Automated Multi-camera Calibration in Real Time

Sambuddha Sarkar[1], Siddharth Raina[1], Yiqing Cai[1], Huan-Yang Chang[1] and Man-Ning Chen[1]
1. Robotics Institute, Carnegie Mellon University

Sponsors: Oculus VR, Facebook
Advisors: Yaser Sheikh and Hatem Alismail

Motivation

In this day and age of automation, camera calibration still relies heavily on human labour and intervention. With Oculus behind us, we wanted to change that.

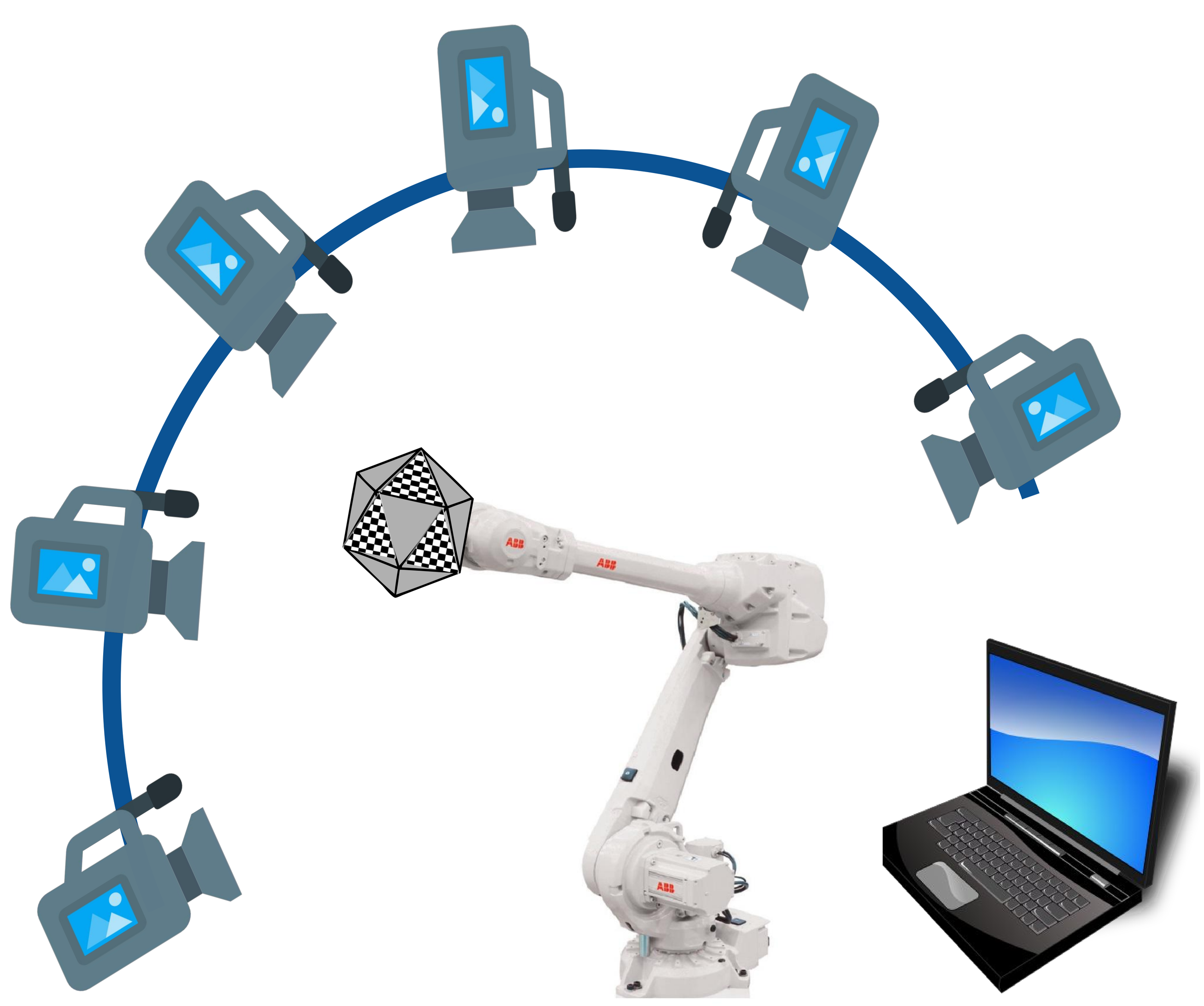
Problem Statement

To design a turnkey solution for automated calibration of multiple cameras in a constrained environment with minimal human intervention.

This system should exceed if not match the accuracy, reliability and precision of the existing methods employed in camera calibration.

Conceptual Design

The scope of the project involves calibrating sensors accurately using a robotic arm, a terminal with server access and calibration targets which would be attached to the end effector of the robotic arm.

