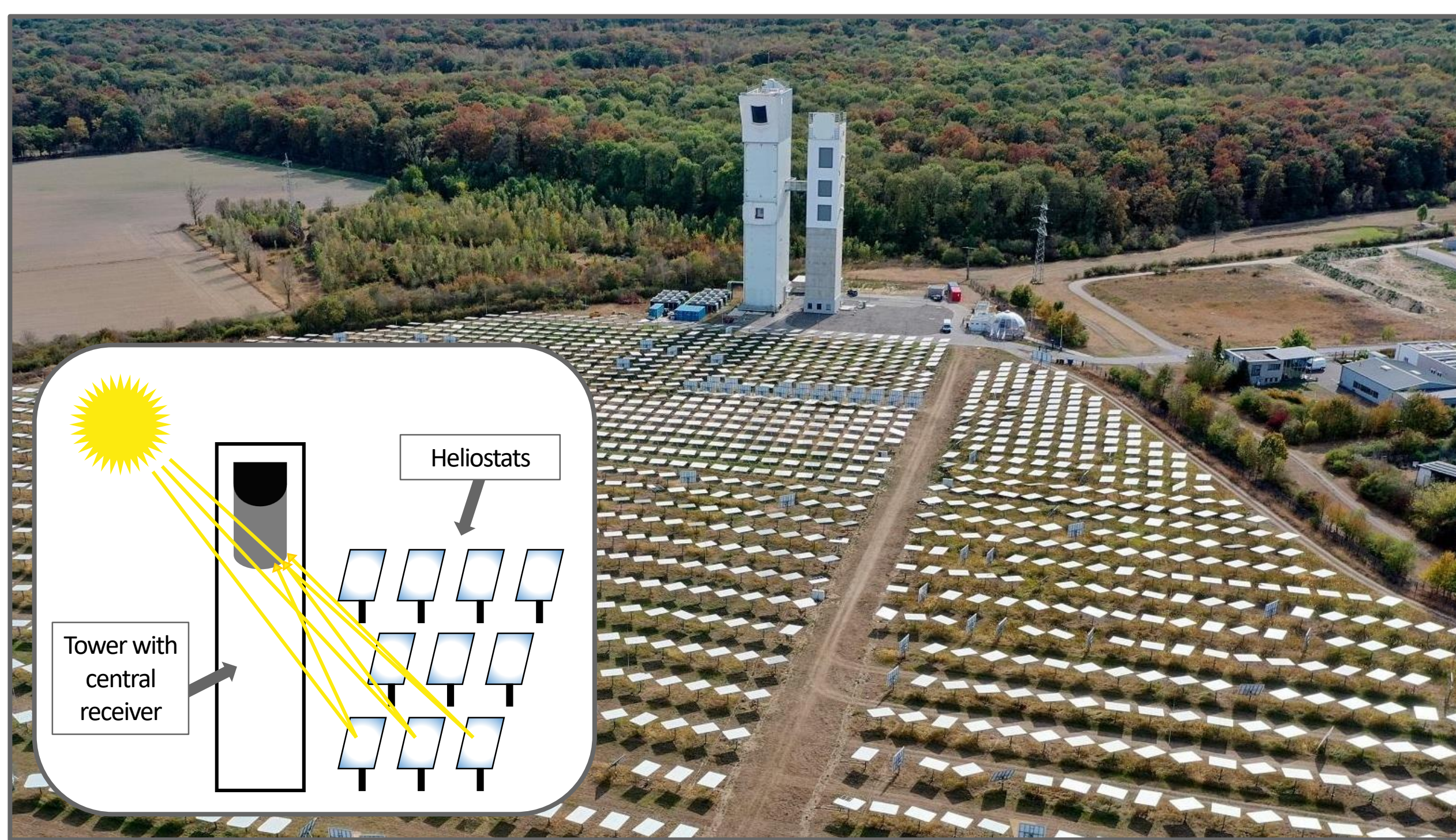


# Condition Monitoring for Heliostat Fields Using Artificial Intelligence (🎓 PhD project)

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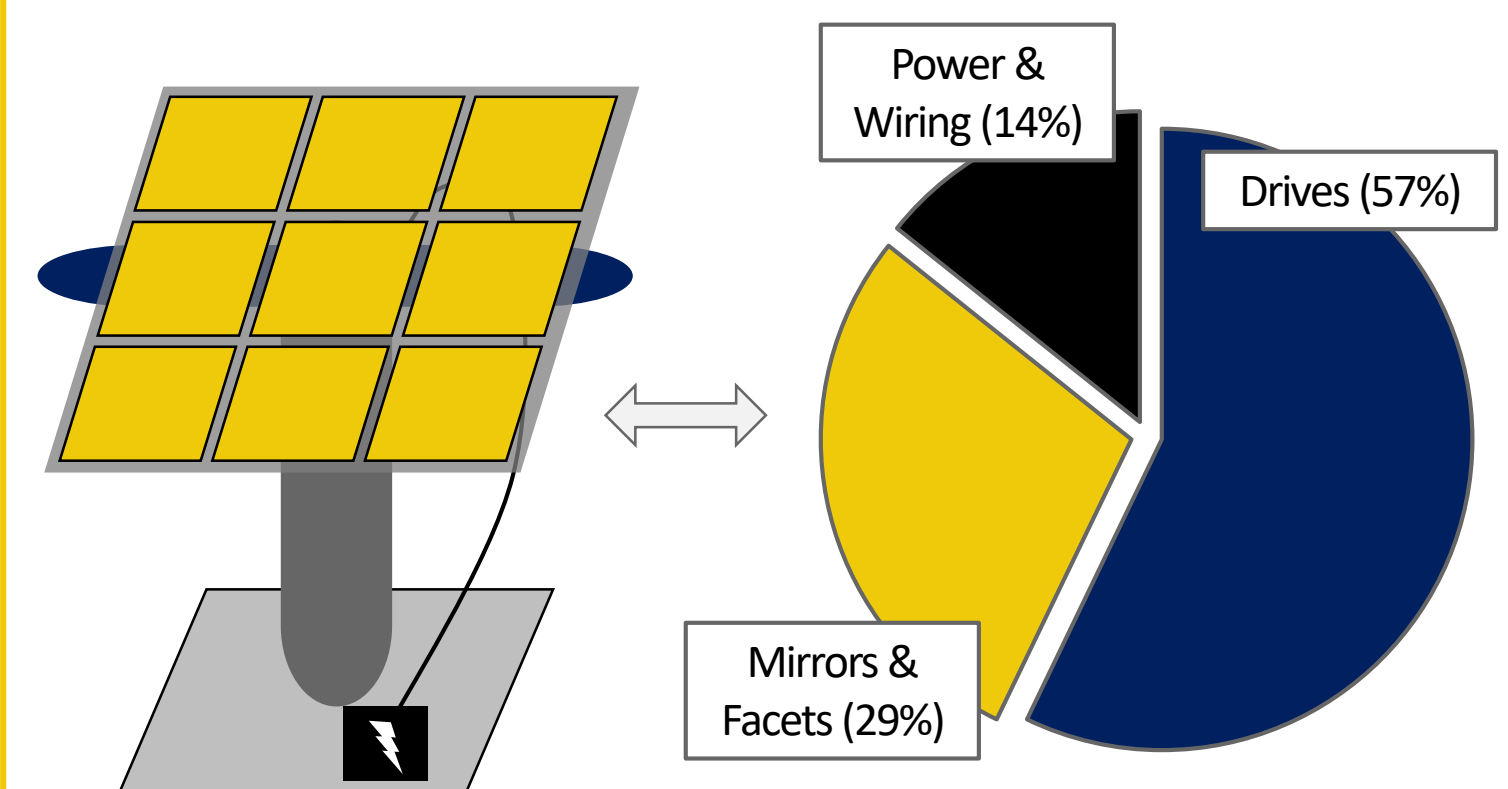


Heliostats arranged in a large field are concentrating incident sunlight onto a central receiver mounted on the top of a tower. Concentrated solar power tower plant (DLR-owned) in Jülich, Germany.

