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Design of Heliostat Fields
in HELIOSTAT STUDIO

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HELIOSTAT STUDIO is an open-source software tool developed by ASTRI for a comprehensive design and modelling of heliostat fields. The modelling is based on a set of customised algorithms which provide a higher level of abstraction than ray tracing and simplify the solution of complex optimisation problems. A significant emphasis is also made on visualisation in all stages of the design process so as to facilitate the choice of the most efficient configuration.

Motivation

- The existing tools for the design of heliostat fields tend to be outdated or not distributed openly [1]
- The ultimate reduction of costs requires a holistic optimisation of power plant with a flexible design of heliostat field [2]
- A commissioned plant needs a specialised software for a real-time control of heliostat field

Implementation

Software components

Qt framework
User interface and common functionality

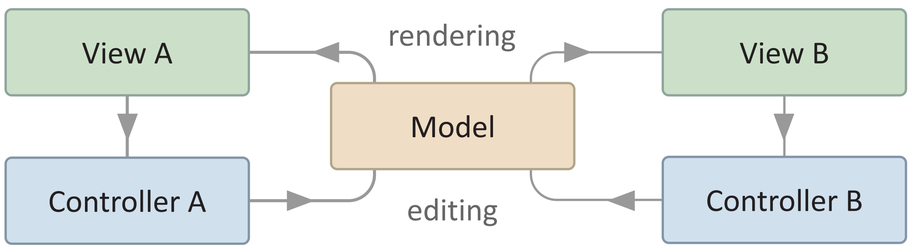
Visualization Library
High-level interface to OpenGL

NLopt
Advanced nonlinear optimisation

QCustomPlot
Interactive plotting and charting

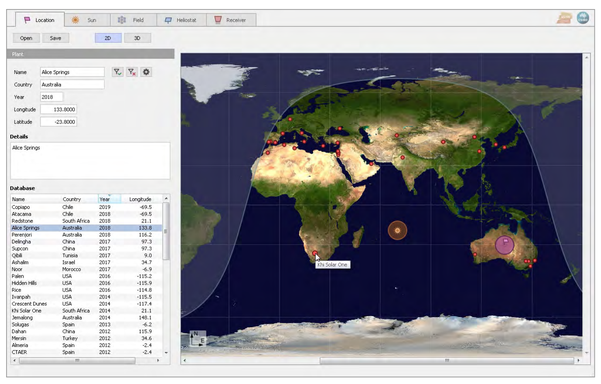
Numerical Recipes
General numerical methods