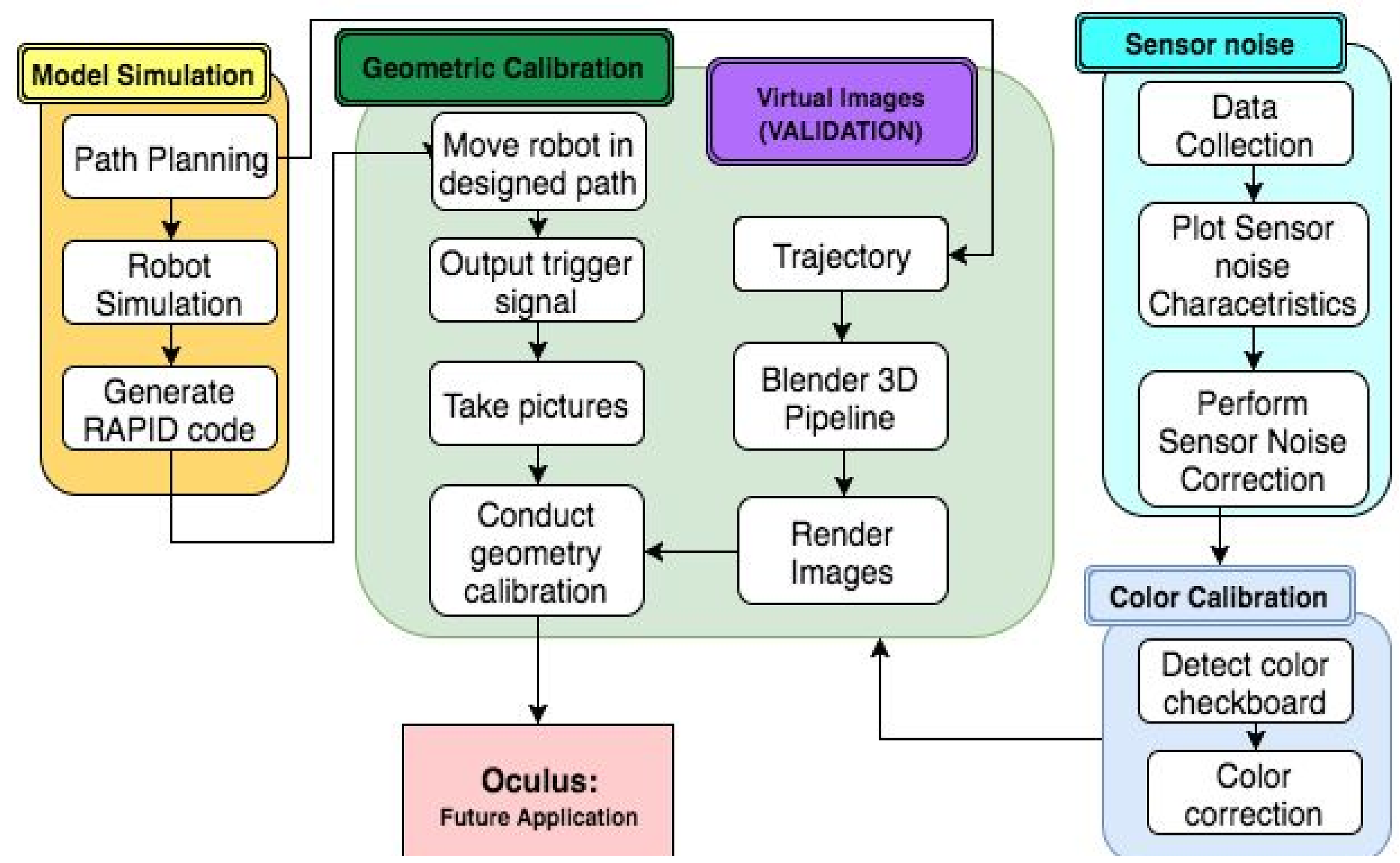


The calibration process employs three methods, namely:

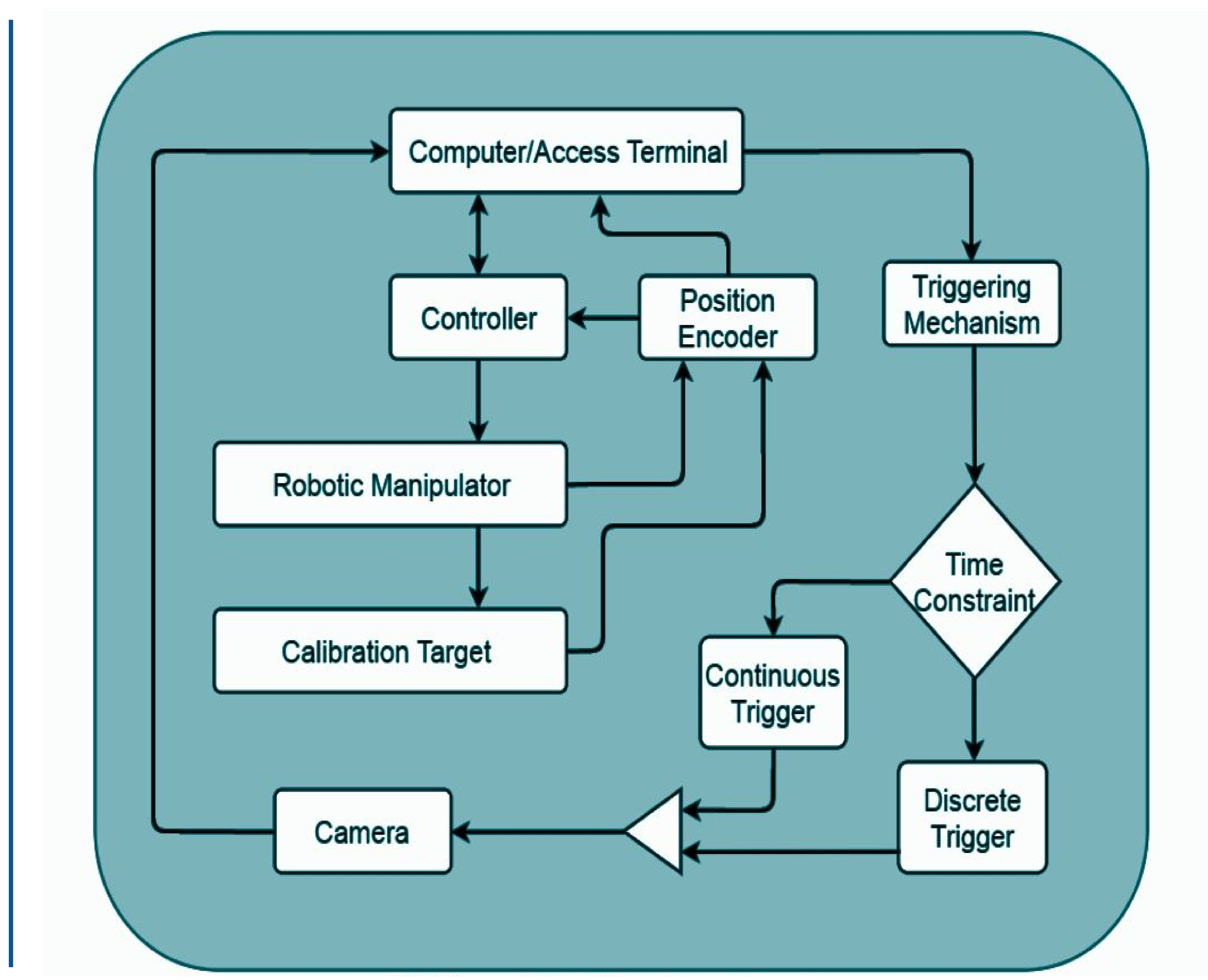
- Sensor Noise Calibration
- Color Calibration
- Geometric Calibration

