APS Material Scanning

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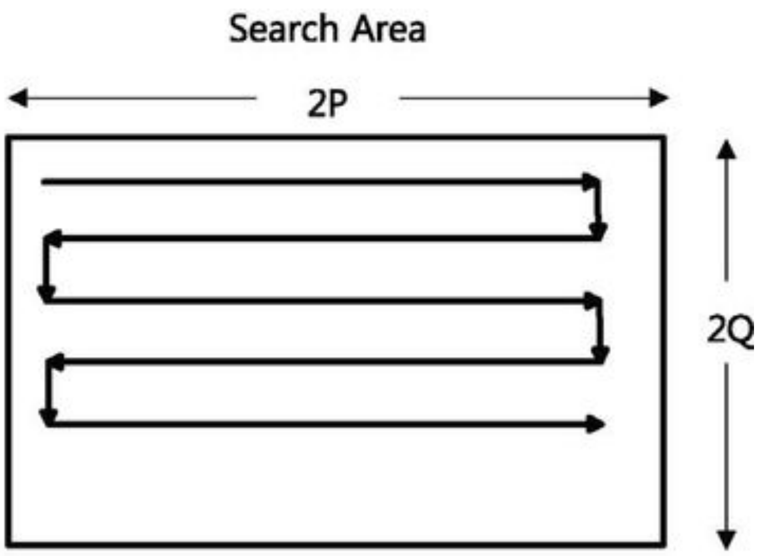
Overview

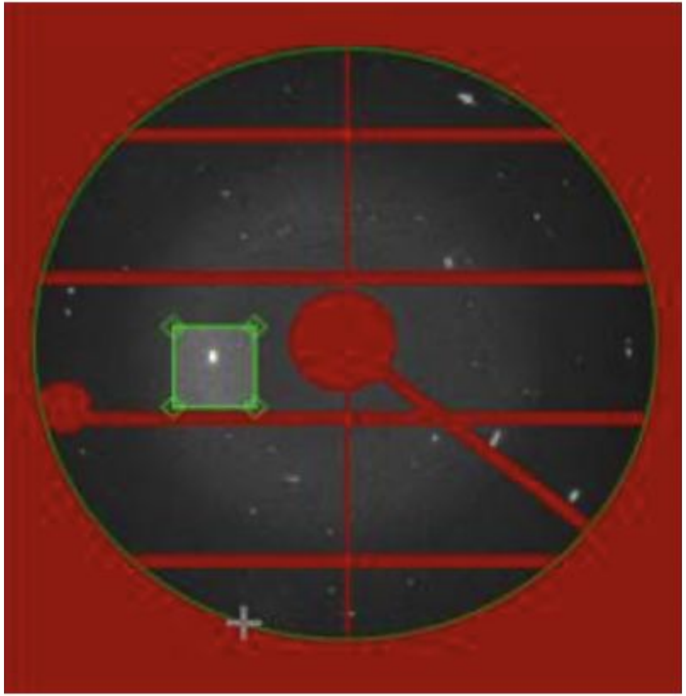


- Overall goal is to replicate x-ray ptychography or diffraction microscopy
  - Scan tiny organisms in µm size using x-ray beam light in nm size
  - Search area is similar to the left diagram

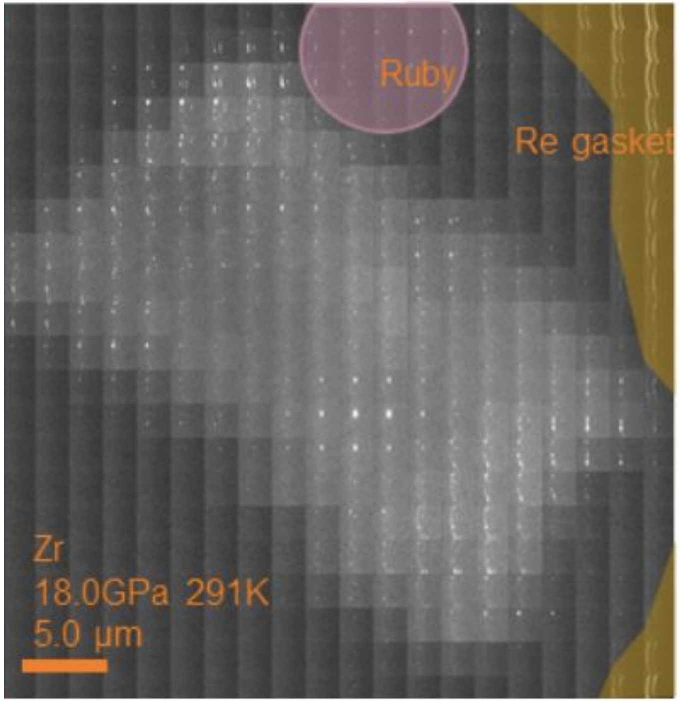
Overview

- Given 1640 different images similar to the left image
  - Goal is to locate the exact position of the white dots and create a small patch on it
  - Exact coordinates will be patched on other 1639 images
  - Lining patches together supposedly can show different materials?
    - Check next slide for example
    - Disclaimer: *seems a little bit more complicated than this but did not get to research far enough*

