Solving the robot-world hand-eye(s) calibration problem with iterative methods

Machine Vision and Applications

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Abstract

Robot-world, hand-eye calibration is the problem of determining the transformation between the robot end-effector and a camera, as well as the transformation between the robot base and the world coordinate system. This relationship has been modeled as \( AX = ZB \), where \( X \) and \( Z \) are unknown homogeneous transformation matrices. The successful execution of many robot manipulation tasks depends on determining these matrices accurately, and we are particularly interested in the use of calibration for use in vision tasks. In this work, we describe a collection of methods consisting of two cost
function classes, three different parameterizations of rotation components, and separable versus simultaneous formulations. We explore the behavior of this collection of methods on real datasets and simulated datasets and compare to seven other state-of-the-art methods. Our collection of methods returns greater accuracy on many metrics as compared to the state-of-the-art. The collection of methods is extended to the problem of robot-world hand-multiple-eye calibration, and results are shown with two and three cameras mounted on the same robot.

**Keywords**

Robot  Hand-eye  Calibration  Reconstruction

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