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Solving Laplace's equation with Physics-Informed Neural Networks

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Abstract

The `ntnuthesis` document class is a customised version of the standard LaTeX `report` document class. It can be used for theses at all levels – bachelor, master and PhD – and is available in English (British and American) and Norwegian (Bokmål and Nynorsk). This document is ment to serve (i) as a description of the document class, (ii) as an example of how to use it, and (iii) as a thesis template.

Sammendrag

Dokumentklassen `ntnuthesis` er en tilpasset versjon av LaTeX' standard `report`-klasse. Den er tilrettelagt for avhandlinger på alle nivåer – bachelor, master og PhD – og er tilgjengelig på både norsk (bokmål og nynorsk) og engelsk (britisk og amerikansk). Dette dokumentet er ment å tjene (i) som en beskrivelse av dokumentklassen, (ii) som et eksempel på bruken av den, og (iii) som en mal for avhandlingen.

Zhang et al., 2022

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Literature study

1.1 Physics-informed neural networks for consolidation of soils

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For the forward problem, it is difficult to obtain analytical solutions for most of the models related to consolidation.

Researchers have revealed that PINNs possess the following advantages compared with the conventional mesh-based numerical methods in tackling the forward problem. First, PINNs is capable of solving the inverse problem with the only minor change of the code that is used in a forward problem (Liu and Wang, 2019). Secondly, neural network-based methods with mesh-free features can reduce the tedious work of mesh generation (Basir and Senocak, 2022). Thirdly, PINNs can obtain remarkably accurate solutions and reliable parameter estimations with fewer data and average-quality data, to reduce the dependence on the need for large training datasets (Zhang et al., 2021). Fourthly, PINNs can produce results at any point in the domain once it has been trained (Basir and Senocak, 2022).

Bibliography

Zhang, Sheng et al. (June 2022). “Physics-informed neural networks for consolidation of soils”. In: Engineering Computations. Accessed January 27, 2025. ISSN: 0264-4401. DOI: 10.1108/EC-06-2021-0255. URL: https://www.emerald.com/insight/content/doi/10.1108/ec-08-2021-0492/full/html.