

Driving Green Energy Innovations: AI-Based Condition Monitoring for Solar Thermal Power Plants

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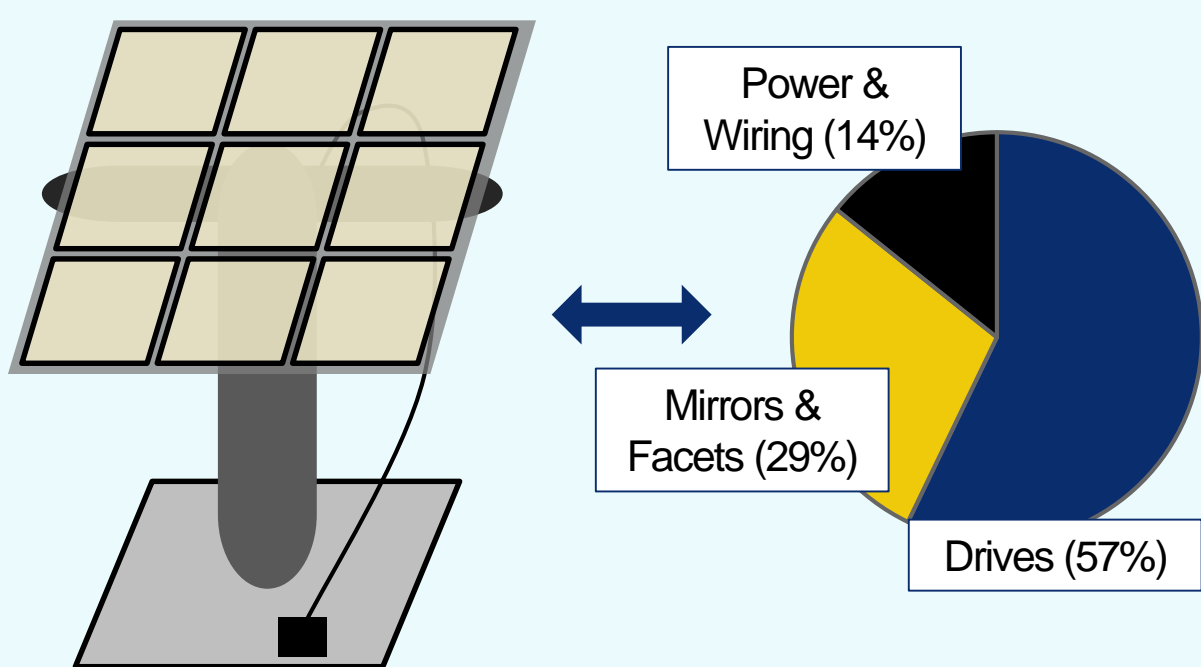