Implementation

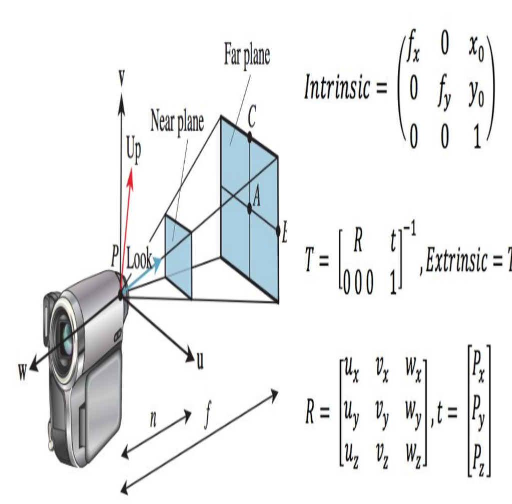
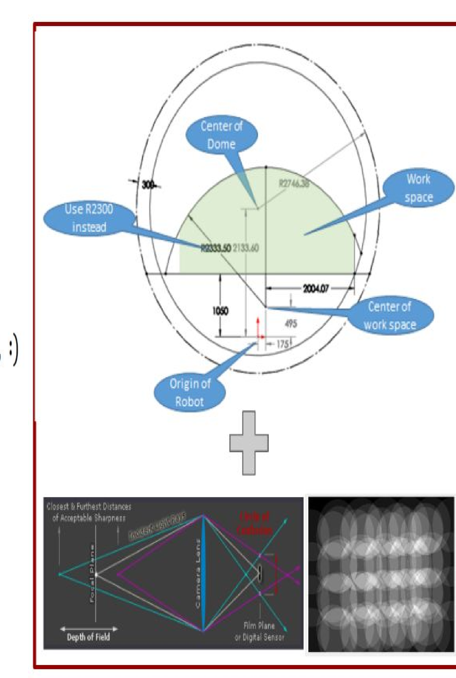
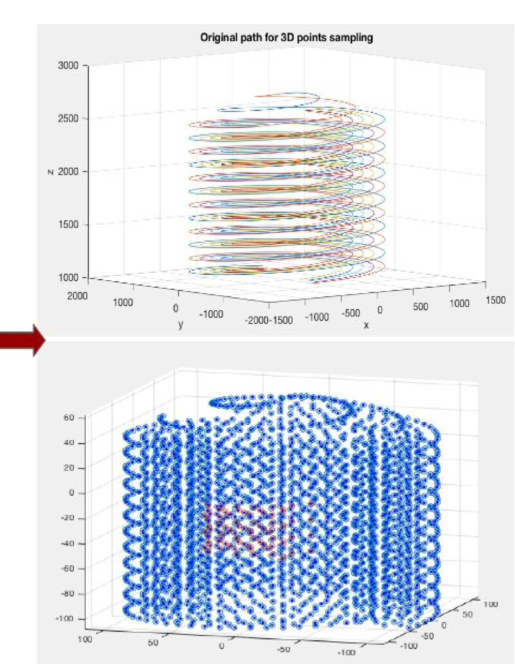
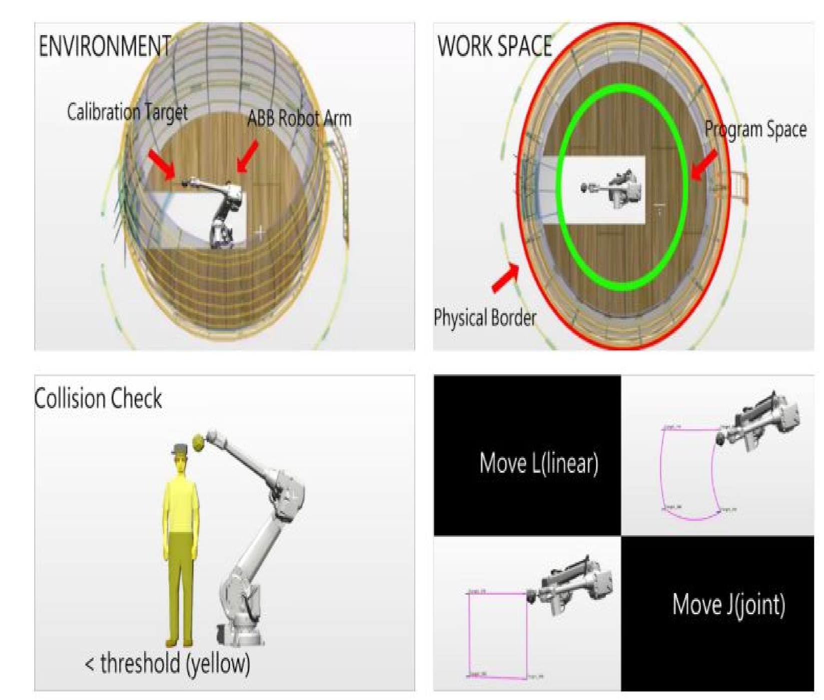
Functional Architecture



Robotic Subsystem

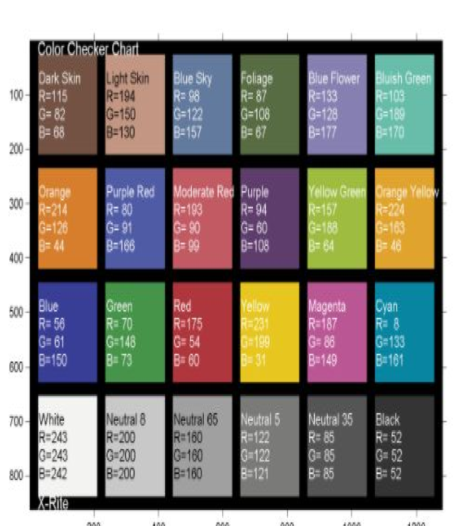
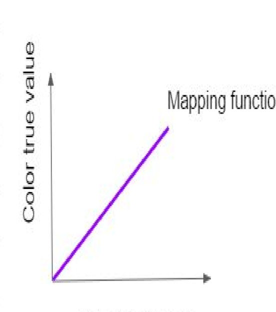


