

Master's Thesis Project: Artificial Intelligence-based Optimization of Sweden's Most Powerful Laser

Laboratory: RELativistic Attosecond physics Laboratory (REAL)

Project Background & Introduction

This Master's thesis project offers an opportunity to work at the forefront of ultrafast science, applying cutting-edge data science techniques to a world-class experimental facility. Machine Learning (ML), a subfield of Artificial Intelligence, is rapidly becoming an essential tool for controlling and optimizing highly complex experimental systems. This project focuses on the application of ML to optimize the Light Wave Synthesizer 100 (LWS100) Laser System, which is currently the most powerful laser in Sweden. With a 100 TW peak power and an ultra-short 4.3 fs pulse duration, LWS100 plays a vital role in groundbreaking studies in attosecond science and laser-driven electron acceleration. Managing this state-of-the-art system is challenging due to its complex control space.

Aim & Project Focus

The primary objective of this project is to design and implement a Machine Learning-based optimization framework for operating the LWS100 laser system. This involves developing and testing algorithms to autonomously tune the 30+ parameters to achieve two key outcomes:

1. Optimize the quality and stability of the laser output.
2. Significantly enhance the speed and reliability of the laser optimization process.

Candidate Profile & Requirements

We seek a highly motivated student eager to work at the intersection of Photonics, Data Science, and Computer Science. This is a genuinely multidisciplinary project that requires the following foundational knowledge:

- **Programming Proficiency:** Demonstrated experience in programming, particularly with Python (essential for ML implementation, scripting, and data analysis).
- **System Control:** Familiarity with LabVIEW is highly desirable for interfacing with the laser control hardware.
- **Optics Fundamentals:** Basic understanding of physical or laser optics is beneficial for grasping the underlying system mechanics.

Contact

If you are interested send your questions and application documents to:

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