Graphical Abstract



Motivation

- Malfunctions, wear and ageing of heliostats

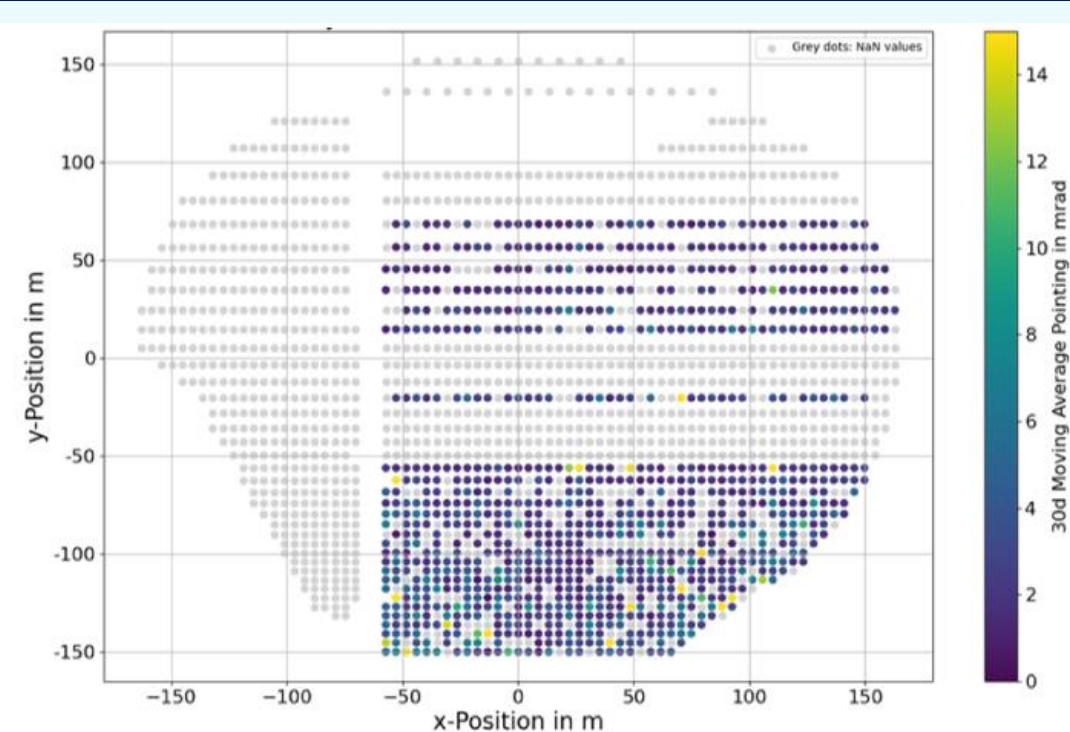


Overview of most important heliostat components and associated availability issues
[derived from Mehos, M. et al. (2020). Concentrating Solar Power Best Practices Study. NREL/TP-5500-75763]

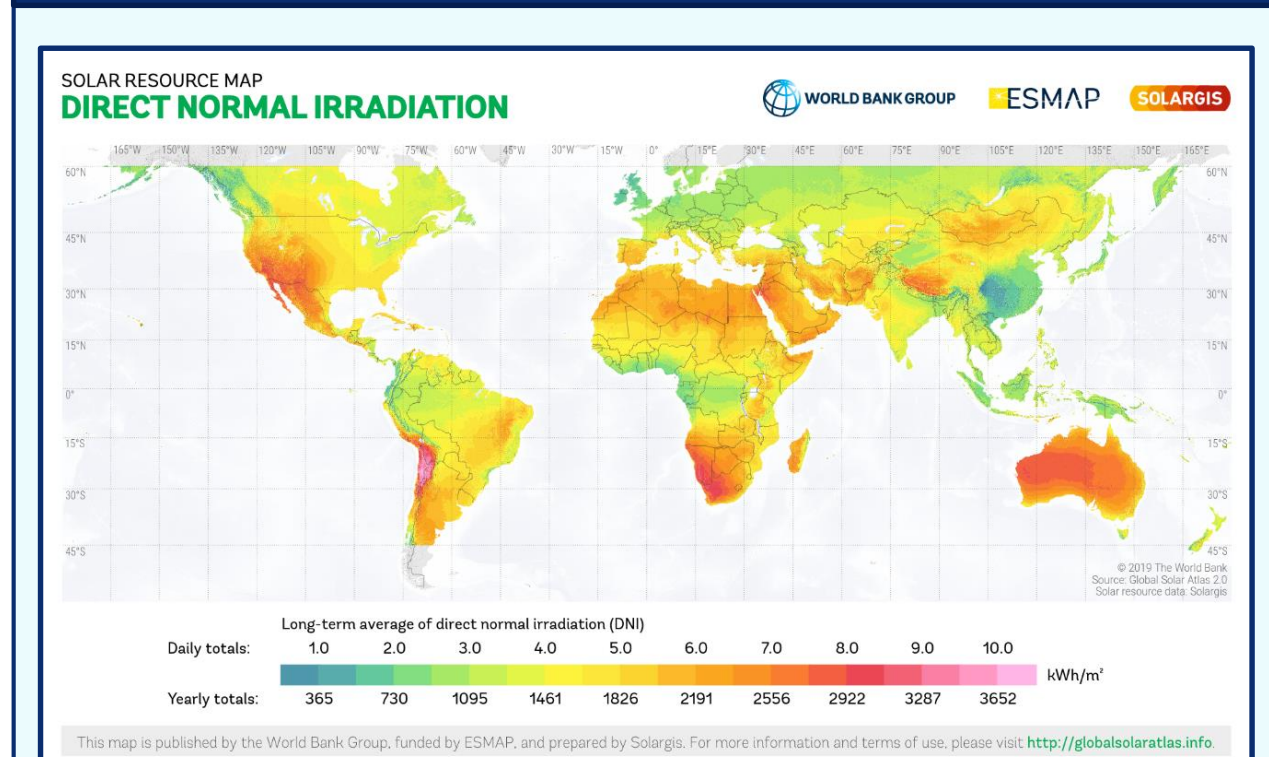
Research Questions

- What **relevant status data** from heliostats can be recorded with **low-cost sensors**?
- How can **virtual sensors** ("soft sensors") be used to accurately map operating states?
- Which **AI techniques** are **optimal** for the development of automated condition monitoring?

