Display-Camera Calibration from Eye Reflections
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Objective

• Estimate display pose in 3D camera coordinates
  • Analyze patterns reflected in cornea of human eye
• Easy to use
  • No external hardware (e.g. mirror)
  • No tedious user interaction (e.g. move device, parameters)
• Controlled illumination system for everyday environments
• Applications:
  • 3D object reconstruction
  • Human computer interaction

Eye Model

Reflected Patterns on Eye Surface and Our Idea

• Reflected patterns on eye surface can be observed from camera images
• Eye positions can be observed from view of the iris

• We can estimate display-camera relations by using eye position, eye model and reflections!

Method

1. Capture face images where the patterns on display are reflected
2. Estimate eye poses using imaged iris and corneal boundary
3. Estimate 3D ray equations from reflected patterns (on eye surfaces) using eye model and eye pose
4. Find intersections of 3D rays (initial estimation)
5. Optimization using display size and geometric restrictions of patterns

Error Evaluation, Setup and Calibration Results for Eye and Mirrors for different Display Orientations 0, 10, 20, 30 and 40 degrees (Before and After Optimization)