Visualization of Patching Result (Example from Dioptas Software)



Patching from 1 image

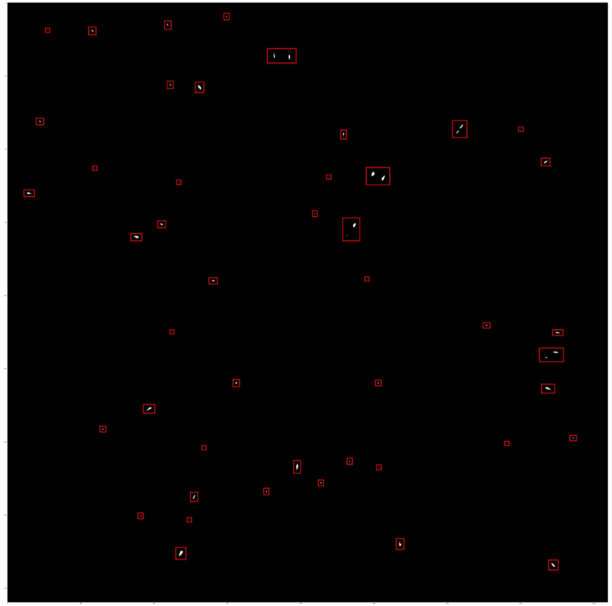


Patching from 1640 images

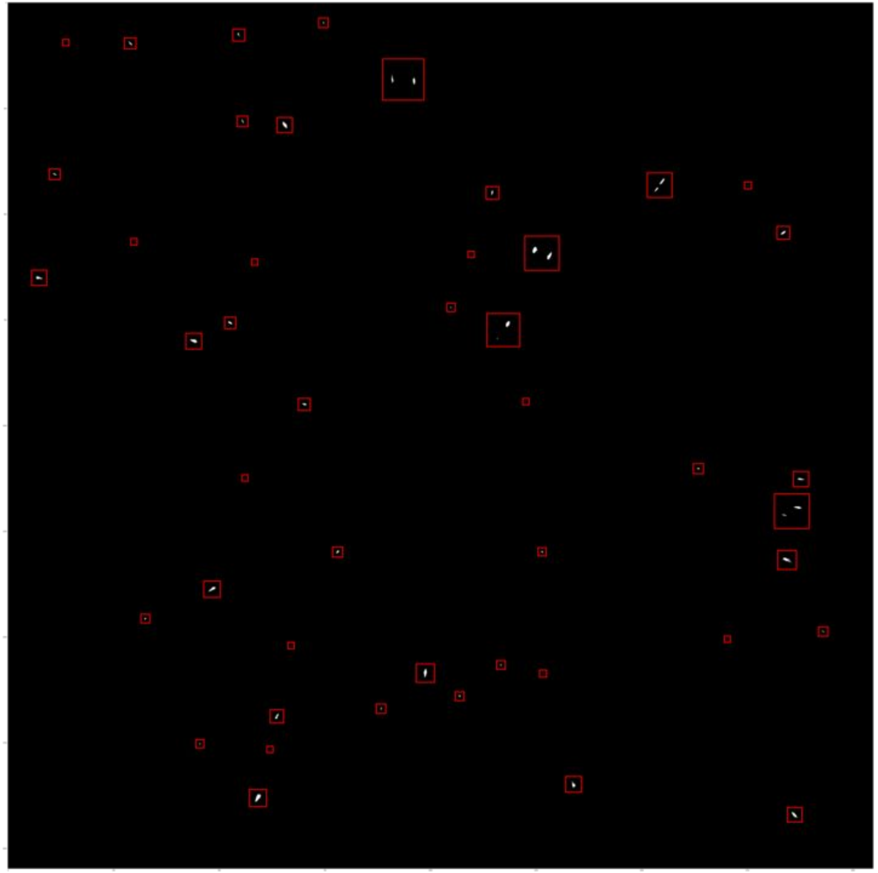
Results

Original

Output

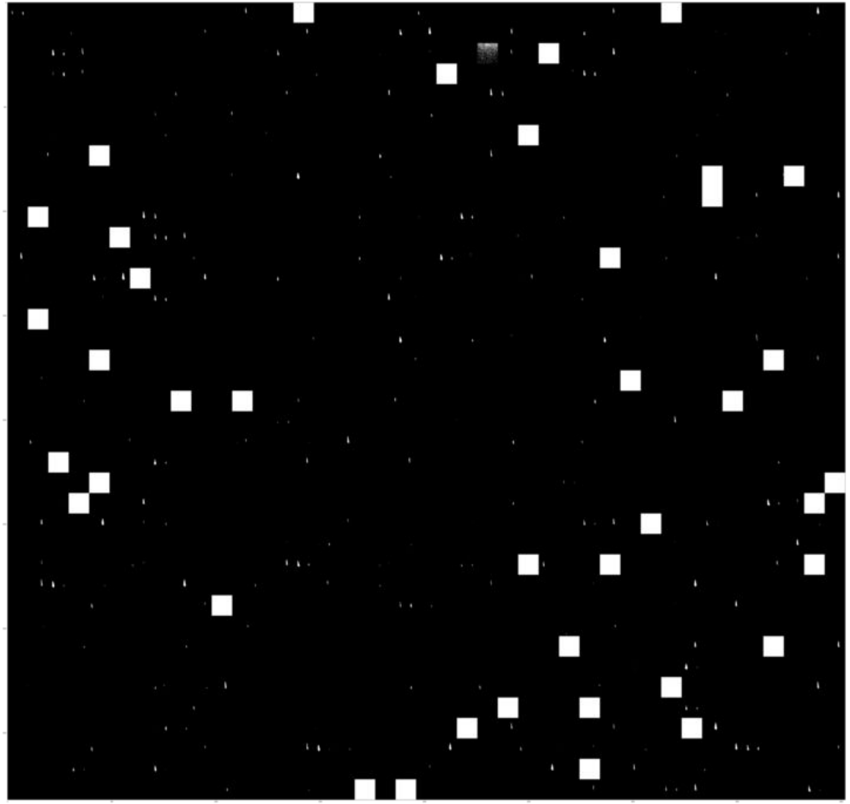


Quick proof displaying the patching worked using open-cv



Quick update changing the rectangular patches to square patches

Example of one of the patches created (failure)



- Ultimately could not extract any meaningful data from this patched image when using methods above
    - White squares seems to be a cv2 rendering issue
    - Should try to render rgb values past 255
- Potential solutions:
    - Replace white squares with fully black squares
    - Use rasterio instead of open-cv

Overall Outlook

Project is difficult to proceed without any background knowledge on x-ray diffraction microscopy

Ideas for improving the project:

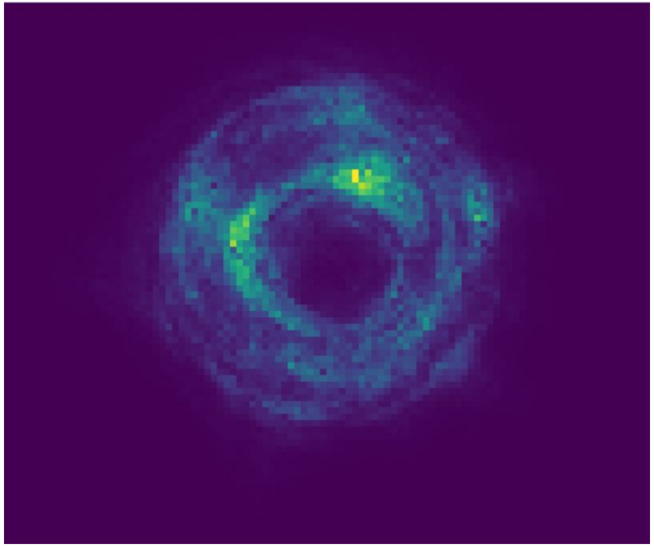
- Consulting an expert on
    - how to use diffraction microscopy softwares (Dioptas)
    - how the patching process works
    - how minerals and atoms are specifically identified from performing such steps

Additional Resources

Potentially the same methodology as this project

- Argonne's X-ray microscope
  - Argonne's article
    - https://www.anl.gov/article/scientists-pioneer-new-xray-microscopy-method-for-data-analysis-on-the-fly
  - Research paper
    - https://www.nature.com/articles/s41467-023-41496-z
  - Numpy array with 121 scans with 943 patches each
    - https://zenodo.org/records/8121606
  - Official GitHub page
    - https://github.com/vbanakha/edgePtychoNN

Example patch in Argonne's solution



Overall Future Goals

- Successfully patch from 1640 images
- Once enough patches are made, find some correlations and train a ML model
  - Classification
  - Segmentation
  - LM based captioning
  - Regression