Karlsruhe Institute of Technology

Steinbuch Centre for Computing

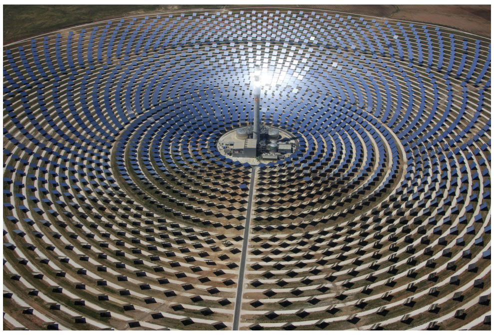
Bachelor or Master Thesis

Turbulent Wind Simulation in Solar Tower Power Plants

Course of study: Mathematics, Computer Science, Computational Engineering
Kind of thesis: Programming, Simulation, and Optimization
Programming language: C++ and others
Start: January 2019

Topic

In this project we are looking at solar tower power plants. The principle of concentrating solar thermal power plants seems to be very simple: Large mirrors are used to concentrate rays of sunlight on an receiver where a fluid (e.g. molten salt) is being heated up. The heat of the fluid is exchanged into steam which powers a turbine to generate electricity.



Solar tower power plant Gemasolar, Spain.

The heliostats need to aim in a very accurate way on the receivers' surface. Because large wind speeds could appear, the heliostat's steel construction is very stable. It is known that the load of the wind onto the heliostats' surface is just high at the outer ring of the heliostat field. Inside of the heliostat field, the wind load is lower, such that a less stable construction could be used.

Tasks

Within this project, turbulent wind flow in a heliostat field is simulated to investigate the load onto each heliostats. The following tasks have to be solved:

- Literature review on wind simulations considering turbulent boundary layer (e.g. Large-Eddy).
- Develop a three dimensional wind flow model to describe the wind flow in the heliostat field. As simplification, for the start, a 2D model could be developed and then progressed to 3D. But trick will be how to appropriately model such complex geometries at that scale.
- Implement the model while using ANSYS Fluent for the simulation of the numerical part.
- In a feasibility study investigate the wind load. Consider different wind speeds, wind directions, and heliostat alignments (e.g. safety mode). As reference solar tower power plant a virtual solar tower power plant (e.g. PS10 in Spain, or Hami in China) is used.
- We are most interested in the differences of wind loading between the heliostats on the interior and exterior of the field. f the inner heliostats see less load they can be made lighter with less material thus leading to significant cost reductions.

Contact This project is offered by the *Steinbuch Centre for Computing* and the *Computational Science & Mathematical Methods* research group headed by Prof. Dr. Martin Frank. The project will be co-supervised by Dr. Daniela Piccioni Koch and Dr. Pascal Richter. For further questions please contact us via email:

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