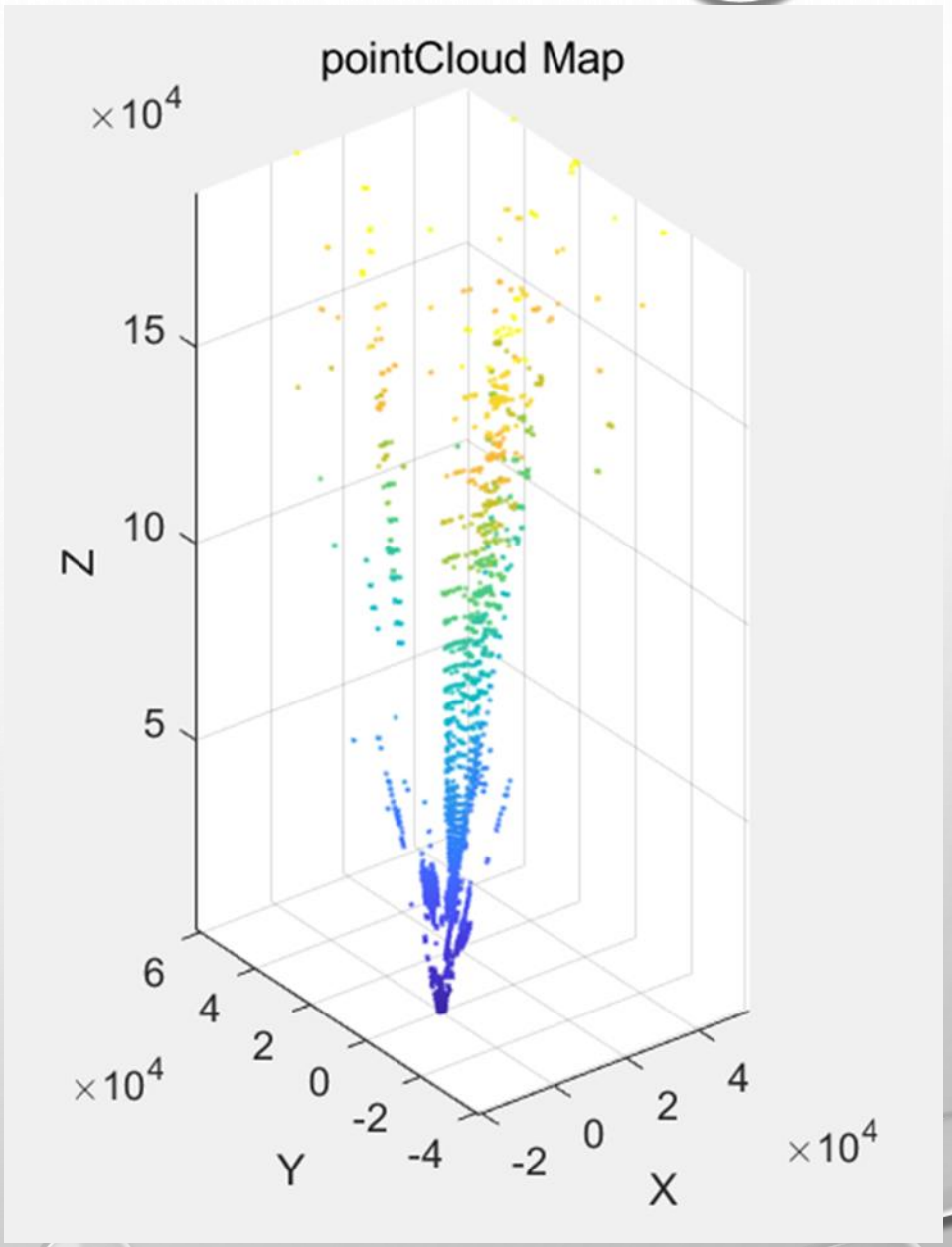


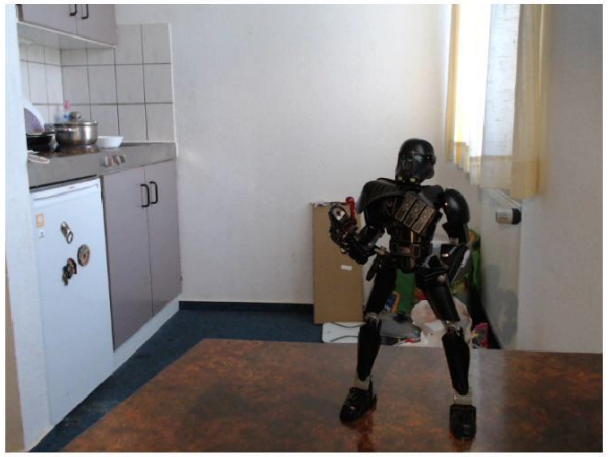
Figure 7
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)


