Computer Vision Algorithm for Automated Search and Categorization of the Crystallography of 2- Dimensional Crystals

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1 Introduction

In the fabrication process of Van der Waals heterostructures, the finding the relevant two-dimensional (2D) crystals for stacking is usually manually done. This means that researchers commonly will have to spend a large portion of their time assembling these heterostructures. Therefore in this project, we have automated the process of searching for desired 2D crystals by developing an easy-to-operate MATLAB application, thereby improving the efficiency of this assembly process. Different 2D materials will have their respective RGB colors, and by matching these colors to the said material, the desired material thickness can be searched. Further, this application can be scaled to categorize thicknesses (provided there is a RGB catalog of different thicknesses). In this automated search application, there are several main steps to begin searching. First, the features and image of the material is inputted. Then the search function is engaged which returns the location and size of the image. The specific layer will pick up by the algorithm, and a viewing function allows the user to visualize the layer picked up by the algorithm. And finally, the angles of the selected material can be determined.

2 Getting started with the application!

This application is compiled as a stand-alone desktop application.

2.1 Installation of MATLAB application

1. Download ZIP file from:
2. Unzip the zip file.
3. Auto_Crystal_Search $\rightarrow$ $for\_redistribution$ $\rightarrow$ $MyAppInstaller\_web$
4. Install the application to the desired location.

2.2 Running the application

In the ZIP file, I have also included some sample pictures of to run in the application.

1. To start the application, open the Auto_Crystal_Search $\rightarrow$ $application$ $\rightarrow$ $Auto\_Crystal\_Search$
2. After the application has loaded, go the the 'RGB Search' window and import 'test_image' (this application supports .jpg, .png, .bmp, .oct').
3. After the file is imported, this automatically opens the target image and you will have click on the color that you are targeting, and when you are done, press 'Enter' on your keyboard. Note: the more points of the color selected, combined with a reasonable variation of color, the more accurate this RGB search will be. This can be done by selecting approximately 50 points, and select the pixels close to the edge of the crystal. Tip: To better select the pixels, please expand the image window before selecting the pixels.

4. Next, click 'Load Data to Area Search', and go to the 'Area Search' window.

5. In the 'Area Search' window, import the same image file (there are two import functions to support searching of the same RGB values for different files).

6. After importing, press 'Search'. - The table shows the area (in pixels) of a crystal found, and its X and Y values (location).

7. Go to the 'Area Selected View' and click on 'Highlighted Overlay' to view the completed search.

2.3 Modifying the application

To modify the application to your desired use, you must first download the source codes as provided in the link above. Open these file in MATLAB, and go to App2.mlapp.

The Scripts in this files are test scripts which are inputted into the .mlapp files for the functionality of the application. You can add custom scripts and application functions to suit your needs.

2.4 How to implement the data gathered

For now, this application only supports searching one image at a time. However, if high resolution images are combined into a single image file, this can be imported into the application. After searching a specific image, we can then copy the entire table from the 'Area Search' window to analyze the location of the crystals, or to make useful this data for extracting this crystal.