

Problem Statement

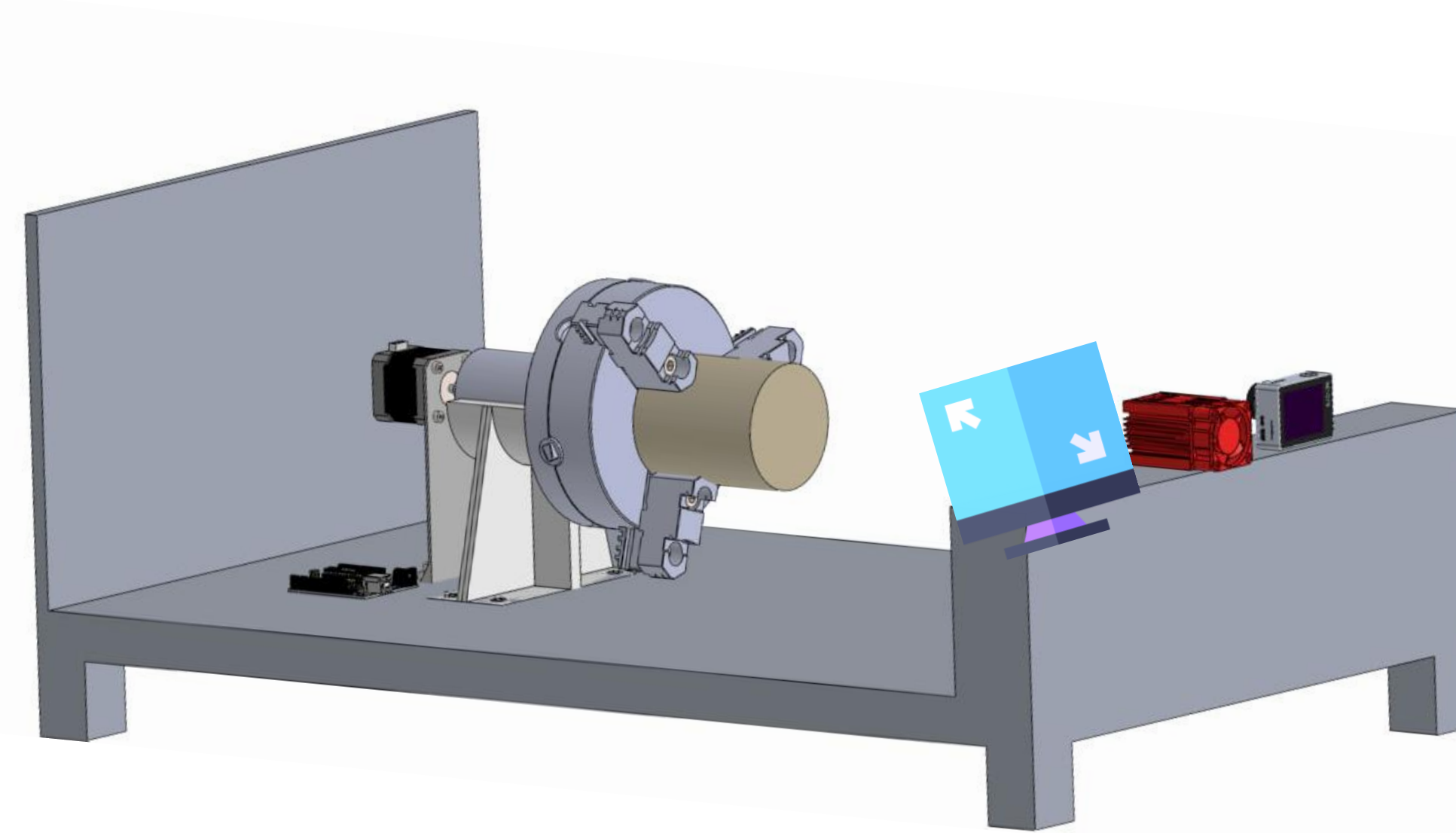
Core analysis properties are direction-dependent due to anisotropy, yet current manual handling practices fail to preserve angular consistency, creating a critical need for a reliable system to mark, detect, and restore core plug orientation between lab experiments.