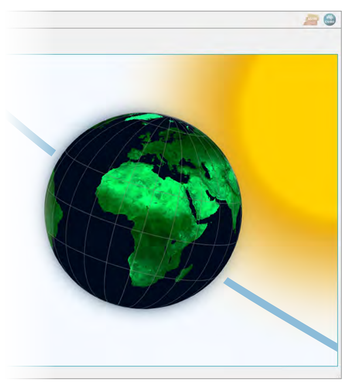
Model-view programming



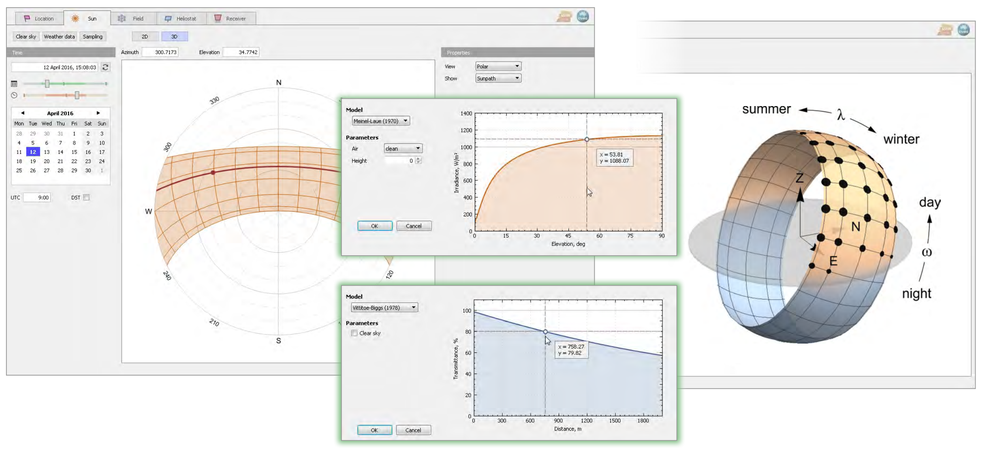
Workflow

Location selector

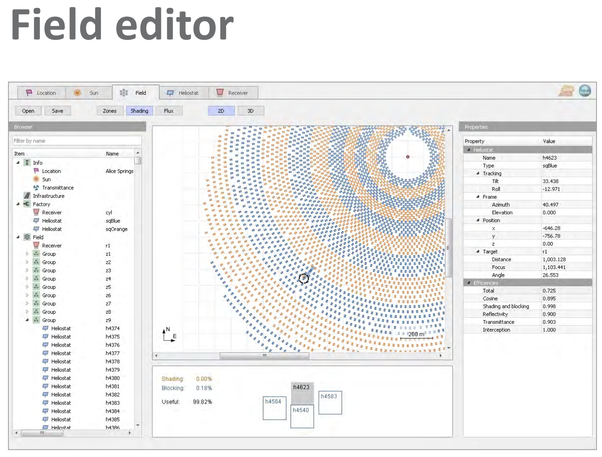




Sun calculators

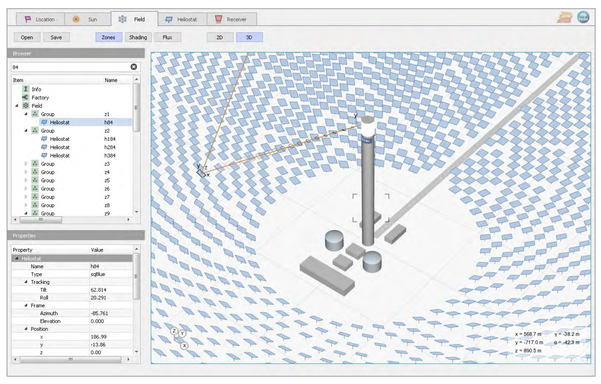


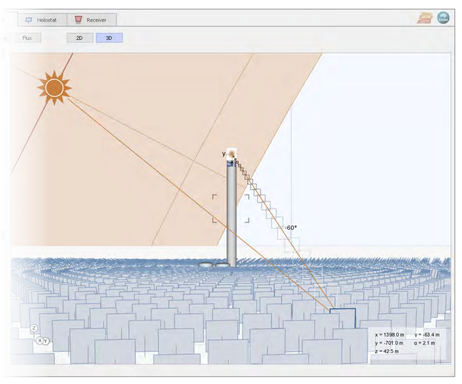
Field editor



XML view

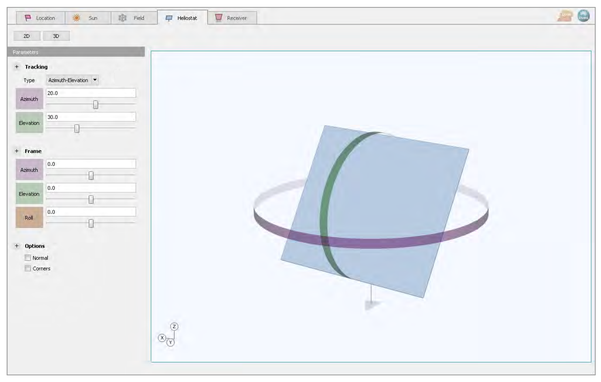
```
<Heliostat-Field version="1.0">
  <Receiver name="r1" type="cyl">
    <Position x="0.000" y="0.000" z="173.980"/>
  </Receiver>
  ...
  <Group name="z1">
    <Heliostat name="h1" type="sq">
      <Position x="-12.179" y="-146.120"/>
    </Heliostat>
  ...
  </Group>
  ...
</Heliostat-Field>
```

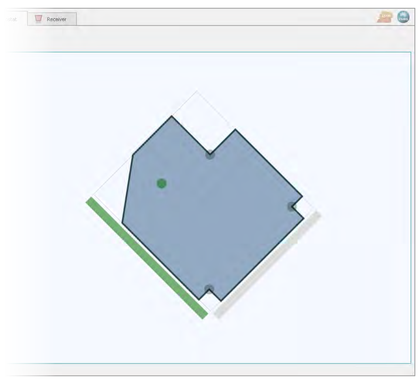




Shading and blocking losses are computed via parallel projection and polygon clipping [3]. Flux distribution is computed by convoluting the principal image of heliostat with a sun shape [4].

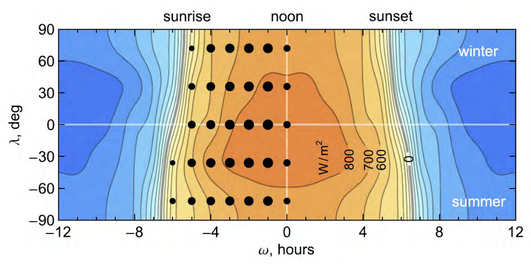
Heliostat editor

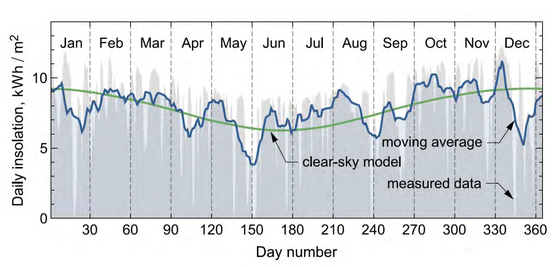




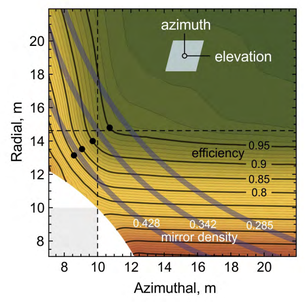
Development

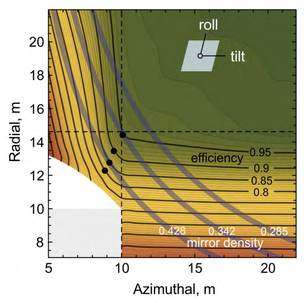
Weather browser with post-processing of irradiance data [5]





Receiver editor, more analysis and optimisation tools





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REFERENCES

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[2] C. Gertig, A. Delgado, C. Hidalgo, and R. Ron, "SoFiA – A novel simulation tool for Central Receiver Systems," Energy Procedia **49,** 1361 (2014).
[3] C. Corsi, V. Grigoriev, and M. Blanco, "Far-field optimisation of heliostat shape and spacings", Asia-Pacific Solar Research Conference, Brisbane (2015).
[4] V. Grigoriev and C. Corsi, "Unified algorithm of cone optics to compute solar flux on central receiver", SolarPACES, Abu Dhabi (2016).
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ACKNOWLEDGEMENTS

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