KTH VETENSKAP OCH KONST

SweGRIDS

Physics-Informed Neural Networks for modelling temperature and loss distribution in power transformers

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Background

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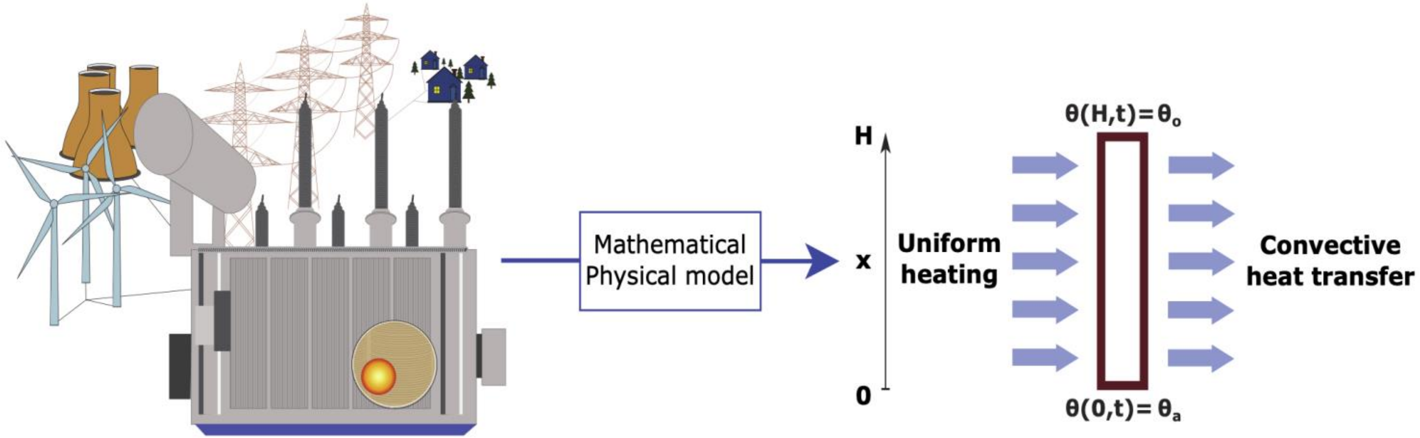
Dynamic thermal modelling of power transformers

- An indicator of transformer thermal performance is the **top oil temperature θ_o**.
- Top oil temperature is a function of **ambient temperature θ_a** and **load factor K**.



Objectives

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- Obtain a predictive model that uses previous time steps to predict future temperature values.
- Optimization of transformer design.
- Extension of transformer lifetime.
- Dynamical adjustment of the maximum load based on online estimated temperatures.

Approach

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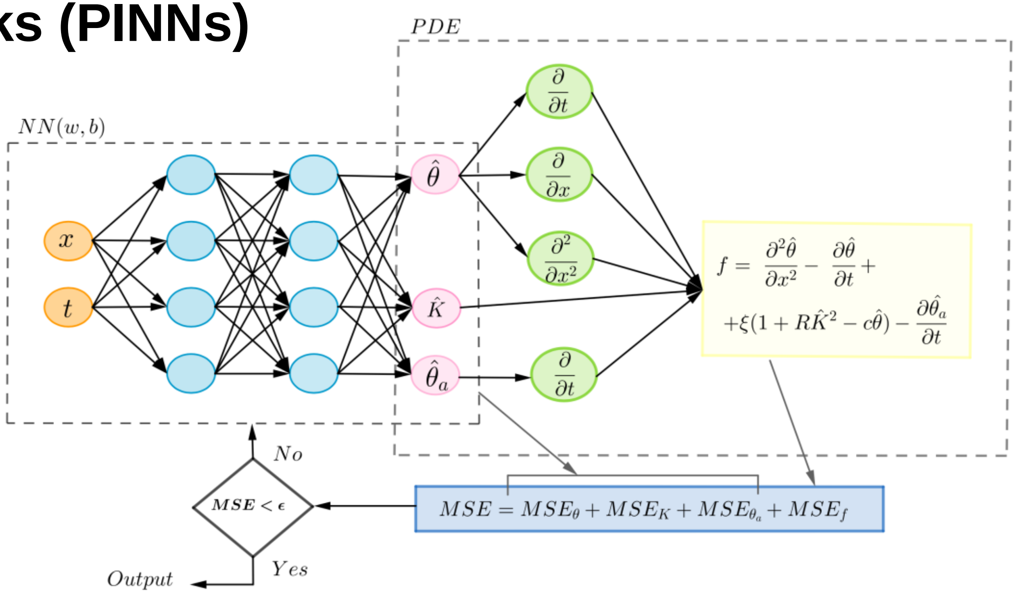
Physics-Informed Neural Networks (PINNs)