Objectives & Solution

The aim of this project is to implement a system capable of tracking angular orientation between lab experiments without damaging the rock samples using laser-based system to impose reference marks which aid in having consistent direction in order to maintain accuracy and track any encountered changes along with their attributions. The proposed system should:

- Identify rock sample
- Impose a laser tick mark
- Detect the angle of the current sample
- Automatically retrieve reference angle

Prototype Design



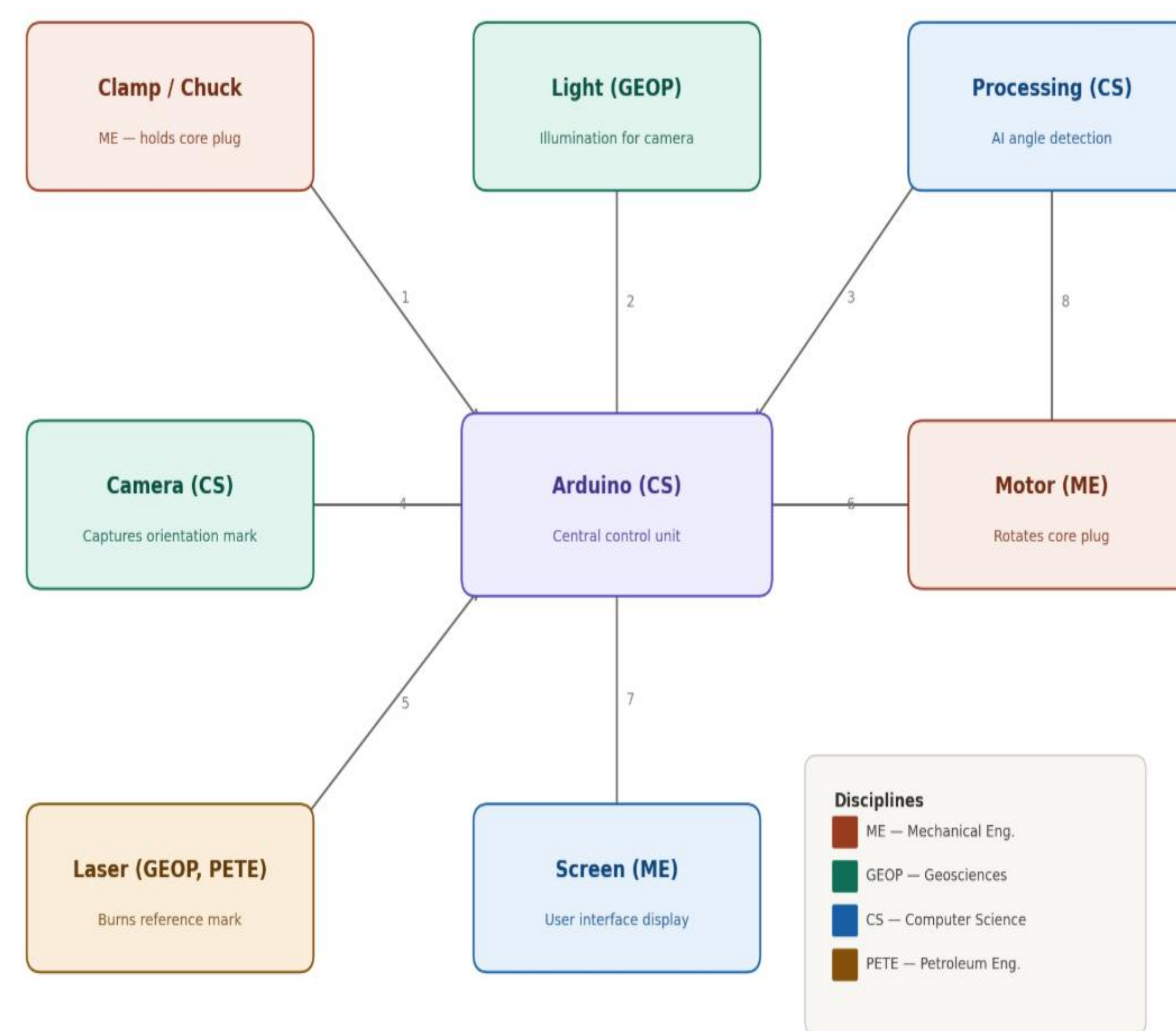
Final Design



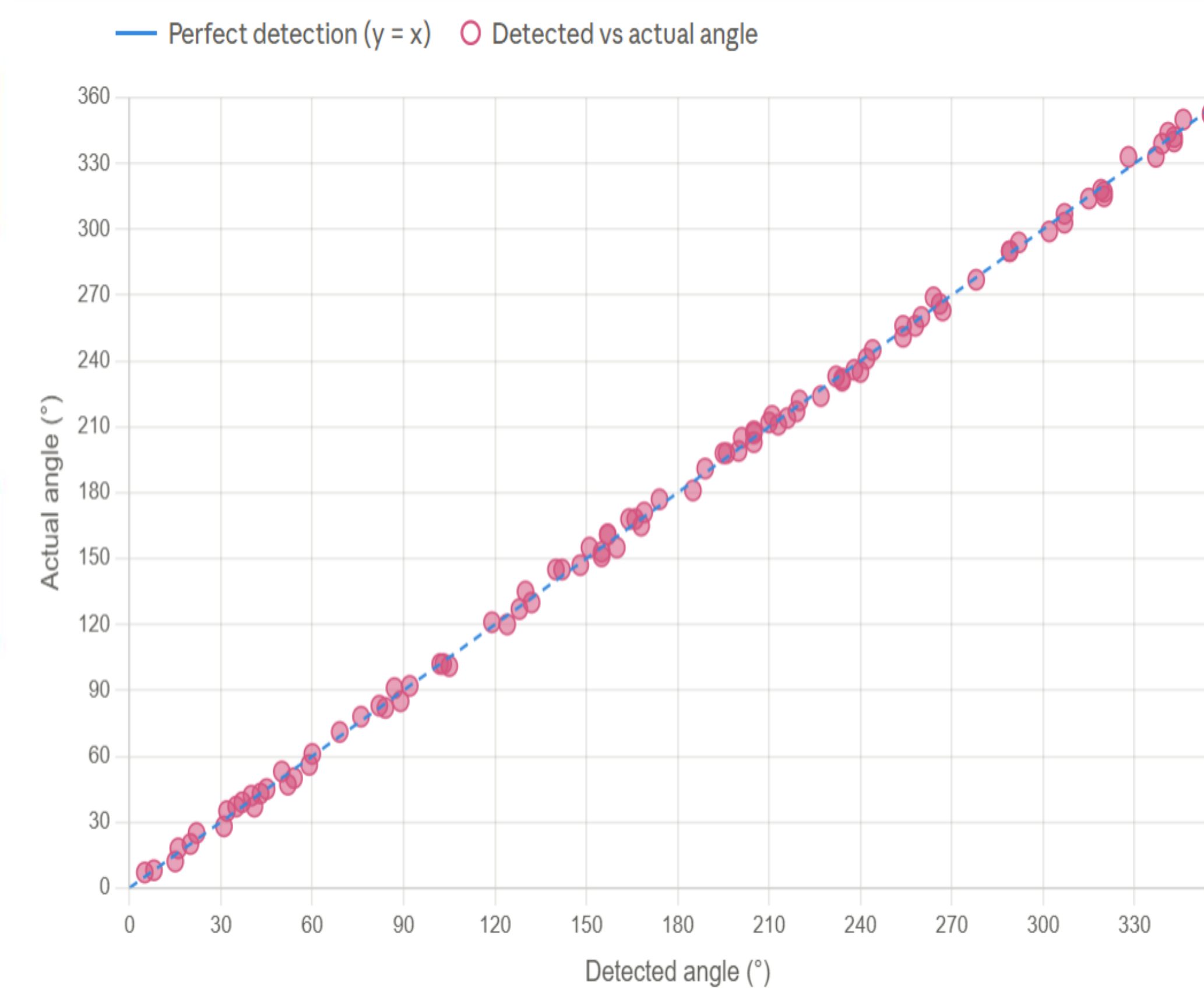
Constraints & Specifications

1. Laser mark should not alter rock properties including porosity and permeability, with maximum limit of 1% change
2. Platform stability while imposing laser mark must be < 0.5 cm to prevent misalignment
3. Angular difference between repeated insertions of sample does not exceed $\pm 5^\circ$
4. Orientation verification/re-alignment must be fully automated with 0 user-dependence
5. Compatible with standard rock dimensions 1.5" in diameter and 2" in length.
6. Software reading and output status must be done within 7 secs
7. Class II/III Laser
8. Detection time < 10 s
9. Platform deflection < 0.5 mm
10. Software response < 500 ms
11. Maximum mass loss of core sample is less than 1%
12. Motor rotation speed < 5 rpm
13. Measured values shall vary smoothly and consistently with orientation angle.
14. Maximum tick mark diameter is 1.5 mm
15. Frame load capacity up to 10 kg
16. System power efficiency < 0.75 kW
17. Re-alignment time < 1.5 mins

Deliverables



Testing & Validation



Images tested	Mean abs error	Max abs error	Within $\pm 5^\circ$
100	1.35°	4.78°	100%