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PhD Application in Physics, Machine Learning and advanced X-ray and neutron scattering

Dear Soft Matter Physics Team,

I'm excited to apply for the PhD position in Physics, Machine Learning, and Advanced X-ray and Neutron Scattering at the University of Tübingen's Soft Matter Physics Group, where your innovative research is redefining how we decode the secrets of materials. Your 2023 work, "Machine Learning for Scattering Data: Strategies, Perspectives, and Applications to Surface Scattering," and the 2024 breakthrough, "Neural Network Analysis of Neutron and X-ray Reflectivity Data Incorporating Prior Knowledge," illuminate the power of neural networks to conquer challenges like the phase problem and supercharge real-time analysis of GIWAXS and XRR data. Inspired by your bold fusion of machine learning and scattering science, I'm eager to bring my Python and PyTorch expertise to fuel your quest to unravel the mysteries of soft matter with cutting-edge innovation.

During my Master's program, focusing on AI, I primarily used Python and Ubuntu as my development environment to develop applications for AI-driven tasks. One notable project involved autonomous navigation of the Turtlebot3 in a selected area, incorporating object detection and avoidance, while also mapping the area and ensuring the robot could return to its origin. This project utilized ROS (Noetic) and Gazebo for virtual testing, with key ROS nodes developed in both C++ and Python. Leveraging PyTorch, I harnessed the Turtlebot's sensor data to train neural networks, analyzing movement patterns to retrain the robot for sharper decision-making, optimizing its navigation efficiency in complex environments. This ML-driven approach mirrors the data analysis demands of scattering experiments, ensuring robust, real-time insights. Parallel to my academic pursuits, during nine months at AVL, I worked on the Adaptive AUTOSAR middleware (Service-Oriented Architecture) and developing its applications in C++. These Adaptive Applications were deployed on a custom Real Time Linux Operating System using Yocto project. After this, I continued at AVL for my Master's thesis, where I was tasked with upgrading their legacy FMU Generation Utility (written in C++) from the FMI 2.0 to the FMI 3.0 standard, thereby enhancing the functionality of the existing tool for co-simulation of automobile parts built in different systems like MATLAB, C++, etc. In my thesis, I also leveraged Google Protocol Buffers through ASAM OSI for efficient data serialization, streamlining integration of sensor and environmental models in driving simulations, enhancing virtual testing capabilities. At Persystems, I was a Junior C++ Developer, where I developed Virtual TestBench, a Qt Desktop application for simulations of electrical components, leveraging Persystems' proprietary library. My responsibilities included designing the UI/UX in the Qt Creator IDE with C++ to ensure a seamless user experience. I have also implemented the application's logic by connecting UI widgets to custom slots, using Qt's signal-slot mechanism to manage data flow between the UI and the backend operations interfacing with Persystems' testbench library. Additionally, I have built a separate license check application for Virtual TestBench using Qt and C++.

Drawing from my Master's work, where I leveraged PyTorch to develop AI-driven navigation solutions for the Turtlebot3, and my professional experience at AVL and Persystems, I am well-equipped to contribute to the Soft Matter Physics Group's mission of advancing ML-based scattering data analysis. My hands-on expertise in Python and PyTorch, demonstrated through training neural networks to optimize Turtlebot navigation, directly aligns with your need for developing ML tools to analyze XRR and GIWAXS data, ensuring efficient and accurate processing of complex datasets. My work at AVL, where I enhanced data serialization with Google Protocol Buffers and deployed applications on real-time Linux systems, equips me to support your data/metadata formats and integrate software into computational environments. Additionally, my experience at Persystems, designing robust software with Qt and C++ for simulation platforms, prepares me to create seamless, user-friendly tools for scattering experiments. My collaborative efforts at AVL and Persystems, combined with my proficiency in English, ensure I can thrive in your international team, contributing to cutting-edge research while presenting findings effectively at conferences.

Among the many skills I have honed throughout my academic and professional journey, collaboration stands out as the most pivotal for advancing technology. My experiences have underscored that breakthroughs in technology are often the result of interdisciplinary teamwork and shared expertise. I am committed to contributing my utmost from the very start, beginning immediately.

I would be greatly honoured to receive an invitation for an interview.

Yours sincerely,

Regensburg, 21.06.2025