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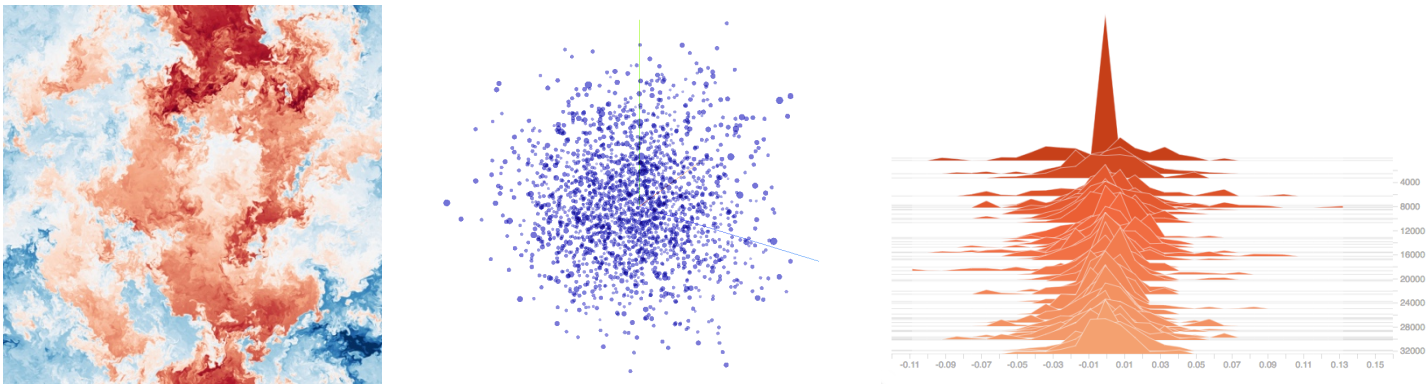
HiWi/Bachelor‘s thesis/Master’s thesis

Using Deep Learning for Scientific Pattern Recognition

In this project, we will pursue a novel research route based on the method of deep learning to approach the problem of turbulence. During the last years, the technique of deep learning was improved substantially, and has proven to be useful in a large variety of different fields, ranging from computer science to life science. However, to our knowledge, the method of deep learning has not been applied to predict statistical behavior of small-scale turbulence. Despite its stochastic nature, turbulence exhibits certain coherent structures and statistical symmetries that are traceable by deep learning techniques. While analytical solutions exist for low-order correlation functions, for higher-orders there is no such tractable solution available so far. Therefore, deep learning techniques are a promising approach to predict statistics of fine-scale turbulence.
We intend to design deep neural networks for learning to predict such analytically intractable higher-order correlation functions from data obtained in specific turbulence simulations. State-of-the-art libraries/APIs such as TensorFlow or Keras will be used on supercomputers (including GPUs).



Turbulent structures (left), weights of CNN (center), and histogram of bias gradients of CNN (right).

Tasks:

- Implementation and evaluation of several deep learning networks
- Improvement of neural networks for scientific pattern recognition
- Documentation and visualization of results

Requirements:

- Knowledge in Python (or comparable language)
- Enrollment in math, engineering, or science study
- Current average of 1.5 or better (German scale)
- Self-motivation and commitment

Please apply with full CV (incl. grade sheets) to:

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