

SiPM visual inspection

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Motivation

- The surface of SiPMs is made of fragile epoxy, which can become scratchy during manufacturing—and this is not easily detectable to the naked eye-almost impossible
- It's visible if looked via HM microscope, but it gets pretty tiring when you have tens of thousands of SiPMs.
- We need a device that automatically takes photos of the SiPMs, which we will then classify using an appropriate algorithm

Hardware and Software

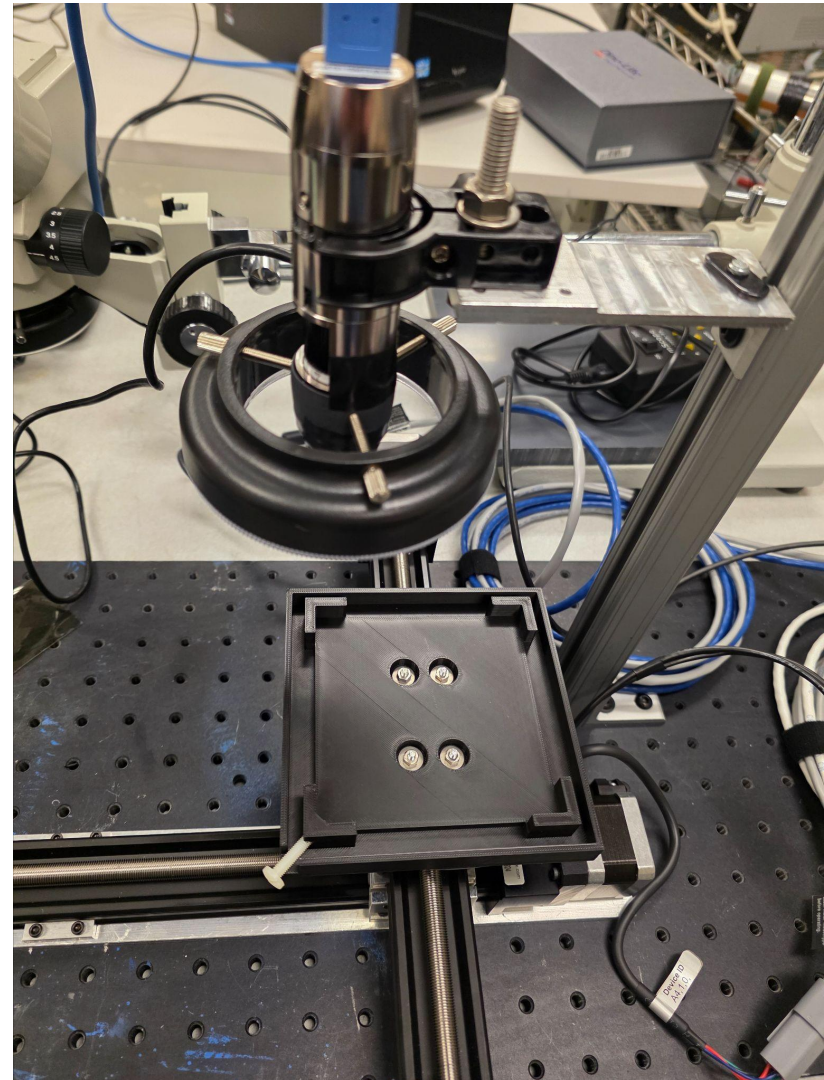
Velmex XSlide translation stage with VXC-2 controller.

Dino-Lite Edge 3.0 microscope.

I implemented the control and image capture using Python code

I installed it on the local PC; for now, the data is being saved to the computer's hard drive

