# COLORADO

Jack Carver Project Manager

# Motivation

- KLA designs & manufactures equipment to support the semi-conductor industry
- Semiconductors used in digital consumer products — are printed on 300 mm silicon wafers
- Every silicon wafer must have a defined coordinate system with a known center
- KLA's current center-finding process takes over 8 seconds

# **System Requirements**

#### Our team was tasked with meeting the following requirements:

- $\checkmark$  Find the center of a wafer to  $\pm 10 \ \mu m$  accuracy
- Center finding algorithm shall be 99.7% repeatable
- Inspection time shall be under 2 seconds
- **Existing camera shall remain in its current** position
- Additional camera shall be positioned according to a viewport in the KLA's current inspection chamber
- Cameras must be able to fit within the existing inspection chamber

# **Test Plan**

### Our team designed 5 test plans to verify the given requirements:

- **1. Lighting**: One set of images at a position with the wafer edges clearly within view of both cameras
- **2. Repeatability**: 400 sets of images at a stationary position
- **3. Accuracy**: 30 sets of images at a primary position; additional 30 sets at a secondary position a known displacement away
- 4. Randomized Displacement: 30 sets of images taken at random positions within a 200 μm range
- **5. Throughput**: Total time required by the system to capture images

## Hank Kussin-Bordo Marty LaRocque Prem Griddalur Dario Garcia CAD & Manufacturing Engineer Electro-Mechanical Engineer Logistics Manager Systems Engineer *80/20 Aluminum* Existing Camera Frame Cameras • Existing camera imitates the one in KLA's inspection chamber

 Additional camera achieves the desired accuracy

> Laser Displacement Sensor



# **Center Finding Algorithm**

- Cameras are calibrated by measuring the observed distortion in a feature with known dimensions
- Points are found at edge of wafer by observing the magnitude and direction of intensity change in pixels
- Candidate edge points are refined by moving each point perpendicular to the edge until all points are at the same intensity

Ben Cloud

Wafer Alignment Stage

• Y-shape stage fully

for flatness

constrains the wafer

Stage is precision ground

- A circle is fitted to the edge points in both images, and the center of the circle is taken as the result

Salam Harb

Tarunark Singh



✓ Throughput — Total image capture time less than 2 seconds

**0.1 sec** 

**T**hroughput