

# Rafał Lewandków

Computer Vision / Scientific Imaging / Research Software

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## EDUCATION

**Doctor of Physical Sciences** - University of Wrocław | 2023

**Master of Physics** - University of Wrocław | 2017

## PROFILE

Experimental physicist and research software developer working at the intersection of scientific imaging, computer vision and applied AI. I design tools that translate domain-specific problems into usable workflows. I specialize in analysing imperfect STM/EC-STM and LEED image data: low contrast, drift, instrumental artefacts, small datasets and correlated frames. I combine classical image processing with deep learning when it meaningfully improves detection, tracking, segmentation, quantitative validation or human-in-the-loop curation.

## SKILLS

### Python engineering

Python, NumPy, SciPy, pandas, PyQt6, pyqtgraph, matplotlib, Jupyter, pytest, Git.

### Computer vision / ML

PyTorch, Ultralytics YOLO, U-Net, SAM/SAM2, OpenCV, scikit-image; detection, segmentation, tracking, optical flow, registration.

### Scientific imaging

STM, EC-STM, LEED, XPS, UPS; noisy data, instrumental artefacts, analysis of interfaces and surface structures.

### Validation

YOLO-format dataset building, train/val/test split for correlated frames, annotation QC, benchmarks, documentation.

## EXPERIENCE

### Assistant Professor - University of Wrocław

2024-present

- Development of ML/CV tools for STM/EC-STM and LEED analysis: object detection, segmentation, tracking, registration and quantitative metrology.
- Training and integration of YOLO detectors for STM/EC-STM molecules and LEED spots; using ROI-based detection, tracking/linking and downstream analysis.
- Design of human-in-the-loop workflows: manual annotation correction, sessions, data export, geometric validation and user documentation.
- Teaching and preparation of materials for mobile-device programming and deep learning courses.

### Lecturer - University of Wrocław

2021-2024

- Teaching and preparation of programming and project materials for students.

### Assistant - University of Wrocław

2018-2021

- Research and teaching work in experimental physics, surfaces and interfaces.

### Analyst - BM@N Collaboration, JINR Dubna

2020-2022

- Preparation of equation-of-state (EoS) tables for the THESEUS code in the NICA/BM@N programme; work with research code and reproducible data-processing workflows.

## SELECTED PROJECTS AND TOOLS

**MolDetA** - PyQt6 platform for curation and analysis of multichannel STM/EC-STM data: registration as a mapping layer, YOLO/classical detection, bbox propagation, manual correction, grouping, sessions and export.

**LFA** - Published open-source Python/PyQt6 tool for quantitative STM/EC-STM metrology: preprocessing, FFT, peak localization, affine correction, lattice parameters, uncertainties and sessions.

**STAL** - Workbench for LEED spot detection, tracking and analysis: classical processing, YOLO, Hungarian linking, optical flow. Integration of a tracker architecture based on a registry of point, bounding-box and mask/video backends.

**NaParA / NanoTrack / QNA** - Tools for analysing nanoparticles, STM sequences, step-edge tracking and ROI-based quantum noise analysis, with emphasis on GUI, validation and reproducible exports.

## SELECTED PUBLICATIONS

1. **Lewandków, R.**; Wira, P.; Futyma, A.; Wasielewski, R.; Kosmala, T. LFA: A Lattice Fourier Analyzer for Quantitative In Situ EC-STM of Adsorbate-Substrate Superstructures. *Advanced Materials Interfaces*, 2026. DOI: 10.1002/admi.70500.
2. Grodzicki, M.; Sabik, A.; Mazur, P.; Tołoczek, A. K.; **Lewandków, R.** et al. Band alignment of amorphous Ge<sub>2</sub>S<sub>3</sub> and GaN(0001). *Journal of Materials Science*, 2026.
3. **Lewandków, R.**; Mazur, P.; Grodzicki, M. Niobium oxides films on GaN: Photoelectron spectroscopy study. *Thin Solid Films*, 2022, 763, 139573. DOI: 10.1016/j.tsf.2022.139573.
4. **Lewandków, R.**; Grodzicki, M.; Mazur, P.; Ciszewski, A. Interface formation of Al<sub>2</sub>O<sub>3</sub> on carbon enriched 6H-SiC(0001): Photoelectron spectroscopy studies. *Vacuum*, 2020, 177, 109345. DOI: 10.1016/j.vacuum.2020.109345.