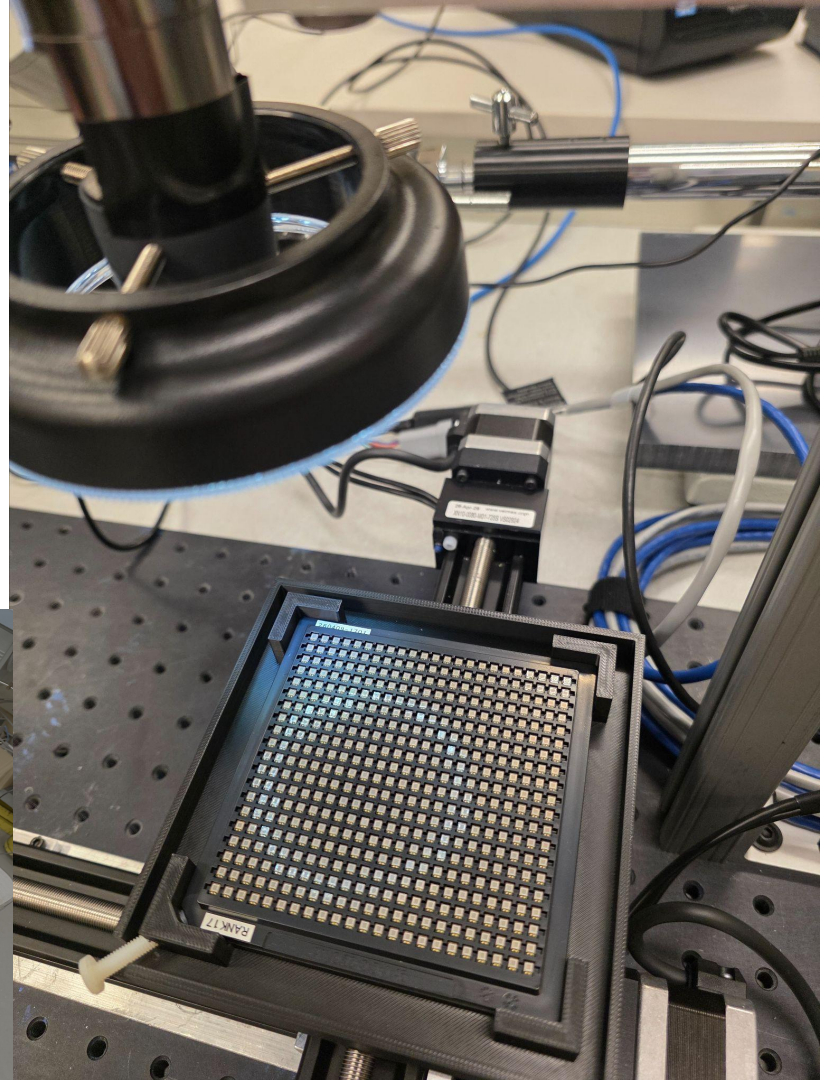
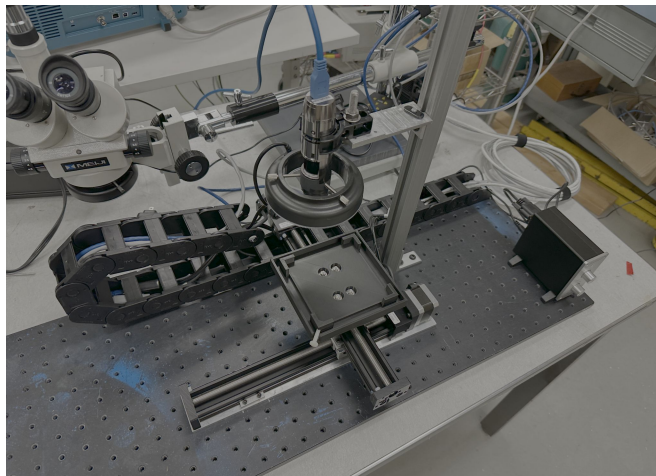
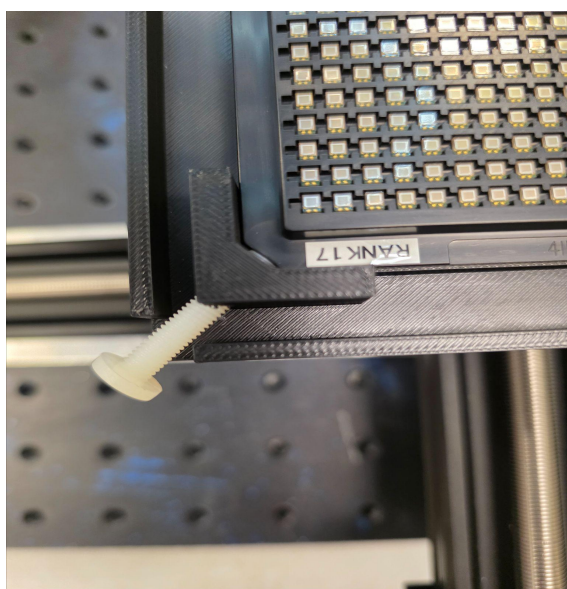
Based on the geometric data of the SiPM array, I wrote an algorithm that generates the positions for the photos relative to the specified origin (the first SiPM)



