Chair of Computational Modeling and Simulation
TUM School of Engineering and Design
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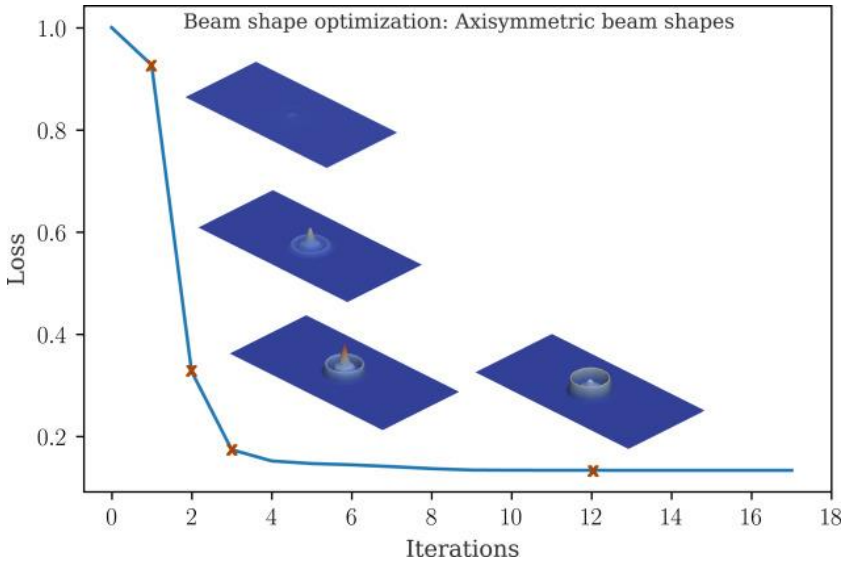
Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Neural network based Laser beam shape optimization

Description

This project develops an approach to optimize laser beam shapes in powder bed fusion (PBF) additive manufacturing using neural networks and adjoint optimization methods. Traditional beam shapes in PBF are often limited to Gaussian profiles, which may not be optimal for all processing conditions. Recent advances in beam shaping technology allows to use more sophisticated beam profiles, but experimentally determining the optimal shape remains a significant challenge. To address this, numerical optimization is employed to directly compute laser beam shapes tailored to achieve a desired temperature profile/melt pool shape [1]. In this project, the laser beam intensity distribution will be parameterized using a feed-forward neural network [2] that maps spatial coordinates (x,y) to intensity values. This approach aims to explore its potential for improving optimization, particularly in applications where classical methods struggles to compute a smooth laser beam shape.



Objectives:

- Develop a neural network architecture to represent arbitrary laser beam intensity distributions
- Implement an optimization framework in pytorch to determine optimal beam shapes
- Validate the optimized beam profiles through thermal simulation.

Supervisor

Vijaya Holla, Divya Shyam Singh, Chair of Computational Modeling and Simulation

References

[1] Holla, Vijaya, et al. "Laser beam shape optimization in powder bed fusion of metals." *Additive Manufacturing* 72 (2023): 103609.

[2] Herrmann, Leon, et al. "On the use of neural networks for full waveform inversion." *Computer Methods in Applied Mechanics and Engineering* 415 (2023): 116278.