

Our research group is looking for student interested in

Master Thesis

Machine learning for boosting fast STM images analysis

The project is a collaboration between the NAT (Prof. Barbara Lechner and PD Friedrich Esch) and CIT (Prof. Alessio Gagliardi) schools. In our labs at the NAT school, we have developed an electronics add-on module for scanning probe microscopes (FastSPM) to follow dynamic processes on surfaces at the atomic scale. This method provides unique access to diffusion paths of individual atoms or particles, visualization of ongoing chemical reactions, and high spatial resolution imaging under extreme conditions. This scientific and technological endeavor, however, requires state of the art image reconstruction from the raw data, machine learning-assisted image corrections and adequate pattern recognition to extract diffusion traces, position-dependent mobility and further quantitative information. The basic algorithms have been developed in the Python package *PyfastSPM*. In the present Master project, the successful candidate will implement the available functionalities into an interactive structured code that can be interfaced with machine learning for an in-depth data analysis. For this project we will take the output of the *PyfastSPM* algorithm and refine it further. Specifically, two possible avenues will be explored. First would be an autoencoder approach leveraging their denoising properties. As second approach, we will try neural fields with Fourier projections which rather than pixel encoding they utilize coordinates allowing them to refine an image to arbitrary resolutions. Eventually, the key focus will lie on optimizing the information depth that can be extracted from the raw data and the visual representation of the experimental movies. This project will be the cornerstone for generating image libraries that give access for more complex semi-automated investigations.

Required Skills

Following skills would be helpful in completing the tasks of this thesis.

- Programming skills in python, pytorch.
- Familiarity with version control using Git
- Experience with or motivation to learn working with high performance computational cluster
- Basic understanding of machine learning models

Application

Write us an email at thesis.sne@nano.cit.tum.de

- Attach your Transcript of Records and a CV

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