
University of Bourgogne

MSCV

# Visual Perception Lab

*Supervisor:*
David fofi

*Submitted By,*
Majeed Hussain
Akshay kumar

# Contents

# 1 Calibration and Triangulation

## 1.1 Camera Calibration

Camera calibration is the process of estimating intrinsic and/or extrinsic parameters. Intrinsic parameters deal with the camera's internal characteristics, such as, its focal length, skew, distortion, and image center. Extrinsic parameters describe its position and orientation in the world. Knowing intrinsic parameters is an essential first step for 3D computer vision, as it allows you to estimate the scene's structure in Euclidean space and removes lens distortion, which degrades accuracy.

### 1.1.1 Using Bouguet toolbox

Firstly we calibrated out webcam using Bouguet toolbox, we used multiple images of checkerboard from different location as an input for calibration Toolbox. Obtained Camera Parameters are as follows:

## 1.2 Simulating 3D Scene

The next step is to simulate a 3d scene.We used Matlab inbuilt 3D ply file name **teapot.ply** and plotted on graph.

## 1.3 Computing the Virtual image of 3Dscene w.r.t First Camera

For this task we fix our camera at origin and with no rotation we compute the Camera Matrix using our Intrinsic Parameters obtained in first step using Bouguet Tool Box
Our First Camera Matrix looks as follow: The next step we perform is using this Camera Matrix we do projet and get the 2d image points, later as now we have both 3D point and its corresponding 2D point we use this as input to DLT to obtain our estimated Camera Matrix.

## 1.4 Implement DLT

The most commonly used camera calibration method is perhaps the DLT (direct linear transformation) method originally reported by Abdel-Aziz and Karara. The DLT method uses a set of control points whose object space/plane coordinates are already known. The control points are normally fixed to a rigid frame, known as the calibration frame. The problem is essentially to calculate the mapping between the 2D image space coordinates (xi) and the 3D object space coordinates (Xi). For this 3D to 2D correspondence the mapping should take the form of a 3x4 projection matrix (P) such that xi= PXi for all i.
This task is performed using the function namely **CalibDLT** After the DLT we obtain a estimated Camera Matrix.

## 1.5 Comparing real Intrinsic with estimated Intrinsic

As from our previous DLT output we obtained the camera matrix we decompose that Camera Matrix.
This decomposition task is done using function namely decomposePMat Comparison results are as follows:

## 1.6 Simulating Second Camera with different Extrinsic

Using the same Intrinsic Parameters we simulate the second camera but with different extrinsic i.e, here we translate our camera say 400 or 500 using same rotation matrix.

## 1.7 Computing the Virtual image of 3Dscene w.r.t Second camera

Now using all the Intrinsic and given Extrinsic parameters we get Camera matrix of second camera and later using those camera matrix we calculate the projection and obtain corresponding 2D point with respect to second camera.

## 1.8 DLT Reconstruction

Now as we have both virtual images w.r.t to both cameras we use this both 3D points and their corresponding 2D points to estimate the depth of the image and

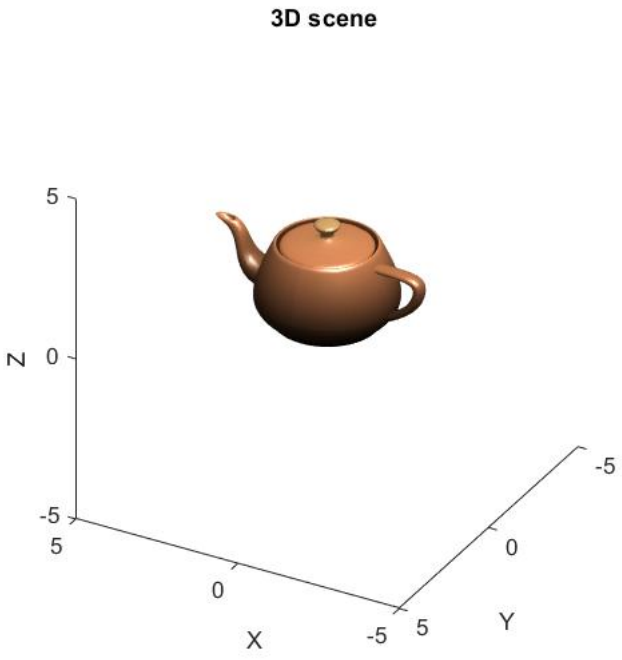
then reconstruct the 3D scene.

### 1.9 Comparing Simulated 3D scene with DLT Reconstruction.

Using the obtained 3D points using DLT Reconstruction we plot and visualize the 3D image to check how close our reconstruction is done.

## 2 Results

### 2.1 Simulated 3D scene



## 2.2 Real Intrinsic Parameters

```
Real Intrinsics obtained using Calibration Toolbox

K1 =

  947.1135         0  630.1067
         0  946.2001  357.5355
         0         0    1.0000
```

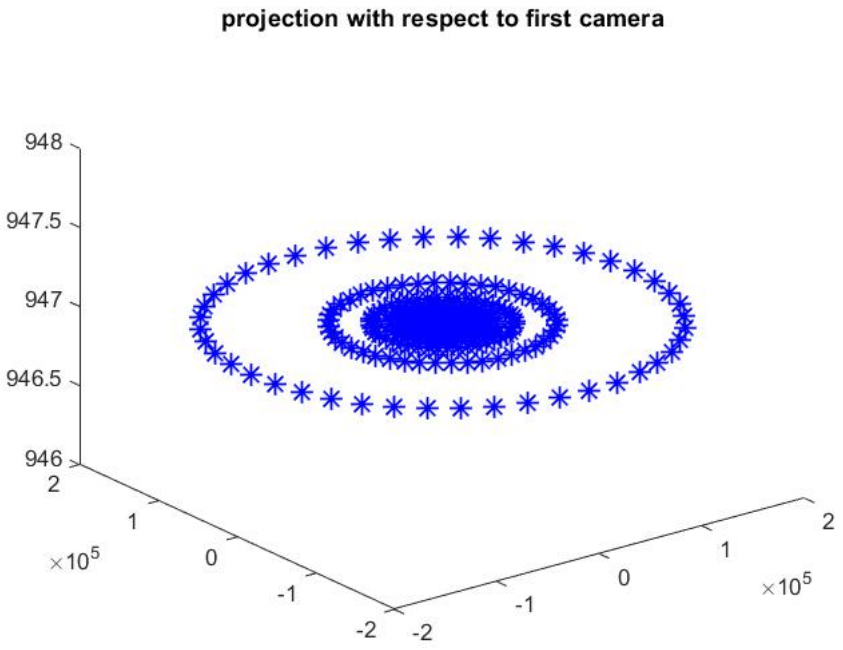
## 2.3 DLT computed Intrinsic Parameters

```
DLT Computed intrinsic Parameters

K =

  947.1135         0  630.1067
         0  946.2001  357.5355
         0         0    1.0000
```

## 2.4 Projection w.r.t to First camera



## 2.5 3D Reconstructed using DLT