pointCloud Map
×10^4
15
10
5
Z
6
4
2
0
-2
-4
Y
×10^4
-2
0
2
4
X
×10^4

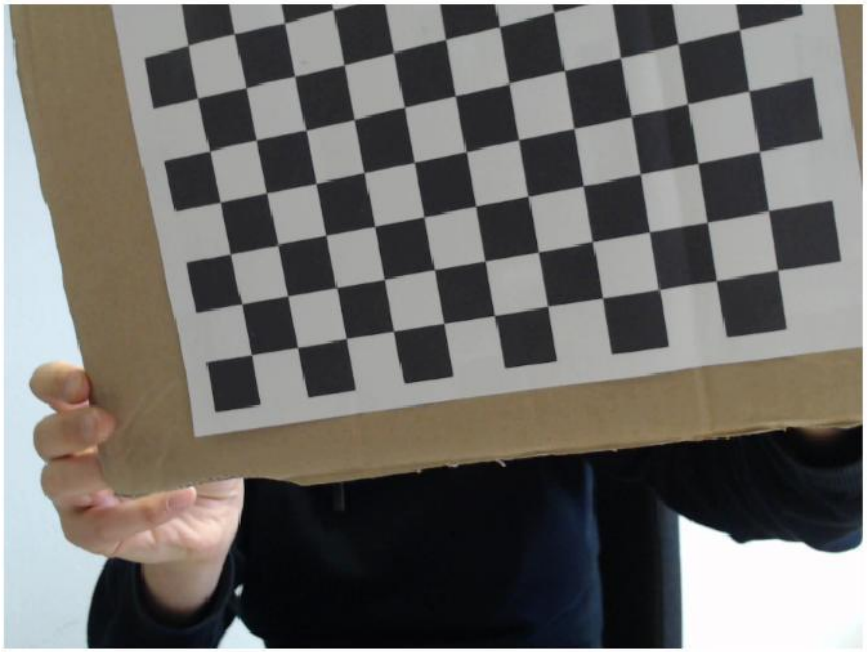
WHAT IS GOOD FOR RECONSTRUCTION?

Characteristic point

No strong reflection



WHAT IS GOOD FOR RECONSTRUCTION?



EQUIPMENTS

- - TWO CAMERAS (LOGITECH C920 HD PRO HD-WEBCAM)
- - MATLAB (ABOVE 2016)
- - A HARDBOARD
- - TRIPOD ROLLEI 5020797

http://www.mediamarkt.de/de/product/_logitech-hd-pro-c920-2063980.html?gclid=Cj0KCQiA5aTUBRC2ARIsAPoPJk8gNUg4kPFX_jPNhn-JAtLO6XfQf7Dm3Cs189ARt_4OIaQCSPG3ZOcaAtoOEALw_wcB&gclsrc=aw.ds

COMPARISON OF TWO CAMERA

Webcam Specifications A	
Connection Type	USB
USB Protocol	USB 2.0
USB VID_PID	082D
UVC Support	Yes
Microphone	Yes
Microphone Type	Stereo
Lens and Sensor Type	Glass
Focus Type	Auto
Optical Resolution	True:3MP Software Enhanced:15MP

Webcam Specifications B	
Diagonal Field of View (FOV)	78°
Focal Length	3.67 mm
Image Capture (4:3 SD)	N/A
Image Capture (16:9 W)	2.0 MP, 3 MP*, 6 MP*, 15 MP*
Video Capture (4:3 SD)	N/A
Video Capture (16:9 W)	360p, 480p, 720p, 1080p
Frame Rate (max)	1080p@30fps
Right Light	RightLight 2
Video Effects (VFX)	N/A
Buttons	N/A
Indicator Lights (LED)	Yes
Privacy Shade	No
Tripod Mounting Option	Yes

Thank You