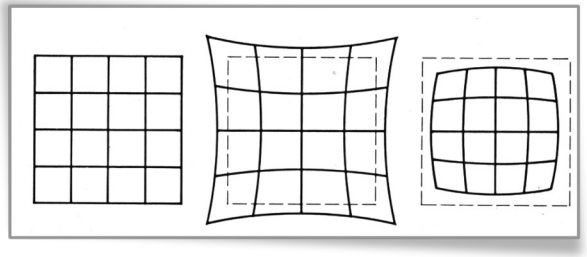


Folien zur Vorlesung am 08.04.2025

3D Computer Vision

KAMERAKALIBRATION

Related problem: camera calibration

- Goal: estimate the camera parameters
  - Version 1: solve for 3x4 projection matrix

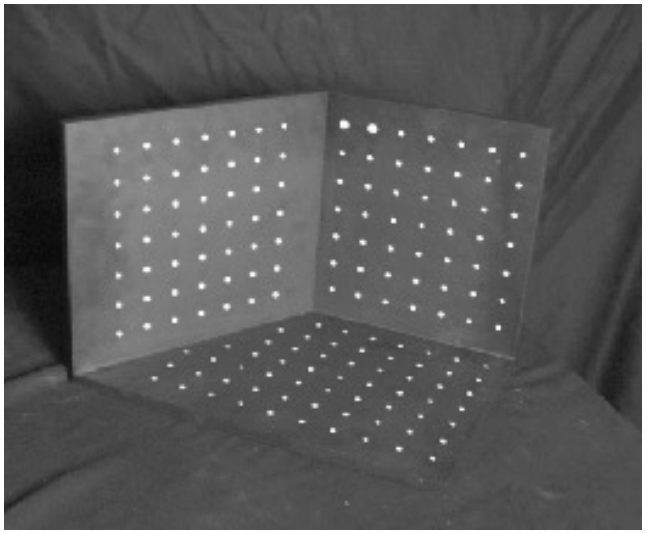
$$\mathbf{x} = \begin{bmatrix} wx \\ wy \\ w \end{bmatrix} = \begin{bmatrix} * & * & * & * \\ * & * & * & * \\ * & * & * & * \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} = \mathbf{\Pi X}$$

  - Version 2: solve for camera parameters separately
    - intrinsics (focal length, principal point, pixel size)
    - extrinsics (rotation angles, translation)
    - radial distortion

Estimating the projection matrix

- Place a known object in the scene
  - identify correspondence between image and scene
  - compute mapping from scene to image

$$\begin{bmatrix} u_i \\ v_i \\ 1 \end{bmatrix} \cong \begin{bmatrix} m_{00} & m_{01} & m_{02} & m_{03} \\ m_{10} & m_{11} & m_{12} & m_{13} \\ m_{20} & m_{21} & m_{22} & m_{23} \end{bmatrix} \begin{bmatrix} X_i \\ Y_i \\ Z_i \\ 1 \end{bmatrix}$$

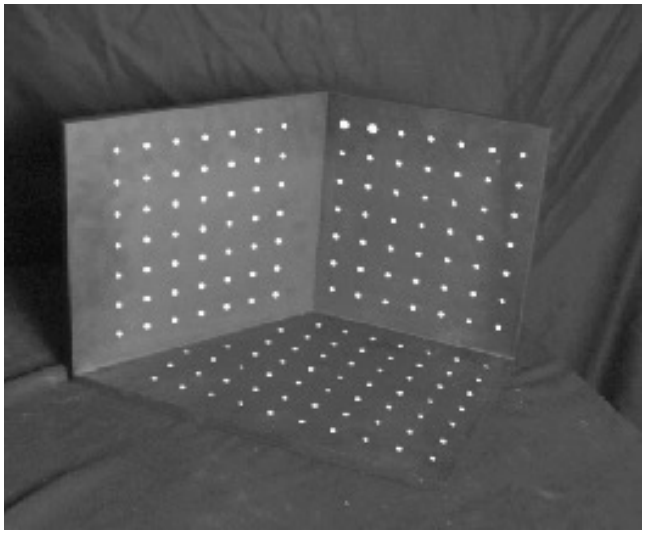


Calibration using a reference object

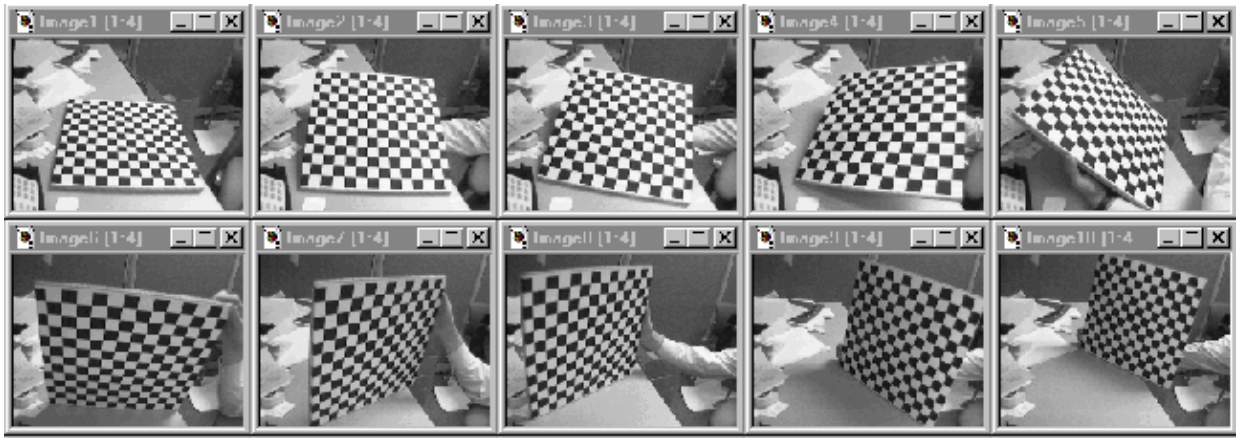
- Place a known object in the scene
  - identify correspondence between image and scene
  - compute mapping from scene to image

Issues

- must know geometry very accurately
- must know 3D -> 2D correspondence



Alternative: multi-plane calibration



Images courtesy Jean-Yves Bouguet

Advantage

- Only requires a plane
- Don't have to know positions/orientations
- Good code available online! (including in OpenCV)
  - Matlab version by Jean-Yves Bouguet: http://robots.stanford.edu/cs223b04/JeanYvesCalib/
  - Amy Tabb's camera calibration software: https://github.com/amy-tabb/basic-camera-calibration
  - https://uhahne.github.io/3DCV/Workshops/Workshop-01-Camera%20Calibration/