TECHNOLOGY OFFER

WISSENS/ TRANSFER/ OST/

www.wtz-ost.at

Distributed state estimation in complex thermal systems

Latent and thermochemical heat energy storage can contribute significantly to increase energy flexibility and decarbonization in industry due to their high energy density. However, these thermal systems are highly complex, which is why integration is still a major challenge.

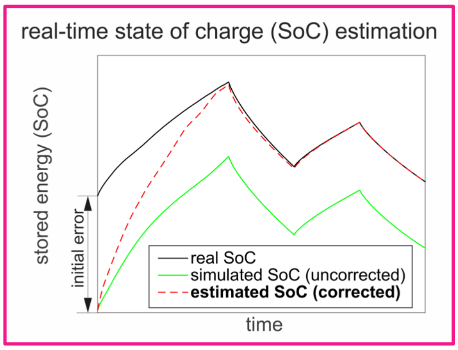
To exploit their full capability, it is crucial to estimate the storages' internal distributed state and subsequently compute the state of charge (SoC). The offered method computes accurate estimates based on typical measurements and a detailed physical model, enabling effective and flexible management of complex thermal systems.

BACKGROUND

Knowing the distributed system state and subsequently the SoC is crucial to fully exploit a storage's capacity and determine the possible load rates and limits in dynamic storage operation. For typical sensible thermal energy storages with fast dynamics the overall system state can be sufficiently described by aggregated measurements such as temperature and mass.

By contrast, in latent heat thermal energy storages (LHTES) most energy is stored during phase transition at almost constant temperature. Due to the complex energy-temperature dependency and low thermal conductivity of phase change materials in LHTES, the state of charge cannot be measured directly, thus a suitable model-based observer is necessary.

TECHNOLOGY



The developed observer increases energy supply reliability and serves as a basis for advanced control methods.

At least two different thermodynamic state variables are measured in the complex thermal system at designated points. Both, the distributed states as well as the output variables of the system are predicted using a detailed model. The distributed states represent the temperature or the specific enthalpy distribution. The predicted states are corrected based on the predicted output variables, the measured output variables, and the sensitivities of the system model. This observer algorithm provides an accurate estimate of the distributed states and the aggregated SoC.

ADVANTAGES

- Detailed estimation of distributed system states (e.g., temperature field, melting fronts)
- Accurate estimation of total state of charge
- Optimal combination of different measurements and sensors
- Estimation of unknown system parameters (e.g., heat transfer coefficient)
- Fully open to other applications and proven on LHTES

REFERENCE:
M004/2020

APPLICATIONS:
Thermal management, State estimation in distributed systems

DEVELOPMENT STATUS:
TRL 4

KEYWORDS:
Energy storage optimization
Distributed energy
Advanced control
Estimator design

IPR:
Patent AT 524238
PCT application filed

OPTIONS:
R&D co-operation
License agreement

INVENTORS:
Dominik Pernsteiner
Alexander Schirrer
René Hofmann
Stefan Jakubek

CONTACT:

Karin Hofmann
TU Wien
Research and Transfer Support
T: +43.1.58801.415241
karin.hofmann@tuwien.ac.at
www.rt.tuwien.ac.at

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

TU Wien is a funding member of the Transfer Allianz.