Field Experiments



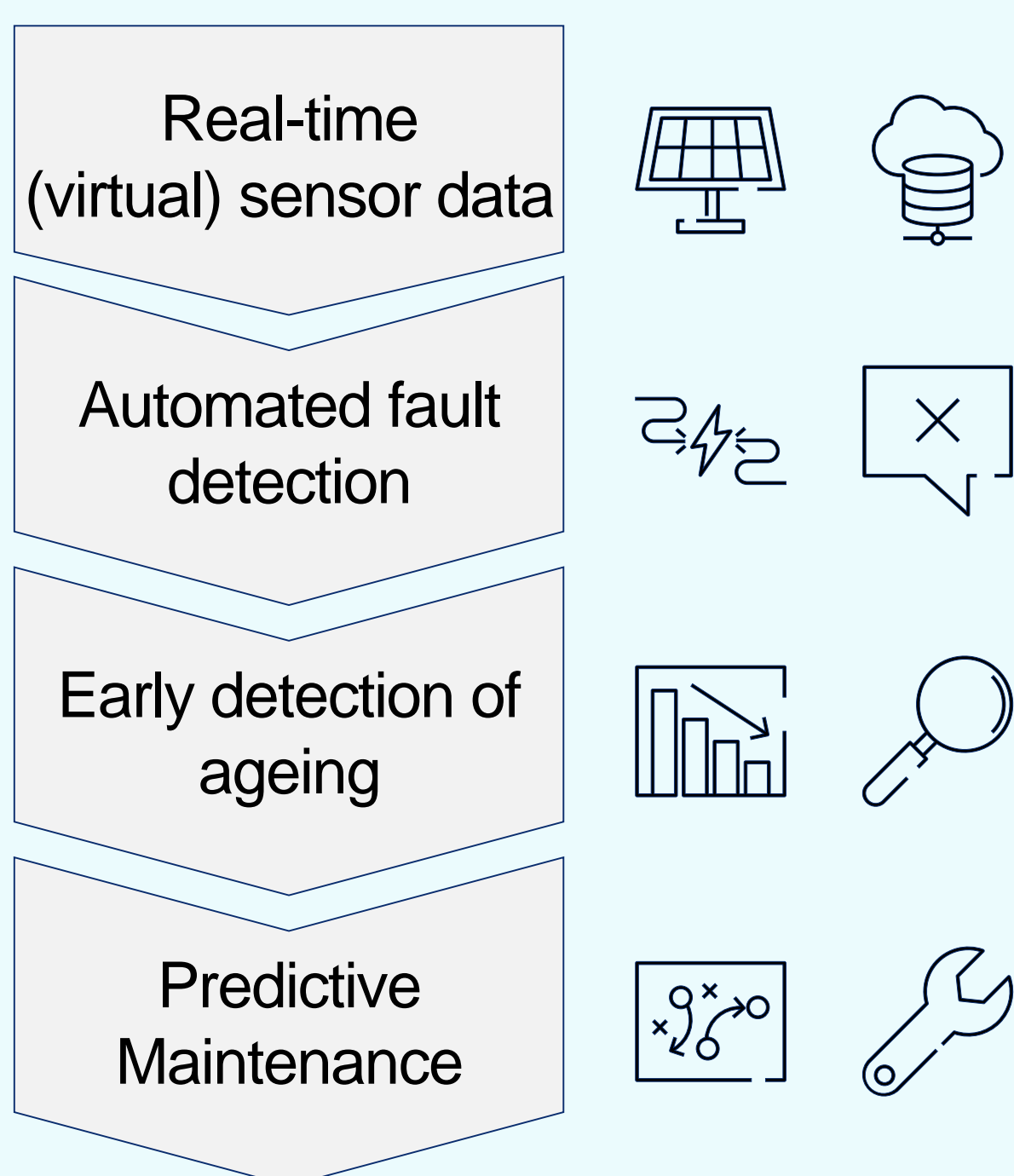
Benefits to Society



- Green and **sustainable**
- Harnessing** worldwide **solar potential** (~1,100 kWh/m²/year ≈ €400/m²/year in Germany)
- Low-cost thermal storage**
- Continuous electricity** generation (even at night)
- Heat supply** for industrial processes and future fuels
- Integrates with existing infrastructure, serving as **backup**

Research Concept

- Development of an **automated condition monitoring** system
- Focus on **heliostat drives, motors, control units** and communication systems



Methodology

- AI-based multi-layered analysis of large amounts of **time series sensor data**

Time series visualization 	Stat. analysis, aggregation
Classical time series models 	Anomaly detection
Spectral analysis 	Decision tree, random forest
LSTM model 	Transformer model

Research Goals

- Minimization of power losses** from heliostat malfunctions
- Reduction of operational and maintenance costs**, enhancing economic competitiveness
- Advancement of green energy innovations**

Contact

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