A Linear Extrinsic Calibration of Kaleidoscopic Imaging System from Single 3D Point
Kosuke Takahashi, Akihiro Miyata, Shohei Nobuhara, Takashi Matsuyama (Kyoto Univ.)

Experiments: Simulation
Evaluation of our proposed method under the observation noise.
[Baseline] Zhang’s method with a chessboard.
Proposed method (5 points) + BA
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Error of distances (mm)
Error of norms (rad)
Reprojection error (pixel)

Experiments: Real data
Evaluation of our proposed method with real data. [Baseline] Zhang’s method with a chessboard.
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AquaVision
Purpose
Ø

Final goal: 3D Reconstruction of micro-scale objects
Our goal is 3D reconstruction of an object with a single 3D point of unknown geometry. It is difficult to capture multiview images with multiple reference points.

Outline of this work
This paper proposes a new linear extrinsic calibration method of kaleidoscopic imaging system from a single 3D point of unknown geometry.

Conventional method
Zhang utilizes a reference object of known geometry such as a chessboard.

Contributions
This paper proposes a new linear extrinsic calibration method from a single 3D point of unknown geometry.

Method
Proposed + BA
Baseline (5 points) + BA

Error of distances (mm)
Reprojection error (pixel)

Application: 3D reconstruction
Right figure shows a 3D rendering of the estimated 3D shape using the mirror parameters estimated by the proposed method. These results show the proposed method provides a sufficiently accurate calibration for 3D shape reconstruction.

Proposed method
Input: microscope mm, microscope mm, microscope mm
Microscope
(a) Calibration
(b) Results

Mirror normal and distances
Mirror normal
Distances

Results

Setup
Camera
Projector

Proposed method (5 points) + BA
Error of distances (mm)
Reprojection error (pixel)

Input
Camera

Problem
It is difficult to capture multiview images with multiple microscopes due to physical constraints.

In this work, we utilize a virtual multi-view system with planar mirrors.

KIS: Kaleidoscopic Imaging System

Camera
Projection
Mirror

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