

# 3D position determination using a camera

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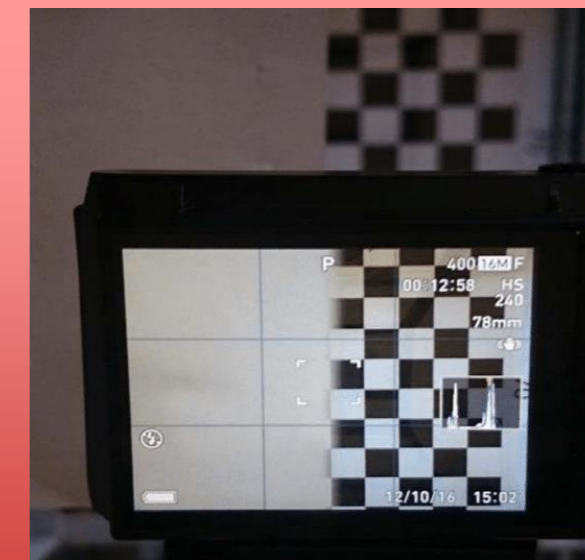
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## Objective

The objective of this thesis is a study into pose estimation techniques using a camera. Several methods are compared and a guide into using the optimal technique in different environments is provided.



## Result

An overview of the properties of the discussed methods.

DLT is an older method, mostly used for comparison. For real-time applications with moderate accuracy, use EPnP.

NPL is a slow but high accuracy method.

NLL is also a slow but accurate method with uses lines.

PRSOI is a complex and accurate iterative method.

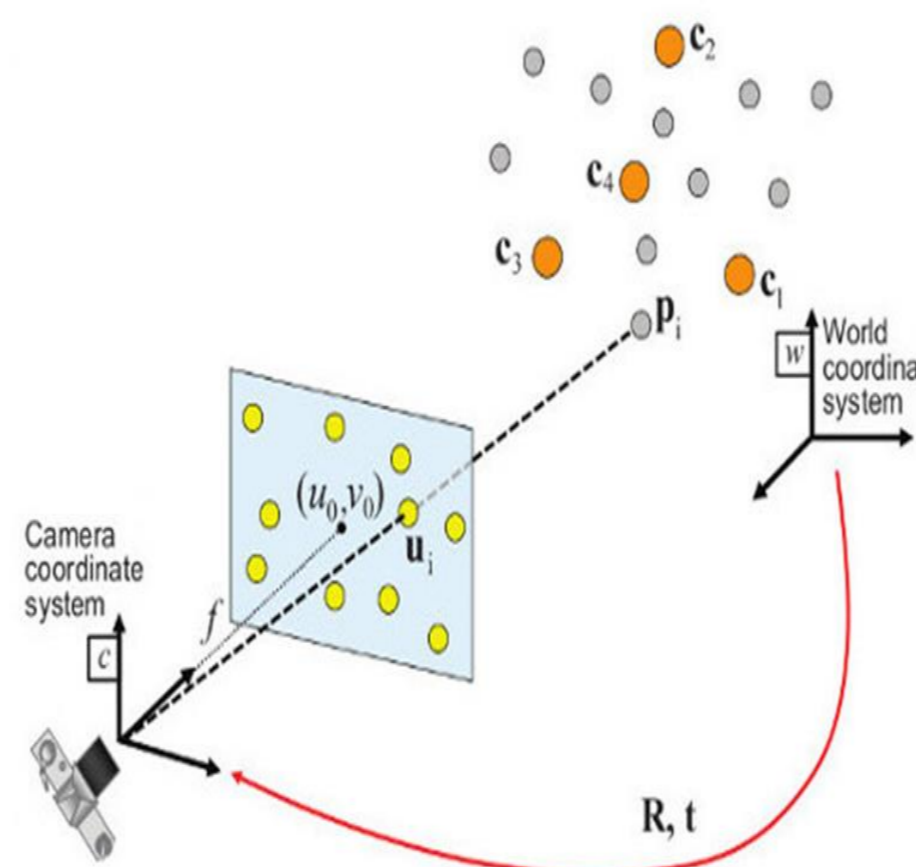
Posit is used as an iterative comparing method.

Moiré patterns have a high accuracy in depth and out-of plane rotations.

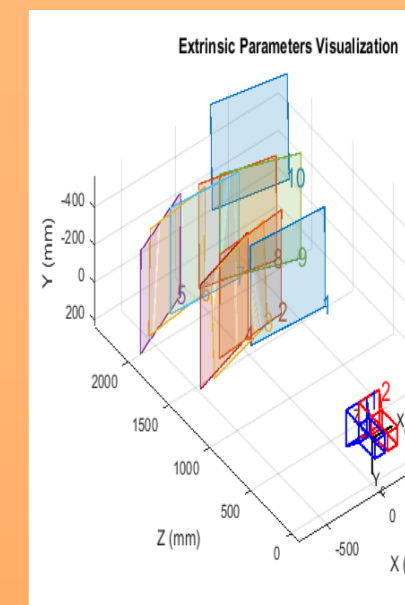
OI has a high accuracy, good outlier rejection and fast convergence.

