Bachelor / Master Thesis

Dynamic Aiming Strategy for Solar Tower Power Plants

Course of study: Mathematics, Computer Science, Computational Engineering
Kind of thesis: Programming, Simulation, and Optimization
Programming language: C++
Start: Winter term 2019/20

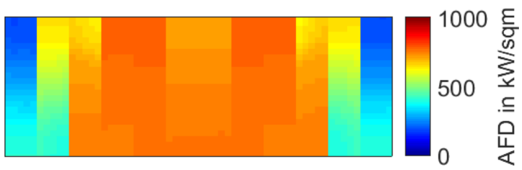
Topic

Solar 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.

Preliminary work

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.



Desired irradiation image on the receiver surface.

Tasks

The following tasks have to be solved:

- Extend the existing deterministic optimization formulation for circular receivers, where for each heliostat just a subset of aim points can be reached.
- Make the model time-dependent, where the possible reachable subset is limited by the angular speed of the motor and the limited time (dependent on the current assigned aim-point of the heliostat).
- Formulate a transient model whereby positioning of heliostats between adjacent time steps is robustly optimized, allowing for reduction of heliostat movement. The time-step is chosen adaptively, which depends on the changes in the field (e.g. clouds or irradiation changes).

Contact This project is offered by the *Theory of Hybrid Systems* (i2) research group headed by Prof. Dr. Erika Ábrahám and will be co-supervised by Dr. rer. nat. Pascal Richter. For further questions please contact us via email:

Dr. rer. nat. **Pascal Richter**
Theory of Hybrid Systems (i2)

Ahornstr. 55
+49 241 80 21244
pascal.richter@rwth-aachen.de