Single-Camera Stereoscopy for Wafer Detection

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Research Question: How can we improve existing metrology tools used in semiconductor manufacturing?

Advancing Stereoscopy

- Stereo vision collects 2D images from two cameras, applying an algorithm to produce 3D images
- Our research project removes the second camera, which reduces the need for calibration and lowers the system cost.
- Interest in this technology comes from mid-scale OEMs that cannot afford to use atomic-force microscopy but need 3D capabilities. It also has applications in education and research work.

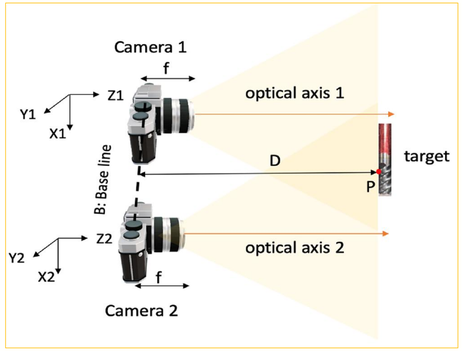

Fig 1. Working Principle of Stereoscopy [1]

National Science Foundation Regional I-Corps

- As a team, our research lab participated in NSF I-Corps + SEMICON West in October, with many major industry players in attendance
- By surveying those in the industry, we determined a need for other kinds of sensing as well.
- We want to see how we can expand our sensor stack and improve algorithms to match the industry trends we discovered
- Overall, this experience was invaluable to breaking down and understanding each part of the semiconductor industry to better inform our research.

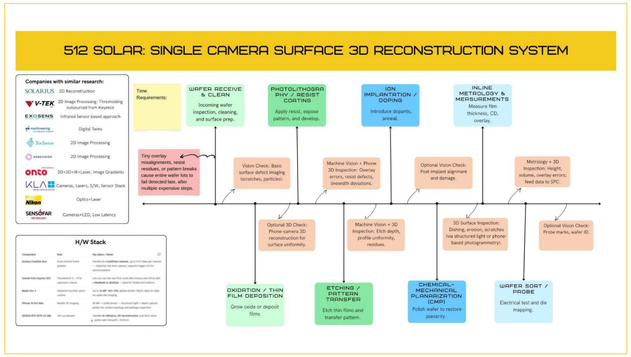

Fig 2. Workflow Diagram of the Semiconductor Industry

Current Prototype

- Our prototype uses a linear and rotational stage to manipulate the sample, while keeping the camera fixed.
- The prototype achieves 15 μm/0.08° translational/rotational accuracy
- Since the system can move the single camera to a variety of positions, we can achieve the same stereoscopic vision as two cameras.

System Improvements

- We will vary the light conditions (blink rate, color) using programmable LEDs
- We can create new prototypes with more sensing capabilities, as requested by various manufacturers
- Another area that we are exploring is achieving stereo vision using a mobile phone, which is ideal for the education and research applications. The phone's single camera is possible to use with our system, unlike traditional systems that need 2.

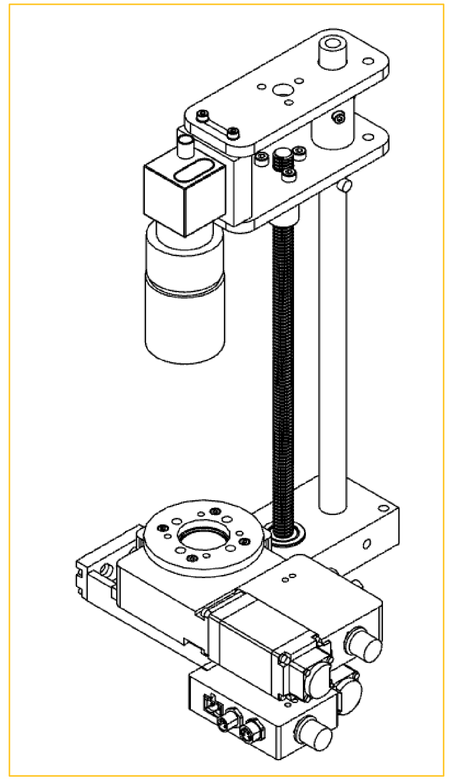

Fig 3. CAD Model of System Prototype

[1] X. Guo and C. Lee, "Preliminary study of phase-shifting strobo-stereoscopy for cutting tool monitoring," *Journal of Manufacturing Processes*, vol. 64, pp. 1214–1222, Mar. 2021, doi: https://doi.org/10.1016/j.jmapro.2021.02.053.

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