# Photogrammetric Computer Vision
# Exercise 03

**Group 18(G_18):**


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## Part 1: Theory

**1.Image Acquisition:**

**a) Describe the acquired calibration object in brief.**

**b) Specify important technical information of the used camera (i.e. type, resolution, etc.)**

**Answer:**

a) the calibration object is a paper of checkboard patterns which turned into two perpendicular planes. 6 chosen control points are marked as grey circles and located at the corners of the squares.

b) the used camera is the camera of mobile phone MI Mix2s.

sensor type: CMOS

resolution: 12MP

aperture radius: 1.25μm

focal distance: 52mm

**2. Control point measurements:**

**a) How did you define the axes of the object coordinate system?**

**b) How precise where the object coordinates measured?**

**Answer:**

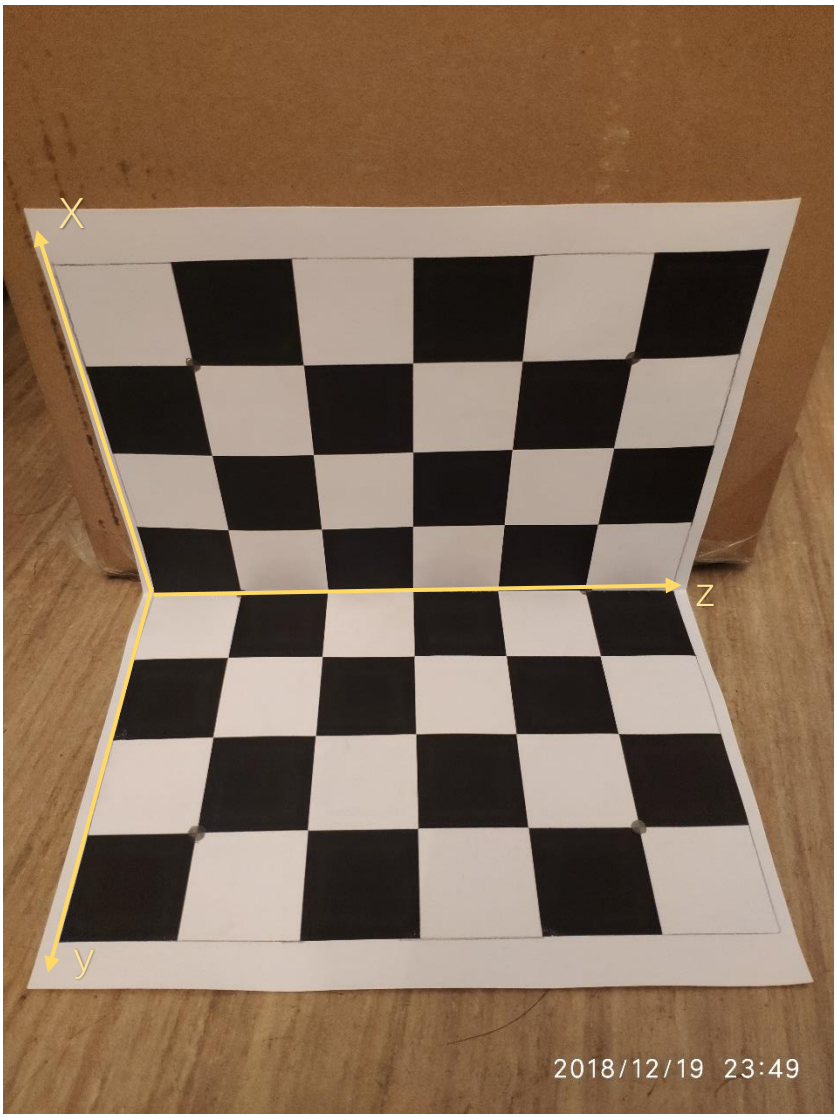
a)We use two perpendicular plane (one paper is on the floor and the other is kept perpendicular to it) to represent the coordinate system, the edges of Planes and the intersection line of the two planes are defined as the axes of the object coordinate system, which is showed as the picture below.

b)we choose the checkboard patterns as background which provide a uniform calibration pattern with distinct corners to improve the precision.

The length of each square in the patterns is strictly and precisely measured and

given, which avoid the error from hand-measurement.

keeping the origin of the object coordinate system in the middle of the image and spreading the control points evently reduce the influence of distortion.




**3. Implementation Only**

**4. Interpretation of the projection matrix:**

**a.) Explain the geometric meaning of the extracted parameters in brief.**

**b.) Evaluate the whole calibration process. How precise is the camera orientation determined and where does the quality depend on?**

**Answer:**

a)There are 5 parameters for interior and parameters for 6 exterior orientation.

in calibration matrix K:

1) **c**: Principal distance, perpendicular distance of the projection center to the image plane.
2) Aspect ratio **γ** and shearing **s** of the image axes
3) **S**: Skew,the angle of shearing along the x axis
4) **x, y**: the location of the principal point in the image plane. section of imaging axis with the image plane.

Exterior orientation:

5) **(X ,Y ,Z)**: Location of the projection center C in the object coordinate system

6) Spatial rotation angles **w, φ, k**:d the angle between correspond axes of image coordinate system and object coordinate system.

b) the camera orientation is determined by extrinsic parameters (**w, φ, k**), we shoot the photo in a way to make the checkboard patterns cover the most area of the image and keep the bisection in the middle, try to keep the lines of the checkboard straight and improve the precision.

the quality depends on the accuracy of the objects coordinates acquisition of the control points, and the precision of image points selection(which is also affected by image distortion ).