Universität Passau
Fakultät für Informatik und Mathematik

Kolloquium
mit Herrn Dr. Frank Filbir
Helmholtz Munich & Technische Universität München
am Dienstag, 1.7.2025 ab 17:00 Uhr
im Hörsaal 11, IM, Innstraße 33
auf Einladung von Prof. Dr. Brigitte Forster-Heinlein

Phase Retrieval in Action
Image Reconstruction from Spectrogram Measurements

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In ptychographic imaging a detector (CCD camera) measures the intensity of many diffraction patterns each obtained by illuminating a small part of the object at a time. The measurements are produced by using *X- rays* of one specific very short wavelength λ or an *electron beam.* The detector is usually placed in the far-field distance (Fraunhofer diffraction). Mathematically this experimental set-up leads to the problem of phase retrieval from spectrogram measurements. That means we are given samples of

$$\mathcal{I}(x,\xi) := \left| \int_{\mathbb{R}^2} f(t)\, g(t-x)\, \mathrm{e}^{-2\pi \mathrm{i}\, \xi \cdot t}\, \mathrm{d}t \right|$$

for a known window function g. The aim is to reconstruct the object f. However, often experimental set-ups do not allow to work with one specific wavelength λ but we have to deal with polychromatic measurements, i.e. we are given

$$\mathcal{I}\lambda(x,\xi) = \left| \int_{\mathbb{R}^2} f(t)\, g_\lambda(t-x)\, \mathrm{e}^{-2\pi \mathrm{i}\, \xi \cdot t/\lambda}\, \mathrm{d}t \right|$$

for $\lambda \in \{\lambda_1, ..., \lambda_L\}$. Moreover, in many cases even the g_λ is unknown. This then leads to what is called *Blind Polychromatic Ptychographic Imaging* (BPPI). In this talk we will provide an overview of BPPI and we present some reconstruction methods and results. Another important problem in material sciences is the reconstruction of the phase-gradient $\nabla\theta(t)$ of the function $f(t) = a(t)\, \mathrm{e}^{\mathrm{i}\,\theta(t)}$ from ptychographic measurements. We will comment briefly on the solution of this problem.

The talk is based on joint work with Oleh Melnyk (Technische Universität Berlin), and our project partners Jan Rothardt (GSI Jena) and Nico Hoffmann (HZDR, Dresden) within the Helmholtz Imaging Platform project AsoftXm, the group of Christian Schroer (DESY, Hamburg), and Xiaoke Mu (INT, KIT Karlsruhe).