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WS 19/20
Exercise Sheet 2
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Exercises in Tracking & Detection

Task 1 Repetition Camera Models

a) **Homogeneous Coordinates** Why do we need them?

b) **Internal calibration matrix** What is its purpose and properties? How to express the pinhole camera model's perspective projection and transformation to pixel coordinates in terms of f, k_u, k_v, u_0, v_0 in the internal calibration matrix. How do changes in focal length f affect an image?

c) **External calibration matrix** What is its purpose and properties? What is an Euclidean transformation $[R, t]$, how many parameters does it have?

d) **Camera Distortion** What types are there and how importand are they? Why are they not part of the intrinsic matrix? How to compensate for these effects?

Task 2 Camera Calibration and Pose Estimation algorithms

a) What is the error we try to minimize + Equation?

b) When can we use DLT?

c) DLT: Why is the null vector not a valid solution?

d) When can we use PnP?

e) What is the minimum number of correspondences required to estimate the camera pose? Briefly explain your reasoning.

- for DLT
- for P3P/PnP

f) Summary. Fill out the missing entries in the following table to summarize your findings about the algorithms

algorithm	#corresp. points	intrinsics
Umeyama*	4	unknown

(*) only briefly covered in lecture slide 43 as Euclidean displacement from World 3D to Camera 3D points, no minimization of reprojection error but of 3D euclidean distance, e.g. for point cloud alignment and without scale. In that case it is called Kabsch algorithm. Note that either Kabsch nor Umeyama methods for point cloud registration has been presented at the lectures.