

**University of Stuttgart** Germany

Department for Stochastic Simulation and Safety Research for Hydrosystems (LS<sup>3</sup>)

## SimTech Forschungsmodul Topic

In geostatistics, many real-world processes (e.g., soil properties, environmental measurements) are observed at a set of spatial locations, but these processes are often influenced by complex, unknown factors. Traditional methods in spatial modelling, such as kriging or Gaussian process modelling, assume certain underlying structures (e.g., Gaussianity or stationarity), which may not be realistic for all processes. Such assumptions can limit the accuracy and reliability of the estimates, especially when the data deviates from these assumptions.

The goal is to avoid such strong assumptions and focus on **learning the moments** (i.e. statistical properties) directly from multiple sample paths. Once learned, these moments can be used to **estimate the moments at new, unobserved locations**, allowing for flexible and robust modelling of uncertainty in geostatistical processes.

The aim of this work is to implement a moment matching pipeline with a modular character, such that different modelling approaches like neural networks, GPEs and aPCE can be tested and compared on several synthetic and real-world test cases, such as randomized GP realizations and rainfall data.

## **Prospective Tasks**

- Literature research on existing moment matching frameworks
- Implementation of a moment matching pipeline for several (already existing implementations of) model approaches
- Numerical experiments for synthetic and real-world data
- Visualization of results and discussion

## **General Information**

- Advisor: Stefania Scheurer, Maria Fernanda Morales Oreamuno
- Examiner: Prof. Sergey Oladyshkin

## **Desirable Skills**

- Advanced scientific programming in Python
- Solid understanding of machine learning, statistics and probability theory



Apply now! stefania.scheurer@iws.uni-stuttgart.de Moment Matching for Uncertainty Quantification in Process Modelling