## Objective

## Result



## Calibration & Normalization



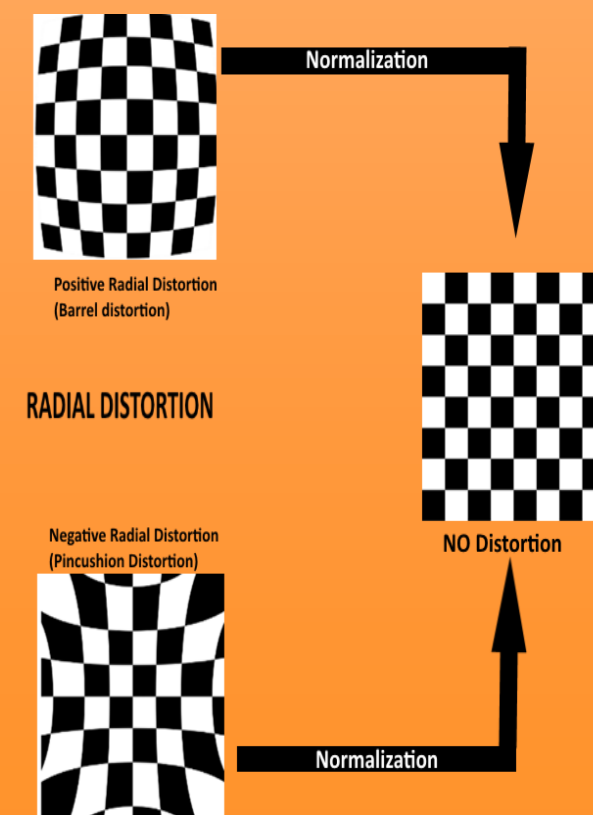
## Calibration:

Find the camera parameters :

- Focal length
- Principal point
- Skew
- Radial distortion
- Tangential distortion

## Normalization

Use the camera parameters to undistort the acquired image



## Pose estimation algorithms

## Feature detection

### Pose estimation algorithms

Several 6 Degrees of Freedom (DOF) pose estimation algorithms exist. Selection of the most suitable pose estimation algorithm is essential.

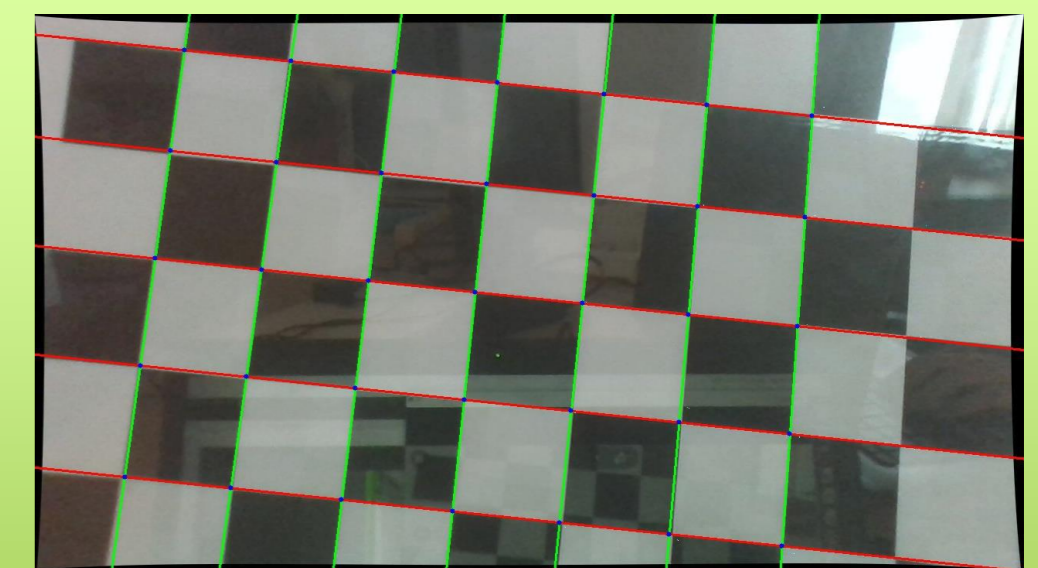
These methods differ in :

- Speed
- Susceptibility to noise
- Accuracy
- Detection of out-of-plane or in plane rotations
- Cost of setup
- Possibility of partial occlusion of the calibration pattern

Discussed methods are: DLT, POSIT, EPnP, PRSO, OI, NPL, NLL and Moiré patterns

### Feature detection

Detection of specific features in the 2D camera image with known coordinates in the object coordinate system. There are methods that use line and/or corner detect. Most also use an iterative algorithm for higher accuracy.



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