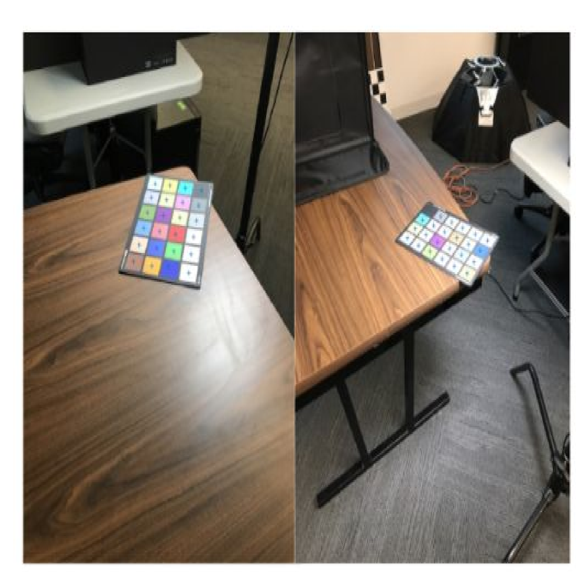
Subsystem: Robotic Image Capture

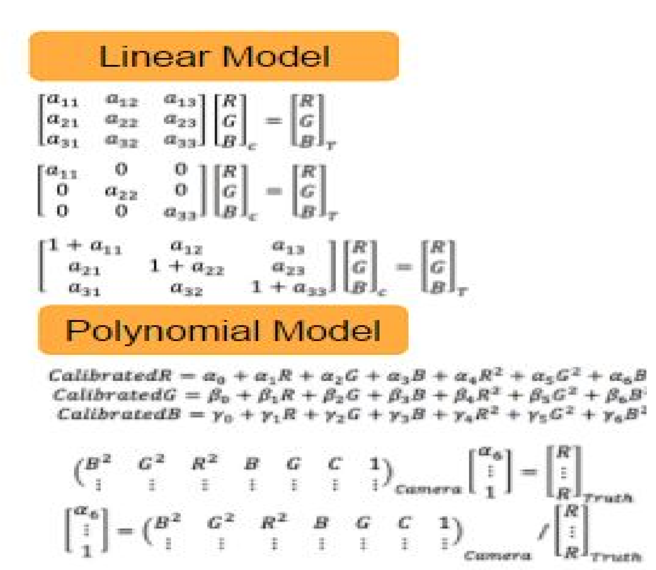





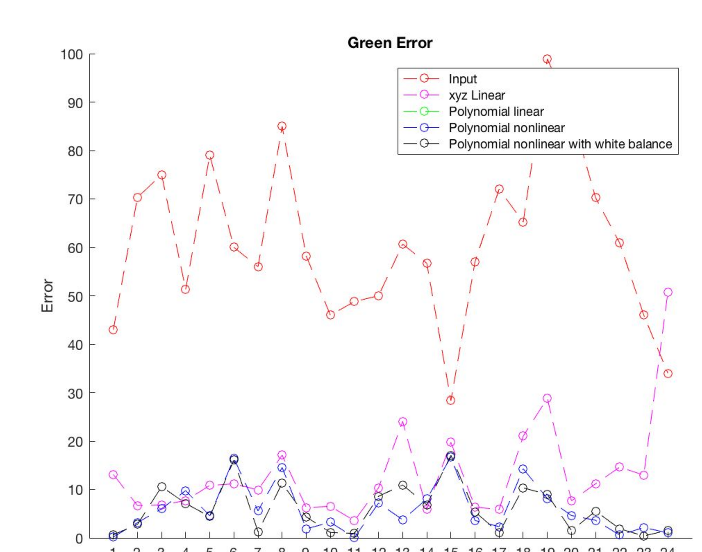
Camera Model | Path Generation | Robot Simulation | Real System

