PhD Position for Adaptive Nonlinear Data Assimilation in Subsurface Systems

Challenge: Advancing the energy transition requires understanding complex subsurface environments.

Change: Developing an innovative nonlinear data assimilation strategy that can adapt itself to the challenges of different natural systems.

Impact: This method will permit safer, more predictable operations in the subsurface and beyond.

**Job Description**

The subsurface plays a critical role in tackling the challenges of a changing climate. It provides drinking water amidst increasingly frequent droughts, and it is a keystone of the energy transition by providing geothermal energy and storage space for hydrogen. Despite its importance, our insights into the subsurface's properties and processes are scarce, limiting our ability to fully characterize this environment. The resulting uncertainties require careful analysis to inform societally responsible subsurface operations: How can we sustainably heat as many homes as possible? Where shall we establish the next hydrogen storage reservoir? What can we do to mitigate our operation's environmental and economic risks?

To answer such questions, data assimilation systematically combines numerical models with data to explore different possibilities of what the true system could be like, but its implementation remains a challenge in complex systems. Most data assimilation methods either over-simplify or are prohibitively inefficient, which compromises our decision-making. In this project, you will join a collaboration between TU Delft and the Norwegian energy company Equinor to co-develop an improved data assimilation strategy that uses a statistical method related to normalizing flows and diffusion models. This method can exploit advanced information about the numerical model, such as which variables are indirectly related to each other (conditional independence) or degrees of nonlinearity (How complex do we have to make our updates?). This allows us to create a powerful data assimilation framework that is always as simple as possible and as complex as necessary, which yields improved subsurface characterizations that will enable better, more reliable decision making.

As a PhD student at TU Delft, you will:

* Familiarize yourself with the methodological foundations of triangular measure transport and data assimilation
* Co-develop a scalable, adaptive, nonlinear data assimilation method based on triangular transport
* Explore innovative strategies to adapt the method to different environmental systems
* Apply the resulting algorithm to analyse the properties and uncertainties of a real geothermal operation

This four-year project is part of a collaboration between TU Delft and DA research at Equinor in Bergen, Norway. You will join the [reservoir engineering section](https://www.tudelft.nl/en/ceg/about-faculty/departments/geoscience-engineering/sections/reservoir-engineering) at TU Delft’s Department of Geoscience & Engineering, where you will find a vibrant and collaborative environment in which you will have the opportunity to interact with experts in data assimilation, geothermal energy, and numerical simulation. You will be encouraged to learn new skills and develop your own ideas, and you will share your findings at conferences and in peer-reviewed journals. These experiences will pave the way for diverse career paths in industry, consultancy, governmental agencies, or academia.

**Requirements**

* You hold a Masters degree in geoscience, geophysics, applied mathematics/statistics, or a similar field
* You thrive on systematic, code-based research, and have an aptitude for abstract or mathematical thinking.
* You have a keen interest in data assimilation and machine learning, and are excited to explore their applications in complex environmental systems
* You have experience with Python or a similar programming language. Experience with computationally intensive numerical methods is a plus.
* You are a highly motivated and self-driven researcher, capable of working both independently and as part of a team
* You have an excellent command of written and spoken English

Doing a PhD at TU Delft requires English proficiency at a certain level to ensure that the candidate is able to communicate and interact well, participate in English-taught Doctoral Education courses, and write scientific articles and a final thesis. For more details please check the [Graduate Schools Admission Requirements](https://www.tudelft.nl/onderwijs/opleidingen/phd/admission).

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**[TU Delft (Delft University of Technology)]**

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**[Department]**

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**Additional information**

For more information about this vacancy, please contact [name], [role], email [email address].

**Application procedure**

Are you interested in this vacancy? Please apply no later than [date] via the application button and upload:

* A motivation letter (max. 800 words) outlining your interest in pursuing a PhD and your interest for this particular project.
* A curriculum vitae including, if available, a link to your MSc thesis.
* Academic transcript, including grades for your qualifying degrees (BSc, MSc)
* Contact information for two referees we can call or email for feedback (no letters are needed at this stage).

After an initial selection, we plan to have a first round of online interviews in the week of xx, and a second round the week after. We understand that you might have other commitments during the summer and will do our best to be flexible when setting up the interviews.

We are acutely aware that we are a diverse society and not every talented student will have had the same opportunities to advance their careers. We therefore pledge to fully account for any particular circumstances that the applicants disclose (e.g. parental leave, caring duties, part-time jobs to support studies, disabilities etc.) to ensure an inclusive and fair recruitment process that does not rely purely on common research metrics. Our goal is to help the next generation of scientists thrive in a safe and inclusive environment.

We are looking forward to receiving your application!

* [Vacancy holder’s name] (TU Delft)

**Please note:**

* You can apply online. We will not process applications sent by email and/or post.
* A pre-employment screening can be part of the selection procedure.
* Please do not contact us for unsolicited services.