Lecture Data Science for Electron Microscopy Winter 2024

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Abstract

This is the website for the Data Science for Electron Microscopy Lecture

Plain Language Summary

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- Pelz Lab website
- Studon Link

1 Lecture 1: Intro (25.10.2024)

- Introduction
- d2l Chapter 2: Preliminaries

2 Lecture 2: Regression and Sensor Fusion (8.11.2024)

- d2l Chapter 3: Regression
- Sensor Fusion Slides

3 Lecture 3: CNNs (15.11.2024)

- d2l Chapter 7: CNNs
- d2l Chapter 8: CNNs

4 Lecture 4: Classification, Segmentation, AutoEncoders (22.11.2024)

- d2l Chapter 4: Classification
- d2l Chapter 14.9: Segmentation
- Segmentation
- Dimensionality Reduction
  - PCA
  - Autoencoder
  - Variational Autoencoder

5 Miniproject (29.11. - 13.12.2024)

1. Segmentation

   We will use the dataset from Rangel DaCosta et al. (2024) to implement a segmentation model.

2. VAE & Dimensionality Reduction

   We will use the dataset from Shi et al. (2022) to implement a dimensionality reduction model and cluster 4DSTEM data.

3. Denoising

   We will use the dataset from Sadri et al. (2024) to implement a denoising model for 4DSTEM data.

4. Image-to-Image Translation

   We will use a simulated dataset from the IMN chair to implement an Image to image translation model.

6 Lecture 5: Mixed Bag (10.1.2025)

- Project presentation
- Generative Adversarial Networks
- Gaussian Processes 1

Rangel DaCosta, L., Sytwu, K., Groschner, C., & Scott, M. (2024). A robust synthetic data generation framework for machine learning in high-resolution transmission electron microscopy (HRTEM). *Npj Computational Materials*, *10*(1), 165.

Sadri, A., Petersen, T. C., Terzoudis-Lumsden, E. W., Esser, B. D., Etheridge, J., & Findlay, S. D. (2024). Unsupervised deep denoising for four-dimensional scanning transmission electron microscopy. *Npj Computational Materials*, *10*(1), 243.

Shi, C., Cao, M. C., Rehn, S. M., Bae, S.-H., Kim, J., Jones, M. R., et al. (2022). Uncovering material deformations via machine learning combined with four-dimensional scanning transmission electron microscopy. *Npj Computational Materials*, *8*(1), 114.