Subsystem: Color Calibration





Ground Truth | Auto-Detection & Segmentation | Mapping Model | Error Analysis

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oculus facebook

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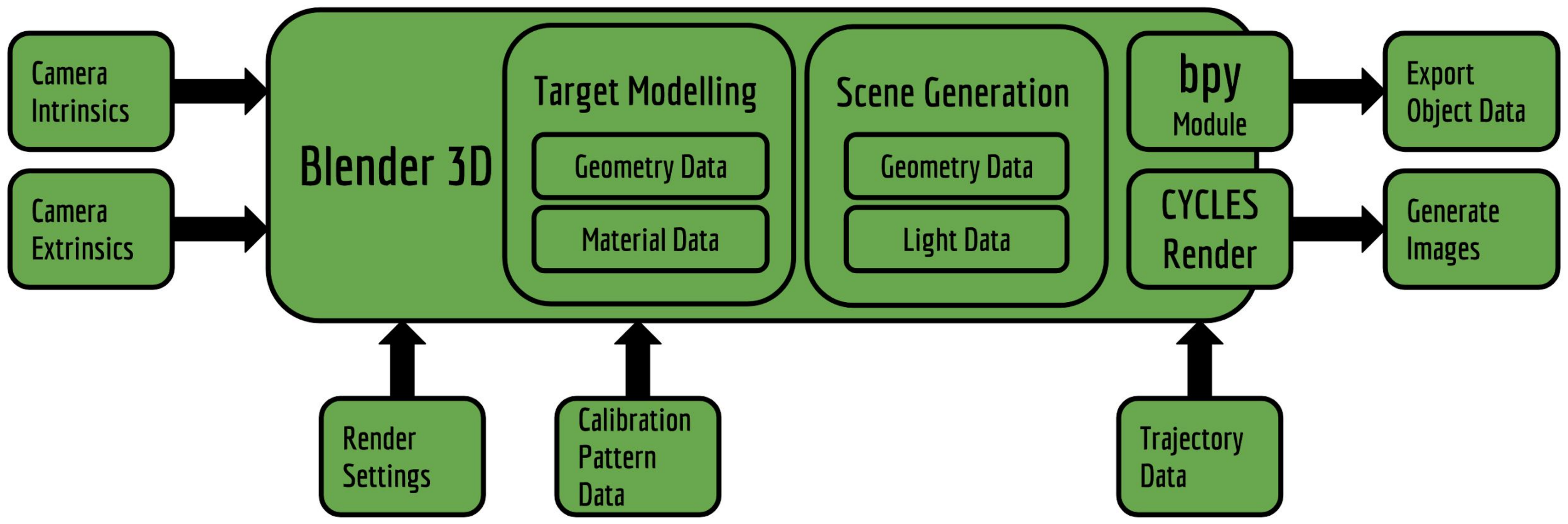
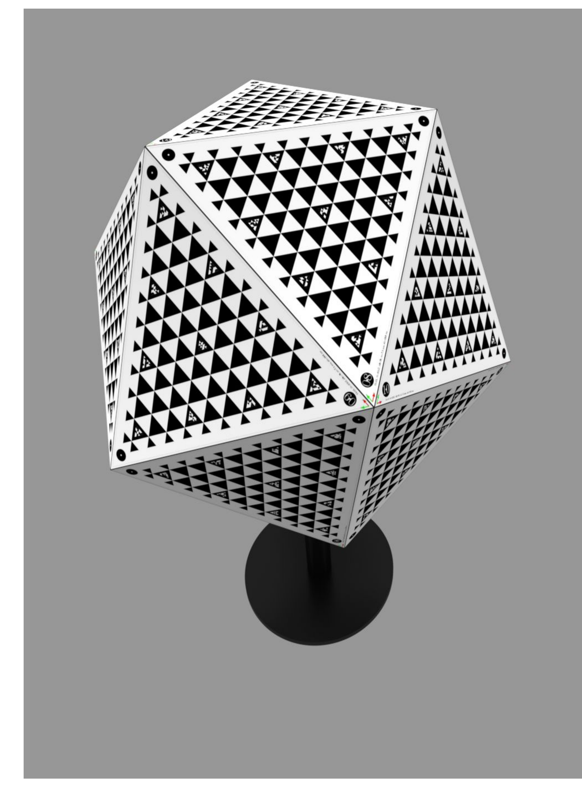
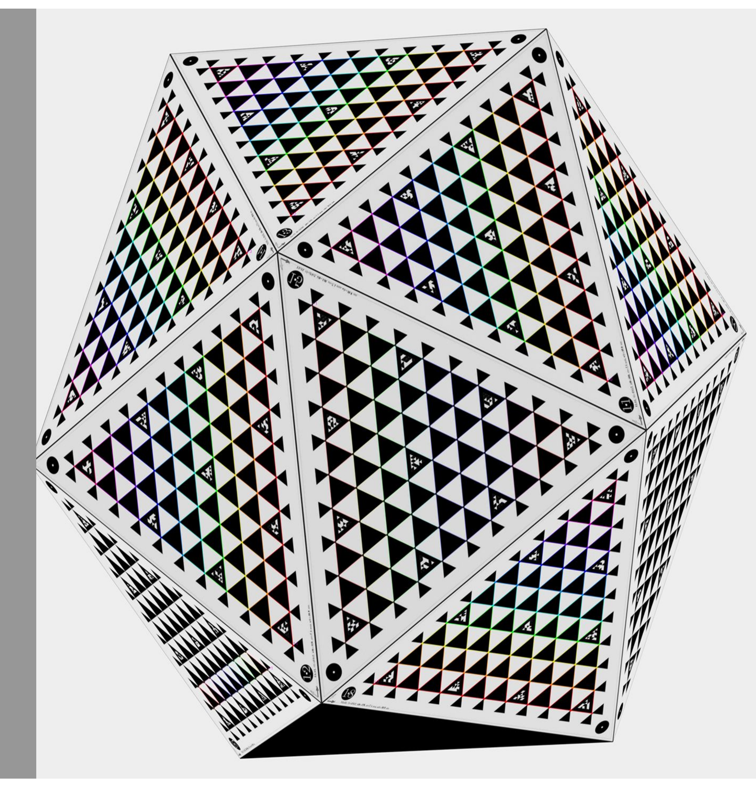
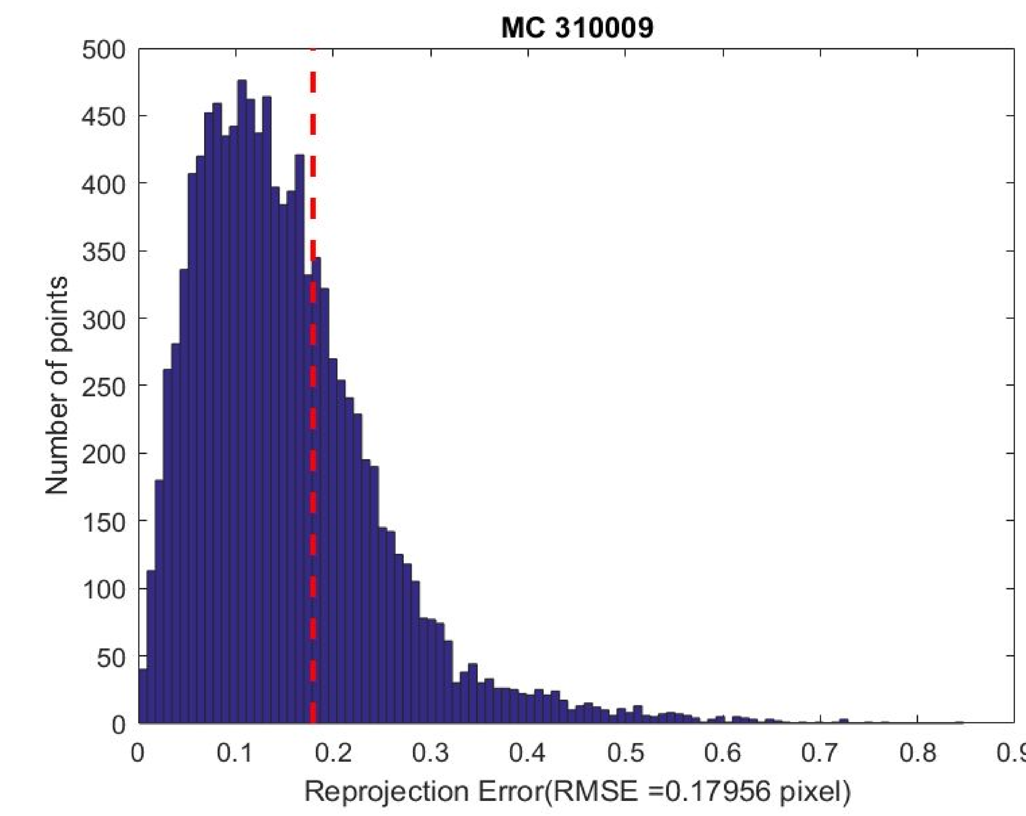
Subsystem: Synthetic Images & Geometric Calibration Validation



