Master's thesis project in Space, Earth and Environment

Machine learning: Physical modeling

Complex physical simulations are required in many areas of physics, this including Earth sciences and climate modeling. In some cases the aim is to obtain most accurate results possible and the only solution is then to simulate the physical processes in full detail. There are also situations where it is sufficient to reach a certain accuracy, but the calculation time should be as short as possible. Examples on the later situation are weather forecasting and climate modeling where various radiative transfer simulations must be performed. These are complex calculations and only a certain amount of computer power can be allocated to this part. As a result, radiative transfer can today not be considered at every time step of the model and this has a negative impact on the overall output. That is, it would be beneficial to decrease the calculation burden of the calculations.

The aim of this project is to start exploring machine learning to replace full physical modeling in radiative transfer simulations. To apply machine learning has the potential of decreasing the calculation burden with orders of magnitude. However, to perform full radiative transfer calculations is a highly challenging task and the problem will be approached in steps, to gradually build up a competence. A suitable first step should be to investigate how machine learning can be used to extract particle scattering features. To correctly describe how particles affect radiation requires today both extensive pre-calculations and costly multi-dimensional interpolation. Machine learning could drastically decrease the required amount of calculations.

In general, the project will give you experience of modern machine learning methods and tools. It will also serve as a general introduction to a relatively new application of machine learning.

Prerequisites: Some knowledge in neural nets/machine learning, basic programming experience; background in physics or Earth science is beneficial

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