## Motivation

- Malfunctions, wear and ageing of heliostats

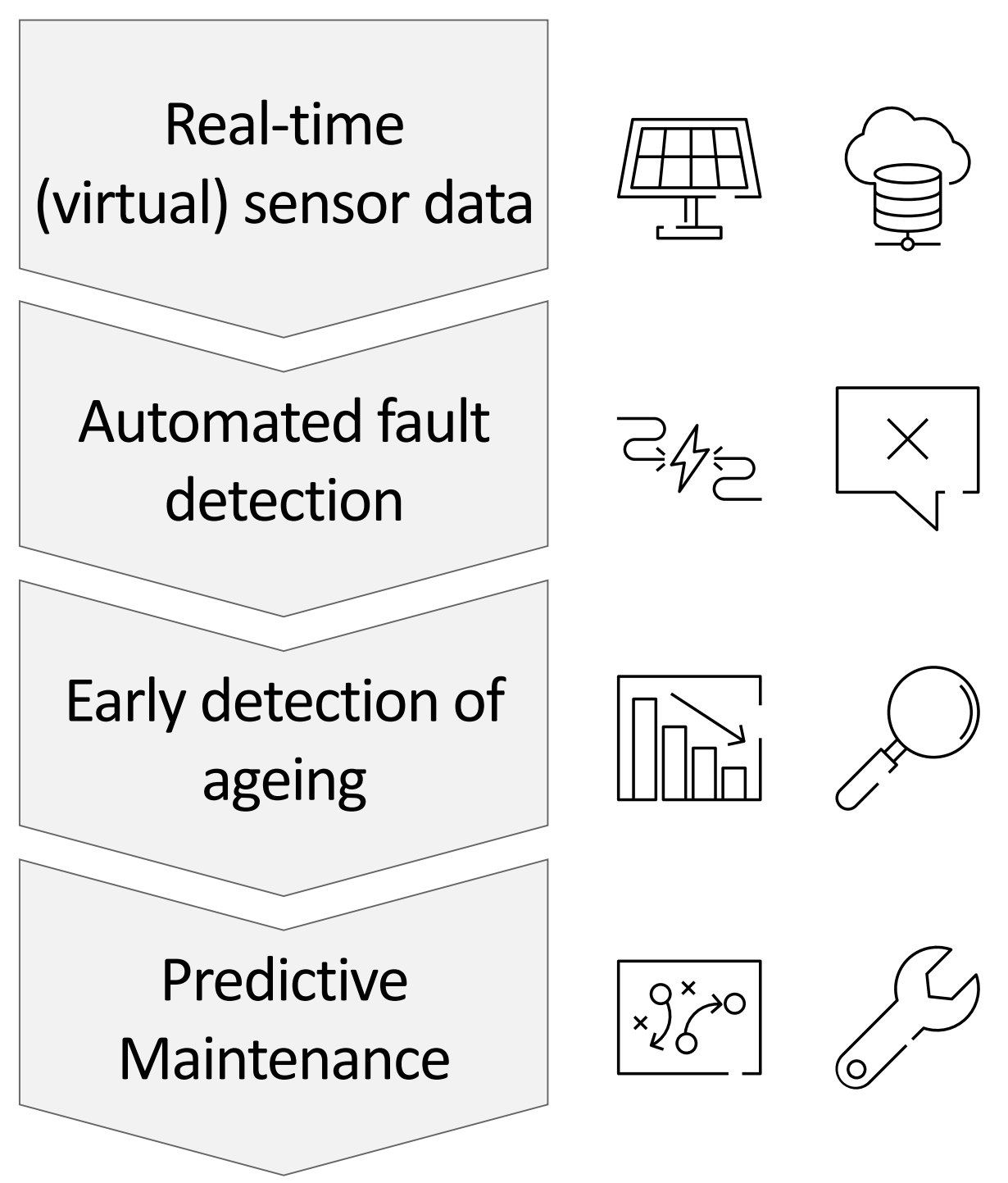
Maintaining a high reliability for thousands of heliostats can also prove challenging.<sup>1</sup>



Overview of important heliostat components and associated availability issues, derived from the CSP Best Practices Study<sup>1</sup>.