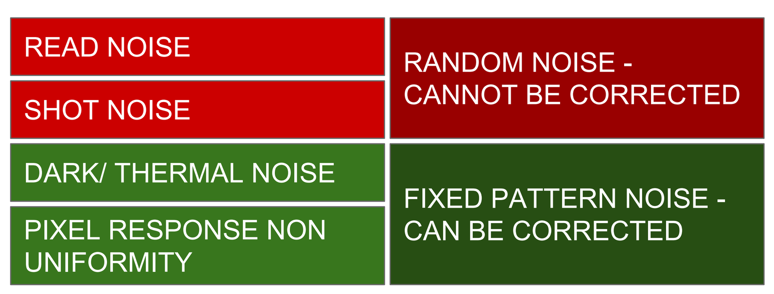


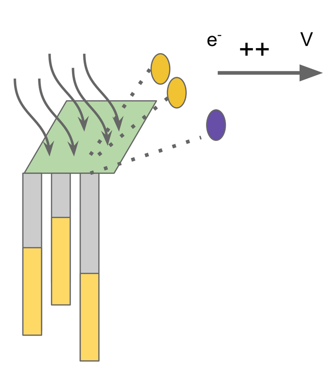


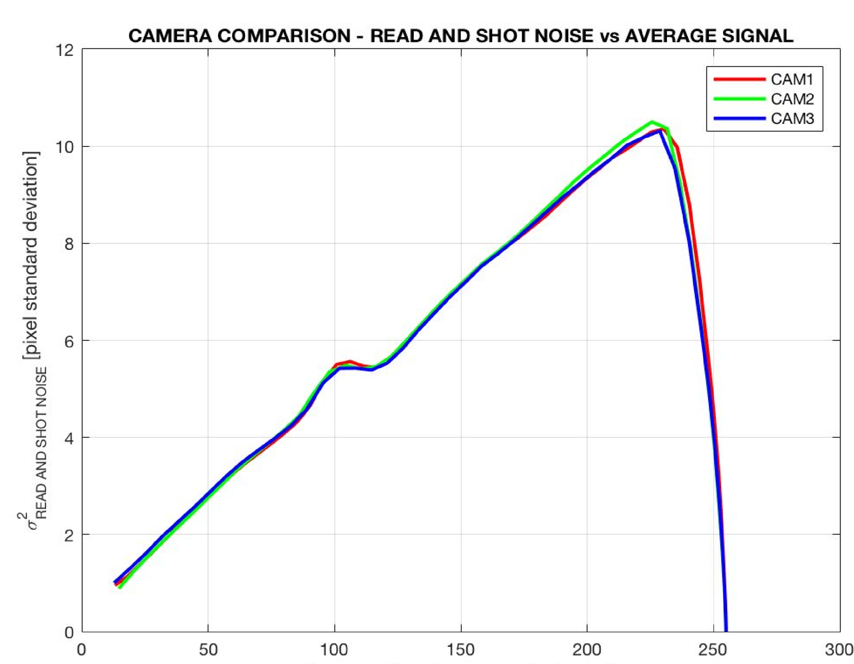


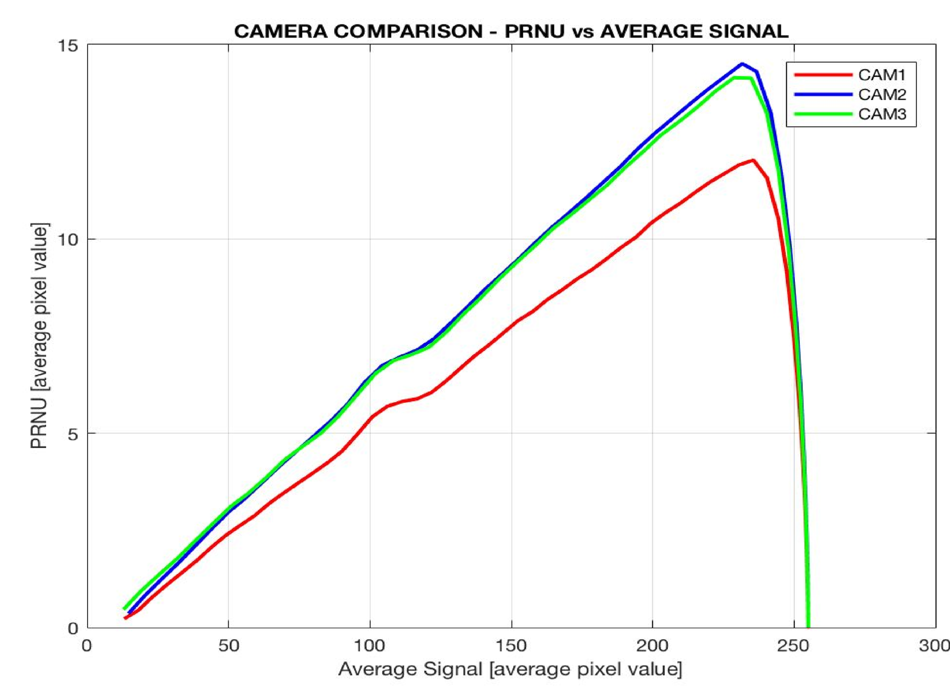
Blender 3D Image Generation Pipeline | Calibration Target: Model | Corner Detection | Geometric Calibration Result

