załącznik do Regulaminu programu „visiting lecturers”

Osoba zgłaszająca z PW	
Tytuł i stopień naukowy	dr hab. inż., prof. uczelni
Imię i nazwisko	Maciej Trusiak
Wydział	Mechatroniki
Mail w domenie PW	maciej.trusiak@pw.edu.pl
Telefon kontaktowy	693696869

Propozycja osoby zgłaszanej jako visiting lecturers	
Tytuł i stopień naukowy	PhD
Imię i nazwisko	Lars Loetgering
Dokładna afiliacja	ZEISS Research Microscopy Solutions
Mail kontaktowy	lars.loetgering@fulbrightmail.org
Opis osiągnięć (1/2-1 strony)	Lars Loetgering is currently a research scientist at Carl Zeiss Microscopy in Germany, Jena, mainly interested in computational imaging, algorithm design, and optics. He is a top scientist in the vibrant and emerging field of computational microscopy. Previously, he was affiliated with the Fibre and Waveguide Lasers Group of Prof. Dr. Jens Limpert at Helmholtz Institute and Institute of Applied Physics, Jena, where he worked on extreme ultraviolet ptychography together with Dr. Jan Rothhardt. Moreover, he had a part-time position in the Bio-Nanoimaging Group of Prof. Dr. Rainer Heintzmann at IPHT Jena, where he worked on inverse modeling. He worked in the EUV Generation and Imaging group of Stefan Witte and Kjeld Eikema at Vrije Universiteit and Advanced Research Center for Nanolithography, Amsterdam. He obtained his Ph.D. in Physics under the supervision of Prof. Dr. Thomas Wilhein at Technical University Berlin. **Scientific Achievements** (Top 5 selected publications, *equal contribution) Heintzmann*, R., **Loetgering*, L.**, Wechsler*, F., Scalable Angular Spectrum Propagation, Optica **10**(11), pp: 1407-1416 (2023) ➢ Algorithm for rigorous scalar wave propagation with flexible scaling of pixel size. **Loetgering, L.**, et al., PtyLab.m/py/jl: a cross-platform, open-source inverse modeling toolbox for conventional and Fourier ptychography. Optics Express **31**(9), pp: 13763-13797. (2023) ➢ Open-source library for solving ptychographic inverse problems.

	Eschen, W., **Loetgering, L.**, et al. Material-specific high-resolution table-top extreme ultraviolet microscopy, Light: Science & Applications, **11**(1), pp.1-10. (2022) ➢ First actinic imaging of computer chip with a laboratory-scale extreme ultraviolet microscope. **Loetgering∗, L.**, Liu∗, X., et al., Tailoring spatial entropy in extreme ultraviolet focused beams for multispectral ptychography, Optica, **8**(2), pp.130-138. (2021) ➢ Multiplexed 7-color extreme ultraviolet ptychographic wavefront sensing. **Loetgering, L.**, et al., Generation and characterization of focused helical x-ray beams. Science Advances, **6**(7), eaax8836. (2020) ➢ First demonstration of generation and wavefront sensing on helical point-spread function diffractive optical elements in the soft-x-ray spectral range.

Code of the course	4606-VL-ES-00013	Name of the course	Polish	**Mikroskopia obliczeniowa**
			English	**Computational Microscopy**
Type of the course	Specialty subject			
Course coordinator	Dr. Lars Loetgering	Course teacher	Dr. Lars Loetgering	
Implementing unit	Faculty of Mechatronics	Scientific discipline / disciplines*	Automatic Control, Electronics, Electrical Engineering and Space Technologies, Biomedical Engineering, Mechanical Engineering, Materials Engineering, Physical Sciences, Chemical Engineering	
Level of education	Doctoral studies and Master degree	Semester	October-November 2024 (stationary)	
Language of the course	English			

Type of assessment	exam + project	Number of hours in a semester	30	ECTS credits	2
Minimum number of participants	10	Maximum number of participants	20	Available for students (BSc, MSc)	MSc Yes BSc No

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	10	-	5	-	-
	in a semester	20	-	10	-	-

* does not apply to the Researcher's Workshop

1. Prerequisites
Linear Algebra + Basic programming skills in Python/Matlab or Julia

2. Course objectives
Advanced mathematical models and signal processing for Computational Microscopy

3. Course content (separate for each type of classes)
Lecture
Week 1 - Advanced Linear Algebra tools for Computational Imaging (Fast Fourier transform, Singular Value Decomposition, Regression, Regularization, Matrix representation of space-variant optical systems, Matrix factorization of space-invariant optical systems) (6 h) - Advanced Wave propagation tools (Helmholtz equation, scalable Angular Spectrum, off-axis diffraction, Fresnel, Fraunhofer, Debye-Wolf Integral) (4 h) **Week 2** - Multiple Scattering approximations: Foldy Lax, Born series, Rytov, Beam propagation method (BPM), Wave propagation method (WPM), Ewald Sphere (basic constructions) (4 h) - Inverse Problems: Linear least squares and nonlinear optimization (2 h) - Phase Contrast Microscopy: Ptychography, Transport of Intensity Imaging, Differential Phase Contrast (2 h) - Tomography: Ewald sphere perspective on various imaging modalities (2 h) Project on a selected computational microscopy method – 10 h (weeks 1-2)
Laboratory
N/A

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	The student knows and understands the world's scientific achievements in selected fields of image procssing including data analysis for computational imaging and microscopy	SD_W3	Written test
Skills			
S01	The student is able to use knowledge from various fields to creatively identify, formulate and solve complex problems in an innovative way or to perform research tasks using selected methods of digital image processing and data analysis for computational imaging and microscopy, in particular (1) define the purpose and subject of research, formulate a research hypothesis, (2) develop research methods, techniques and tools and apply them creatively, (3) formulate conclusions based on research results	SD_U1	Oral exam

S02	the student is able to analyze and creatively synthesize scientific and creative achievements in order to identify and solve research problems n the field of digital image processing and data analysis for computational imaging and microscopy	SD_U2	Oral exam
	the student is able to discuss topics related to data analysis for computational imaging, especially in terms of its use in the scientific discipline they represent	SD_U4	Oral exam
Social competences			
SC01	The student is ready to creatively use the methods of data analysis and computational imaging in tasks related to the represented scientific discipline	SD_K4	Oral exam

*Allowed learning outcomes verification methods: exam; oral exam; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Solid knowledge of least squares solvers for linear inverse problems (written exam), knowledge of microscopy modalities (oral), programming skill (project)

6. Literature

Primary references:

[1] Computational Imaging, lecture script by Dr. Lars Loetgering, Prof. Dr. Rainer Heintzmann (will be made openly available to course)

[2] https://github.com/larsloetgering/ComputationalImaging.m (Matlab repository for codes discussed in lecture)

Secondary references:

[1] Introduction to Applied Linear Algebra, S. Boyd and L. Vandenberghe (freely available at author's website https://web.stanford.edu/~boyd/books.html)

[2] Data-driven science and engineering: machine learning, dynamical systems, and control, S. Brunton, N. Kutz (freely provided by the authors: http://databookuw.com/databook.pdf)

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	30
2	Hours of consultations with the academic teacher, exams, tests, etc.	3
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	25
4	Amount of time devoted to the preparation for exams, test, assessments	2
	Total number of hours	**60**
	ECTS credits	**2**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	1
Number of ECTS credits earned by a student in a practical course	1