Bachelor/Master Thesis
Developing Heuristics for Optimisation of Concentrating Solar Thermal Heliostat Aiming

Course of study: Mathematics, Computer Science, Engineering
Kind of thesis: Programming, Simulation, and Optimization
Programming language: Python & C++
Start: ASAP

Problem
Solar power towers use many flat mirrors to concentrate sun light on a central, tower-mounted receiver. The receiver then transfers the resulting heat to a fluid (i.e. molten salt or air) that, in turn, exchanges the heat to steam. The steam then powers a turbine, generating electricity.

During operation, the aiming strategy of heliostats dictates the way in which heliostats aim on different locations of the receiver to avoid the risk of permanent damage to receiver components from thermal overloading due to sharp flux gradients. Consideration of uncertainties like cloud shading or wind makes is necessary to adjust the aim-points quickly and steadily.

Work to date
An optical model computes the heat flux distributions of the heliostats for a given sun position. A deterministic linear constrained optimization calculates optimal flux distributions for a given heliostat layout and sun-position. This is being extended to included robustness to account for tracking and heliostat surface errors.

Tasks
Within this project, the optimisation problem will be formulated according to existing optimisation heuristics in order to reduce problem complexity and computation time. This shall be achieved with the following steps.

- **Literature Research**: Describe the state of the art for aiming strategies.
- **Optimization formulation**: Formulate the problem for solution using optimisation heuristics such as, for example, a greedy algorithm, simulated annealing or a genetic algorithm, while investigating the merit of reformulating of problem parameters to resemble common problem formulations such as, for example, knapsack problems or travelling salesman problems.
- **Validate Heuristic approach**: Quantify the benefit of the investigated problem formulation and solution approach in terms of computation time or improved solution.

Contact
This project is offered by the Systemverfahrenstechnik research group headed by Prof. Dr. Alexander Mitsos. The project will be co-supervised by Dr. Jeff Cumpston. Please contact us via:

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