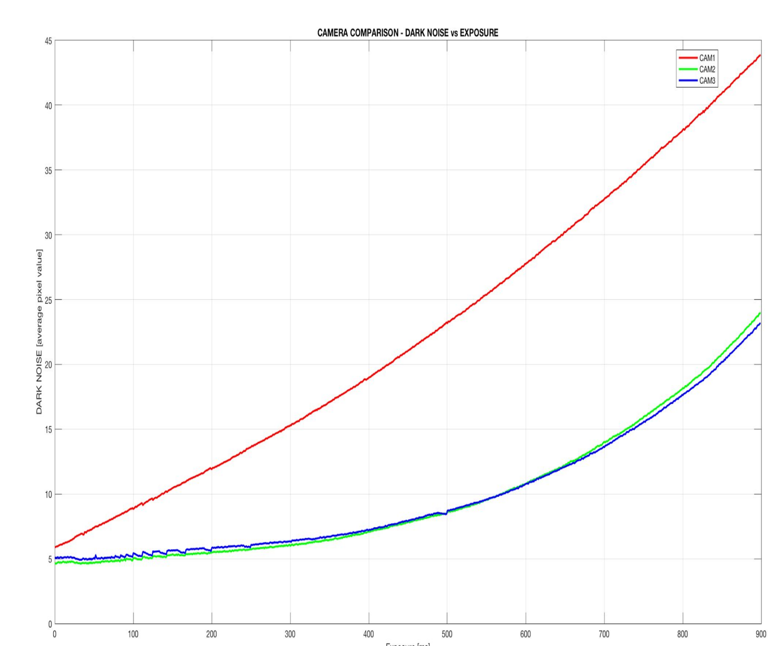
Subsystem: Sensor Noise

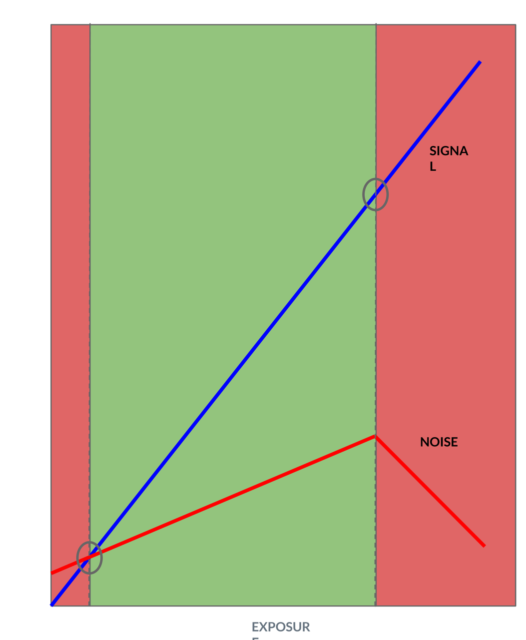




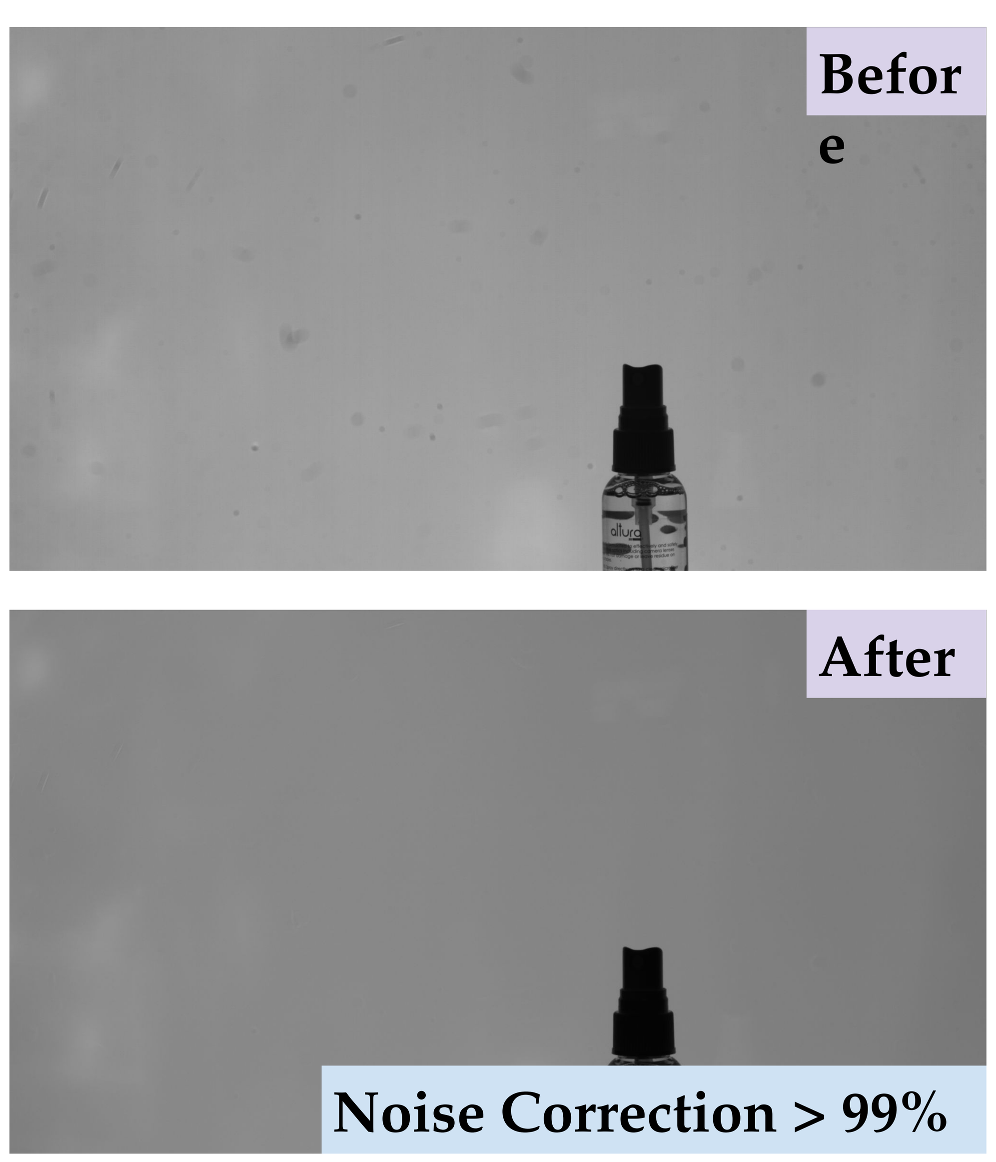


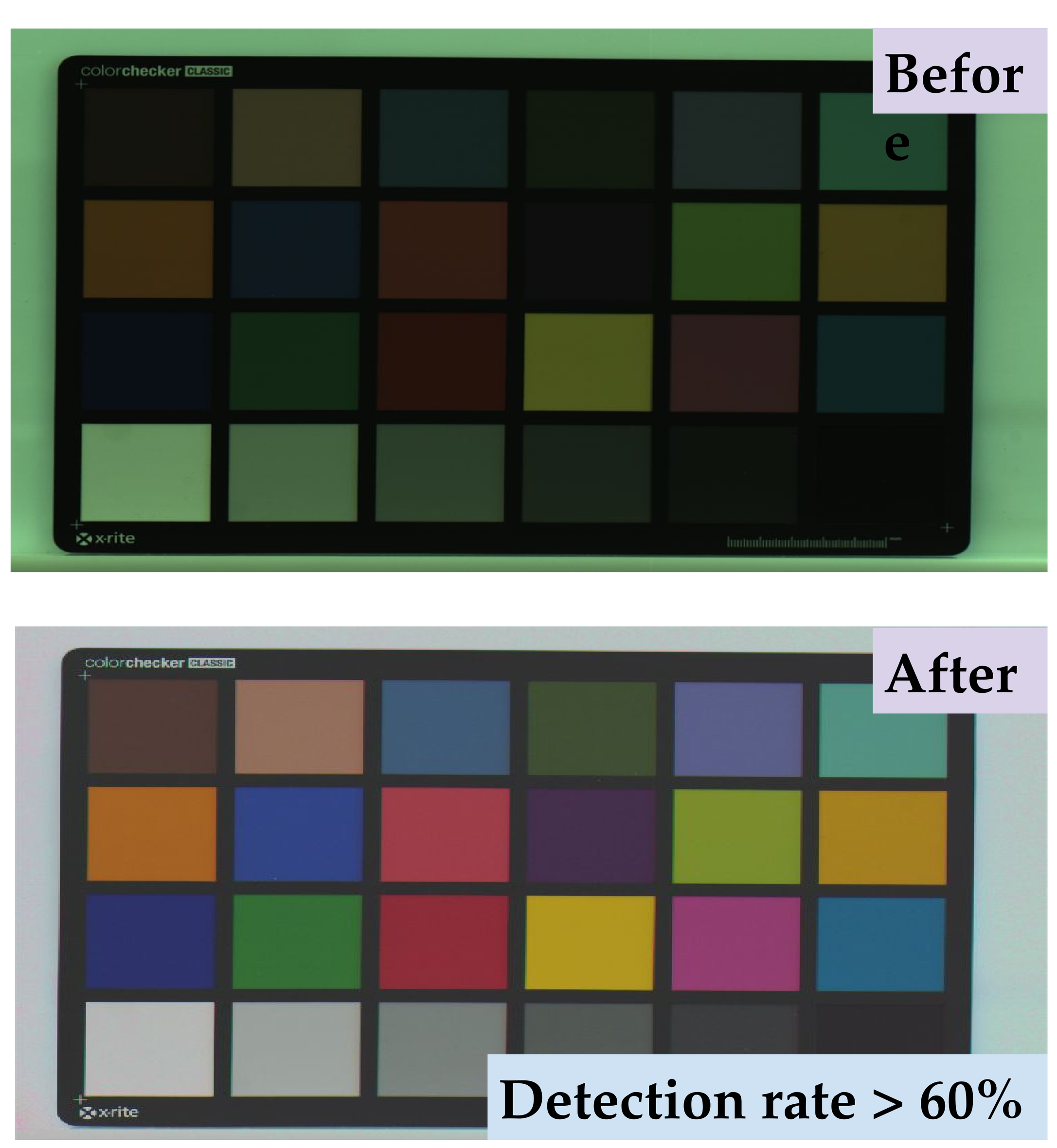