Operation

Fix the tray

Control the light intensity



GUI and result

Yale SiPM Automated Tester & Velmex Controller

Port (e.g. COM3 or /dev/ttyUSB0): /dev/ttyACM0 Disconnect Current Pos: X=0, Y=0

Manual Control & Machine Homing

Step Size: 20

Y- (Up)

X- (Left) HW Home Y X+ (Right)

HW Home X Y+ (Down/ Next Row)

Sync Zero (Set Current as 0.0)

STOP / KILL MOTOR

System Log

```
Laptop@0: sipm_k1y_L42.png
--- INSPECTION COMPLETE ---
Moving to Named Home 'zero'...
>> C
>> I1M-33440, I2M32680, R
<< ?
>> C
>> I1M20, R
<< ?
>> C
>> I1M20, R
<< ?
>> C
>> I1M20, R
<< ?
>> C
>> I1M20, R
<< ?
>> C
>> I1M20, R
<< ?
>> C
>> I1M20, R
<< ??????????
>> C
>> I1M20, R
<< ?
Moving to Named Home 'zero'...
>> C
>> I1M-140, R
<< ?
```

1. Inspection Dashboard 2. Calibration & Tray Setup

Image Save Location (Folder Manager)

Base Path: /home/operator2/sipm_project/SiPM_Images Browse

Tray Number / Name: Tray_260409-1702 Create & Set Folder

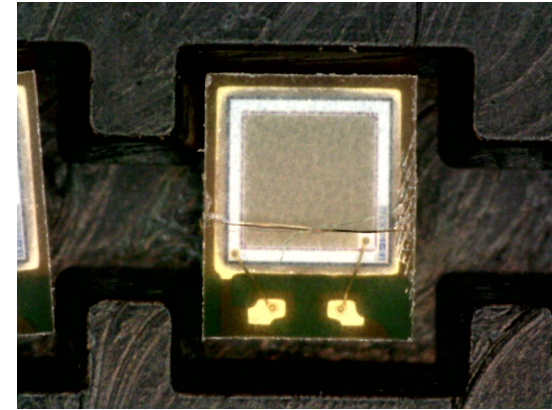
Current Output: /home/operator2/sipm_project/SiPM_Images/Tray_260409-1702

Pending Active Completed Error

SiPM Tray Layout (23 x 20)

Stop Live View

START INSPECTION EMERGENCY STOP



This is how the scratch will be visible on the SiPM

How to use it? (Step-by-Step)

Setup: Place the tray with the 460 chips onto the machine's table.

Connect: Open the program and click the blue *Connect* button so the computer takes control of the motors. If the port is not set to `/dev/ttyACM0` change it. It's on the left side of the Connect button. Name the tray and click on Create & Set Folder.

Start Camera: Click the *Start Live View* button. The program automatically finds the microscope and displays the live video.

Find the First Point: Use the X and Y arrow buttons on the screen (like a remote control) to move the table until the microscope is directly above the very first sensor. **The one in the top-left corner of the tray(set this point to 0,0)**. This sets the starting point for the grid.

Generate the Grid: Click the *Generate 460 Points* button. The machine now mathematically knows where the other 459 sensors are.

Start: Click the big green *START INSPECTION* button. Sit back, grab a coffee (far from the trays), and watch the machine automatically capture and save all 460 images into a neat folder!

Important things about the GUI

-Do not change the step size in the automatic generation.

1 mm=400 step

-When you locate the first SiPM, set the home point: Save Current Pos as Home (yellow button, Calibration & Tray Setup menu)

0.1 inch=1016 step

-Change the tray name every time and click on Create & Set Folder

-Make sure the bolt is tightened enough.