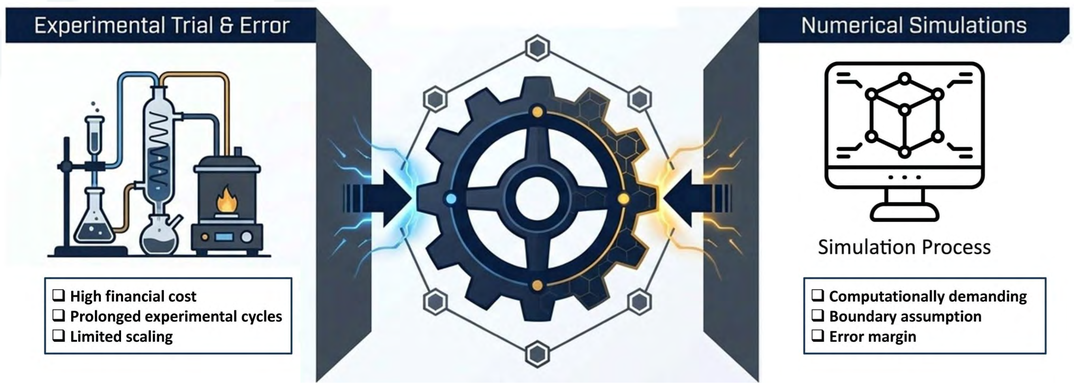
Water Adsorption Predictions in STES Reactor via Machine Learning

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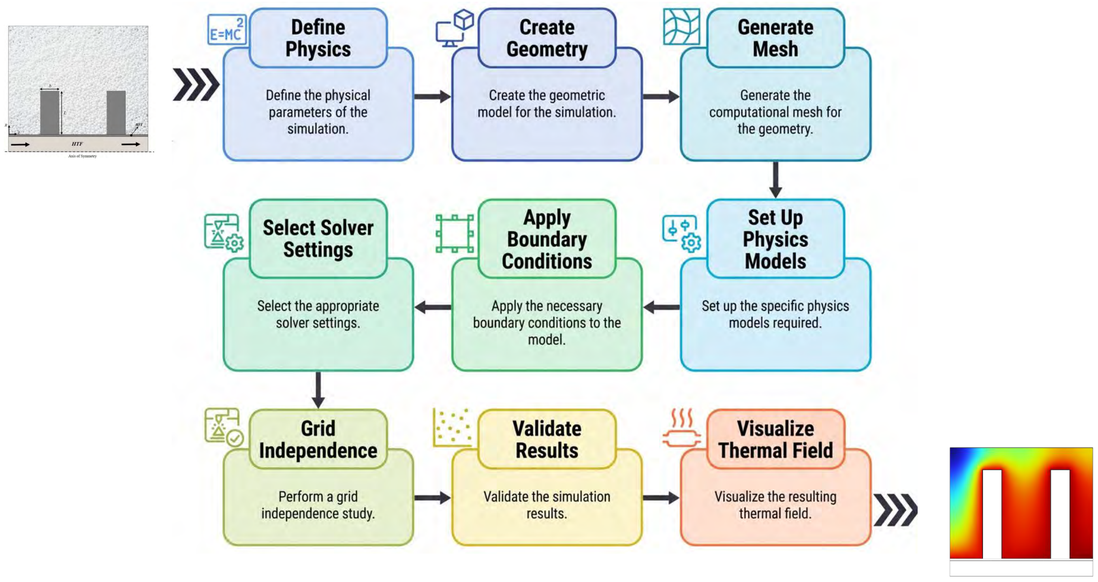
Sorption energy storage is a promising TES technology due to its high energy density. This study uses supervised machine-learning models to predict water uptake in a sorption reactor. The models generalize beyond training data, improve thermal-management design, and cut simulation time and cost.

Problem

Sorption-based TCES offers high energy density and near- zero thermal loss, but Complex research and development

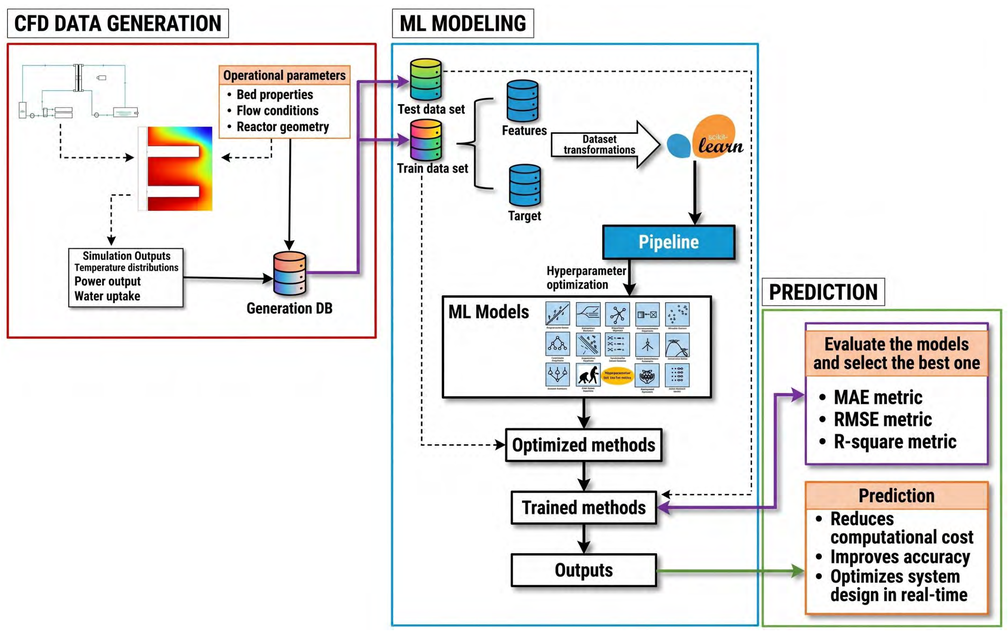


Simulating a simple sorption reactor is computationally intensive and time-consuming