## Concept

- Focus on heliostat drives, motors, control units and communication systems



## 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?

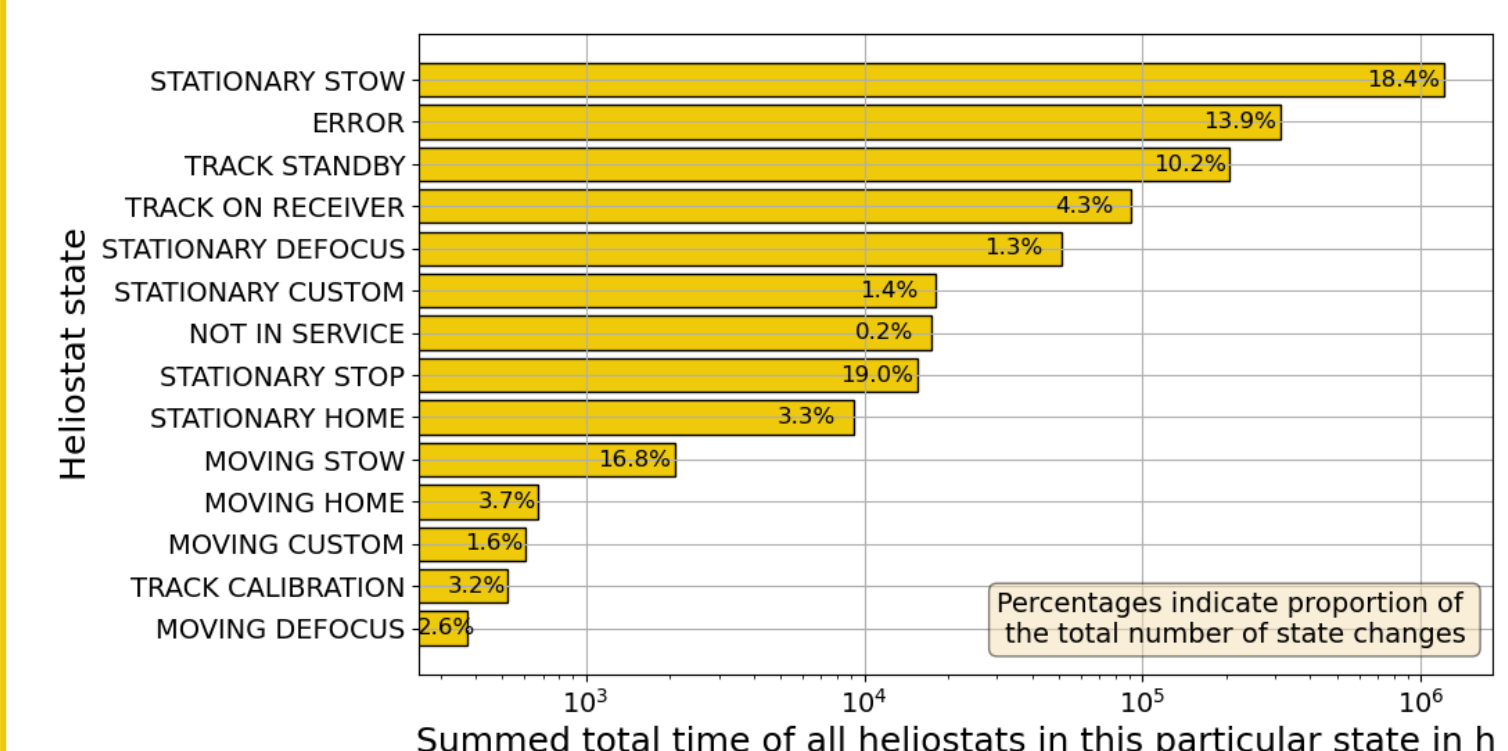
## Methodology

- Machine learning-based multi-layered analysis of large amounts of **time series data**
- Relevant condition data** from sensors (real/ virtual)