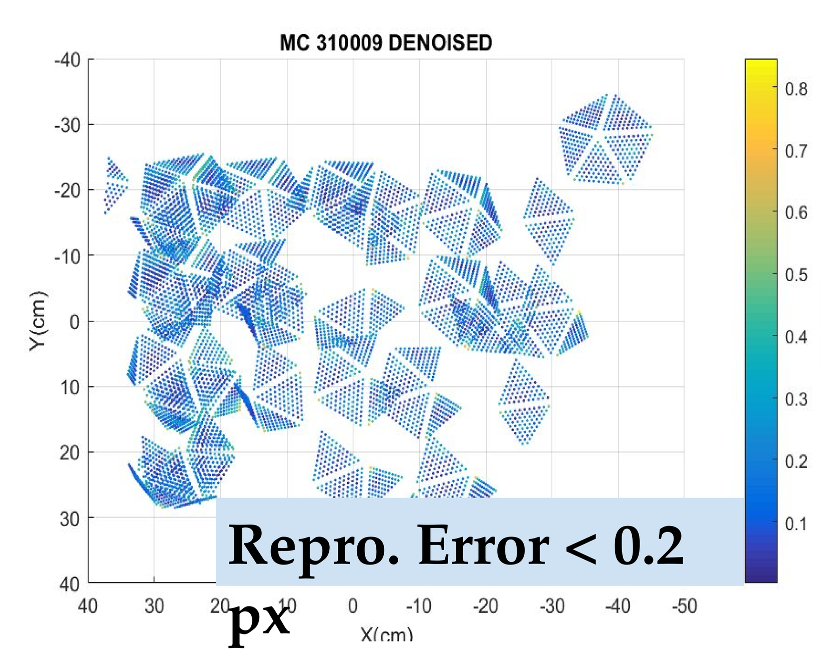


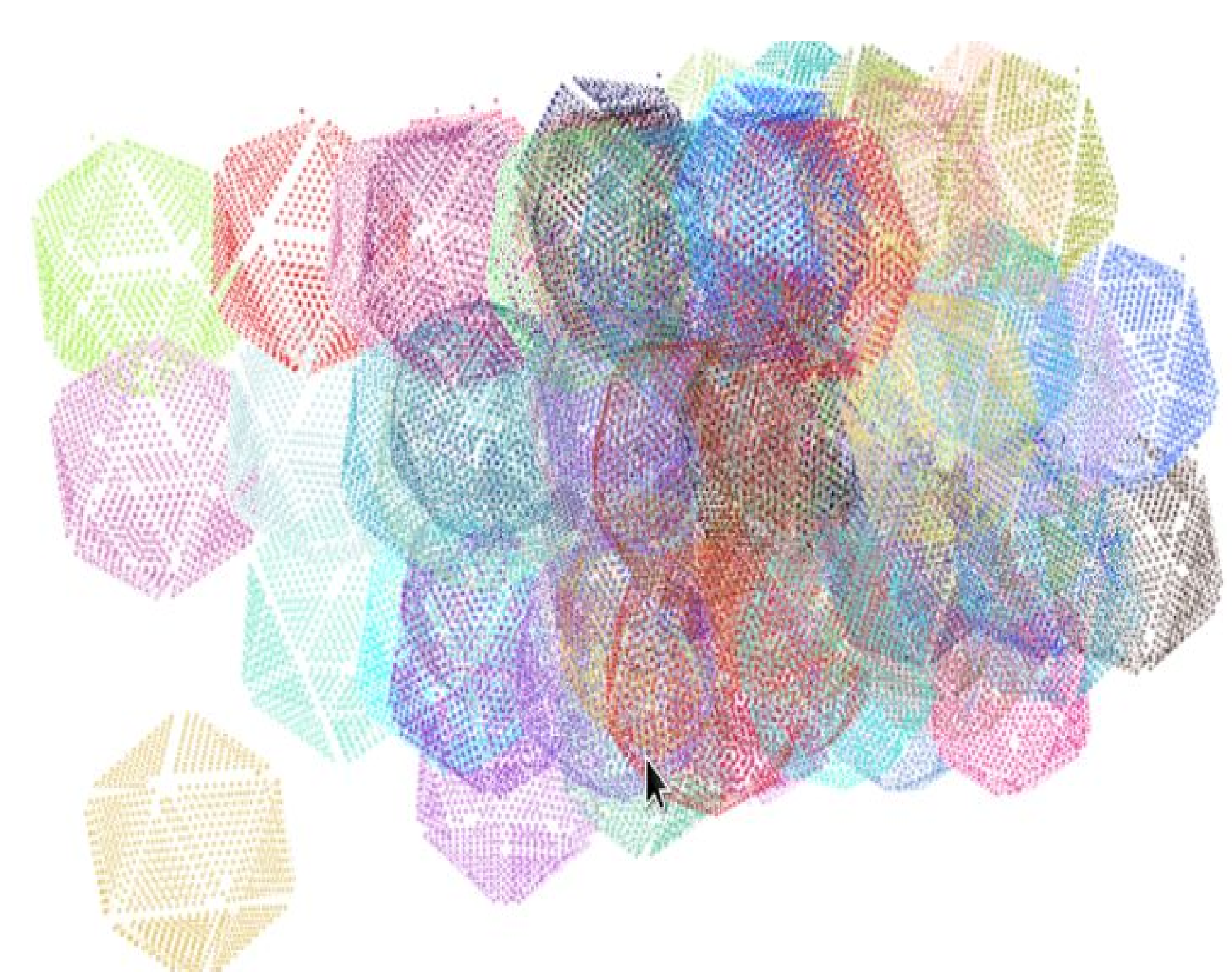


Results









Sensor Noise Calibration | Color Calibration | Geometric Calibration | 3D Reconstruction