

Advanced Robotic Perception: Lecture 10

Lecture Notes

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October 12, 2023

1 Camera-Robot calibration

- Eye-on-hand / eye-in-hand
- Eye-on-base / eye-to-hand

1.1 Eye-on-hand - Theory

We find transformations from the base of the robot to the end effector, and a transform from the camera to the end-effector, and then from the object to the camera. This way we can compute the transformation between the object relative to the robot base.

Then you can take multiple positions of the camera, and then we can equate them to one another.

The camera to the gripper transformation is unknown.

Rearranging the equation gives: $AX = XB$ Where

- A is the robot transformations
- B is the camera transformations

Seperable solutions Estimate rotation, **and then** the translation

Simultainously solutions estimates and rotation and translation together.

1. Mount camera
2. Take images of checkerboards
3. Calibrate camera \rightarrow extract the extrinsic parameters.

Note: the checkerboard must be fixed, but can be placed anywhere, because we use the relative pose between the measurements, and not the absolute positions.

Note: This method is only applicable if you do not know the actual transformation between the gripper and the camera mounted on the robot.

1.2 Eye-on-base - Theory

Here we place the checkerboard on the end-effector and move that around. Then we can estimate the camera to base transformation.

Note: that ${}^gT_t^{(1)}$ is the transformation from the calibration target (checkerboard) to the gripper. and it is the first measurement.

The base-gripper transformation is inverted compared to the other cameraplacement.

1.3 Other methods and variations

- Naive approach, \rightarrow manual allignment
- 3D printed camera mount where we know the actual position.