

University of Stuttgart Germany

Department for Stochastic Simulation and Safety Research for Hydrosystems (LS³)

Project / B.Sc. / M.Sc. Topic

In this project, we are investigating the impact of climate change on water demand in southern Germany by utilizing real-world data provided by regional water suppliers for the period between 2010 and 2020. Recent advancements in artificial intelligence and machine learning offer unprecedented potential for modelling complex, nonlinear relationships that are often beyond the scope of conventional statistical models. Currently, no established models exist to reliably predict future water consumption under varying climate conditions, making this a critical area of research.

Current research efforts have primarily focused on linear regression and Gaussian Process Regression (GPR) techniques. GPR, as a machine learning method, is well-suited for creating accurate models even with small training datasets. However, it has limitations when it comes to

extrapolation, as its predictive performance often diminishes outside the range of the training data. In contrast, Polynomial Chaos Expansion (PCE), a method that represents a system as a series of orthogonal polynomials, inherently offers better extrapolation capabilities, making it a promising alternative for addressing this limitation. This thesis will explore the combination of GPR and PCE, leveraging their complementary strengths to model water demand using realworld data. The specific scope of the project can be adjusted based on the student's interests, expertise, study program and type of thesis, allowing flexibility to tailor the research focus.

Prospective tasks

- Literature research on GPR and PCE
- Implementation of a coupled model using Python
- Evaluation of the model performance by comparison to existing models

General Information

- Advisor: Philipp Hofmann
- Examiner: Prof. Dr.-Ing. Sergey Oladyshkin

Desirable Skills

- Solid understanding of mathematical and statistical concepts
- Experience with programming in Python
- Interest in application of machine learning to real world problems



Apply now!

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