PINNs are artificial neural networks (ANNs) that make use of prior knowledge that nonlinear partial differential equations (PDEs) store.

PINNs aim at mitigating the issue of ANNs, considered as ”black boxes”, by constraining outputs of neural networks to a physical model expressed via nonlinear PDEs.



Results

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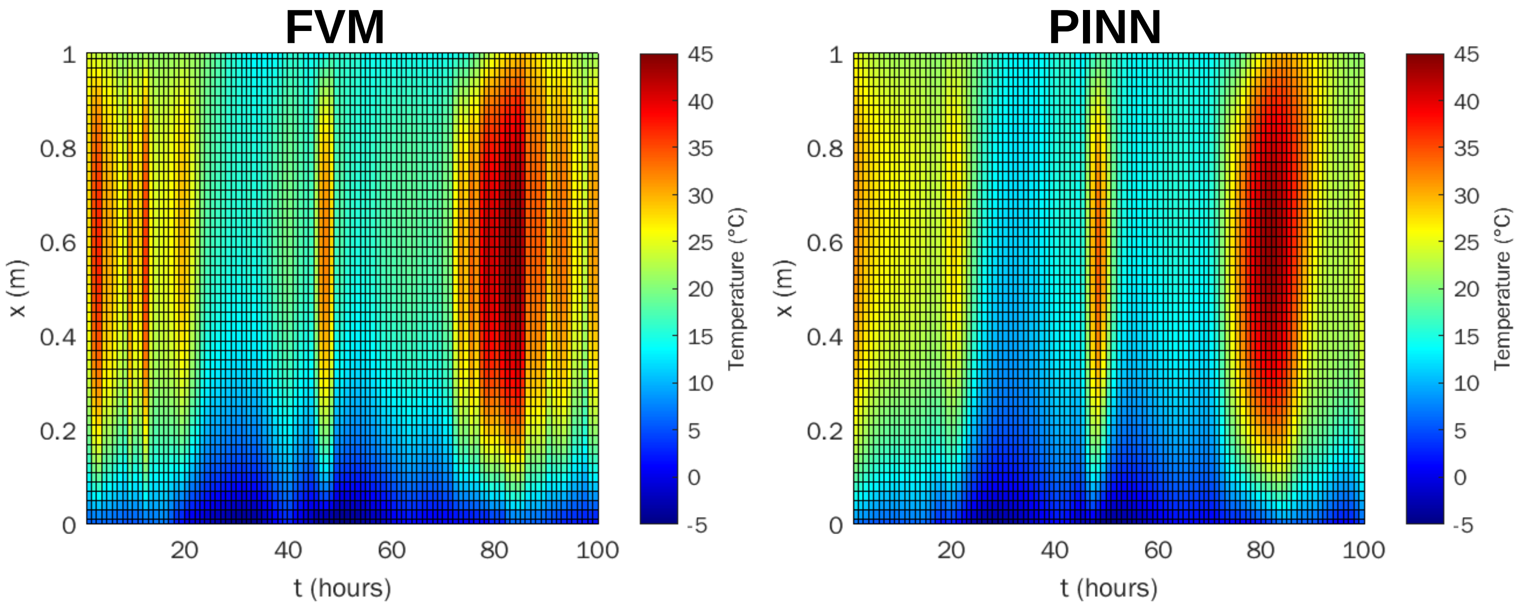
Comparison of the results between the Finite Volume Method (FVM) and PINN.



RMSE = 2.35˚C