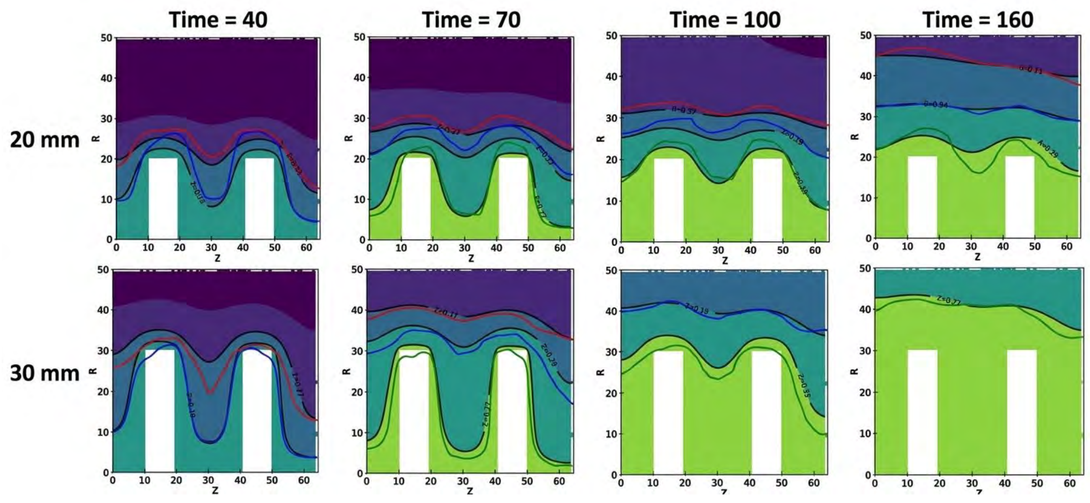
Methodology

- Reactor is modeled in COMSOL Multiphysics 6.1.
- Simulations with varying fin lengths generate spatial water-uptake data over time.
- Providing a comprehensive dataset for training machine-learning models.

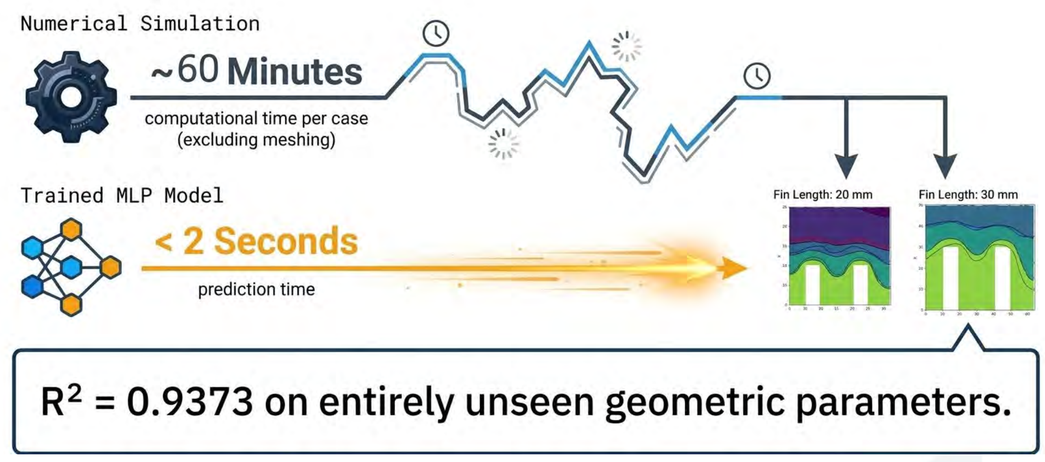


Results

- The ML model accurately predicts water uptake for fin lengths of 20 mm and 30 mm, demonstrating its reliability.
- Small errors occur in the early stages due to complex behavior near fin walls.

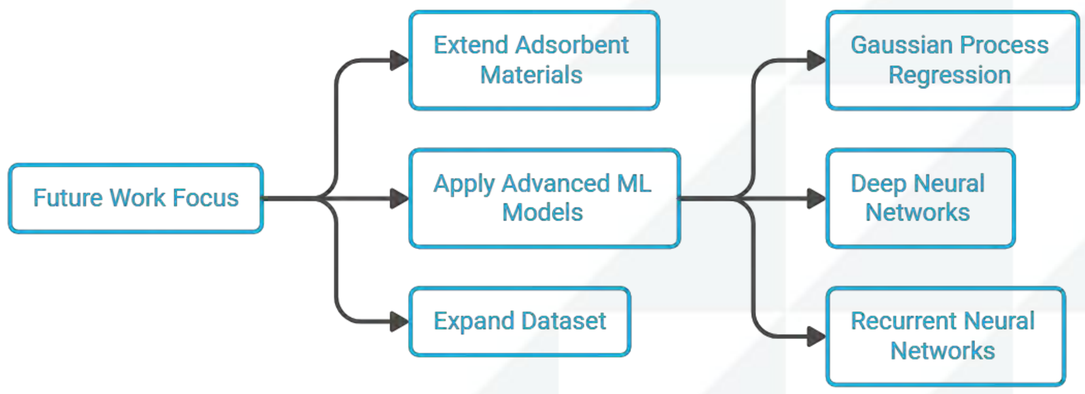


Prediction in just seconds, compared to about hours for full simulations



Future work

- Future work will extend the framework to other adsorbents, explore advanced ML models, and expand the dataset to cover a wider range of geometries.



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