Lecture Data Science for Electron Microscopy Winter 2024

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5 Abstract

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

7 Plain Language Summary

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

- 7 Lecture 6: GPs (17.1.2025)
- 8 Lecture 7: Bayesian Optimization, Active Learning, Deep Kernel
 Learning (24.1.2025)
 - 9 Lecture 8: Inverse Imaging Problems 1: Tomography, Deconvolution (31.1.2025)
 - 10 Lecture 9: Inverse Imaging Problems 2: Phase Contrast Imaging, Superresolution Imaging (7.2.2025)

52 References

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- 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 fourdimensional scanning transmission electron microscopy. *Npj Computational Materials*, 8(1), 114.