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A differentiable simulation approach for Solar Power Plants

In Solar Power Plants, temperatures sufficient for chemical processes or the generation of electrical power are created by reflecting sunlight with thousands of mirrors (”heliostats”) to a surface (”the receiver”). In operation, the temperature distribution on the receiver is critical for the performance and must be optimized. The heliostats are never perfectly flat as due to budget constraints, the construction is not optimal. We have devised a method to infer the heliostat surface from the reflection of the sun. The technique is based on an implementation of a simulation in PyTorch, where the automatic differentiation engine is used to optimize the surface. The surface is modeled as by a Non-Uniform Rational B-Spline (NURBS) and the NURBS parameters are subject to optimization. Furthermore we employ a regularization technique to mitigate the appearing challenge of ambiguous solutions. Our approach makes efficient use of GPUs based on PyTorch’s linear algebra engine. We believe our approach poses an interesting example of a fruitful interaction of techniques originating from Machine Learning and simulation.

Significance

This is a novel approach where we bring together tools from Machine Learning with “classical” simulation. We hope to spark discussion where similar approaches could be useful.

References

Experiment context, if any

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