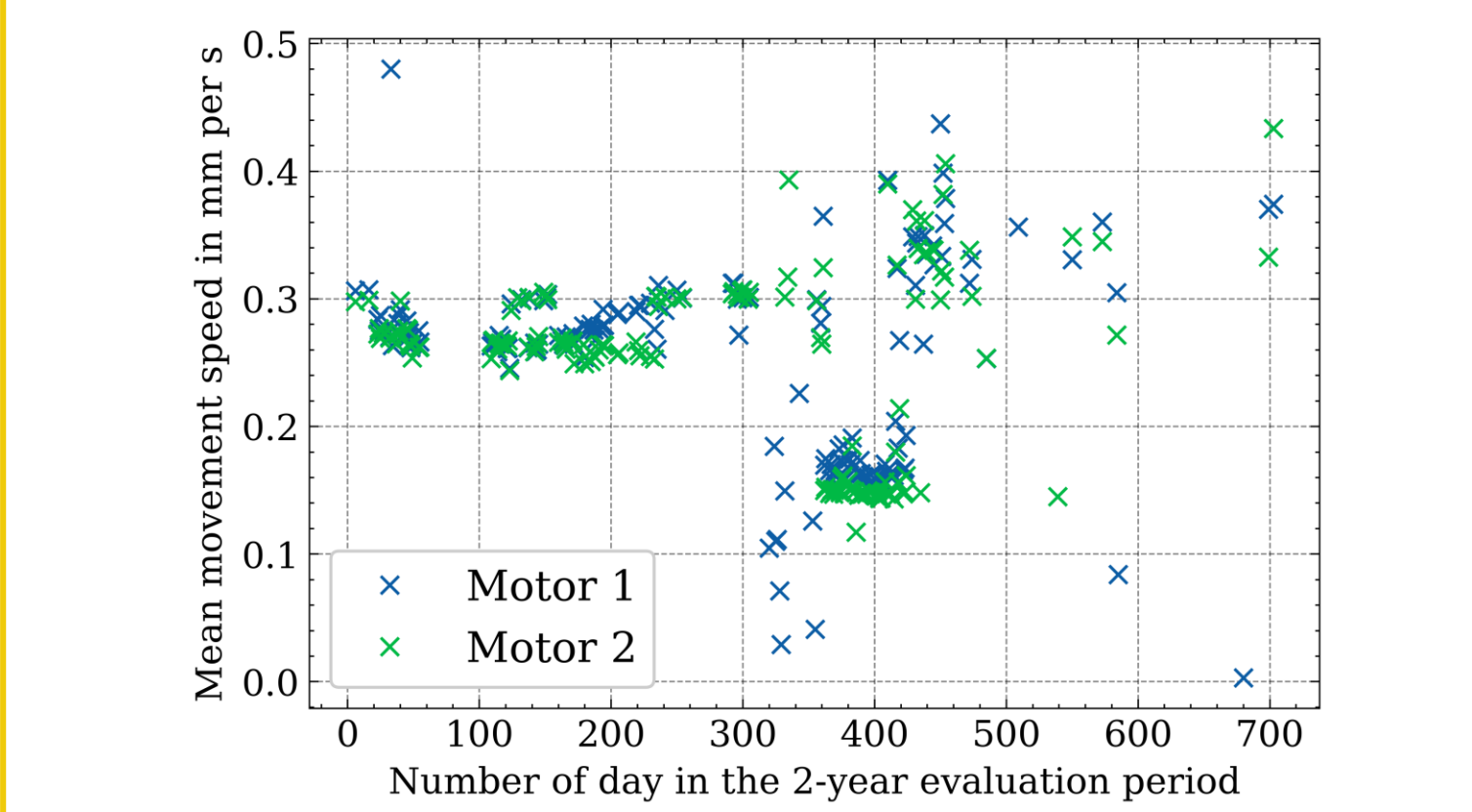
Tools:	
Time series visualization 	Stat. analysis, aggregation 
Classical time series models 	Anomaly detection 
Spectral analysis 	Decision trees, random forests 
LSTM models 	Transformer models 

- Goal: Extracting **information hidden in measurement data** and deriving valuable insights

## Preliminary Results



Statistical overview of different heliostat operating states and the amount of time the heliostats are in these states.



Comparison of movement speed of the motors of the two heliostat axes.

## Discussion & Next steps

- Preliminary analysis of **first small data set** shows **no** heliostats faults or ageing effects
- Gaining access to **further measurement data**, carrying out **own measurement campaign**

## References

<sup>1</sup>Mehos, M. et al. (2020). Concentrating Solar Power Best Practices Study. NREL/TP-5500-75763.