Data Analysis, Processing, and Algorithms for Weather and GHG reduction

Predicting the weather and in general large-scale particle, fluid, and gas systems is a task that is critical nowadays for making sustainable decisions about our environment. One use case, for example, is to assess the environmental impact of carbon capture in waste incineration plants, to avoid CO2 emissions. In this thesis, several implementation and data aspects of fluid and gas simulation models can be tackled for enabling precise simulations about CO2 emissions, as well as weather models in general. The used models for this are the infamous GRAMM/GRAL models developed by the Institute of Thermodynamics and Sustainable Propulsion Systems (ITNA). GRAMM, the Graz Meteorological Model, is a model for weather and climate prediction, while GRAL, the Graz Lagrangian Model, is one of the benchmarks for high-resolution dispersion-models in science and for regulatory assessments. Both together have the potential to predict and simulate local weather and pollutant phenomena in unprecedented resolution and accuracy. This topic potentially consists of several theses that can be tailored according to the interests and motivation of the student, ranging from hardcore number-crunching physics and simulations models, to retrofitting FORTRAN code, to implementing data conversion scripts in Python or new graphical user interfaces in C#. This thesis is done in cooperation with the Institute of Thermodynamics and Sustainable Propulsion Systems (ITNA).

Goal and Tasks:

- Writing applications for automatic cleaning and post-processing of recorded and simulated data.
- Implementing scripts for automatic transformation and adaption between data schemes.
- Integrating highly sophisticated dispersion models in applications for impact assessment of carbon capture in waste incineration plants.
- Upgrading and retrofitting legacy code e.g. from FORTRAN to C#.
- Data interpolation and conversion between models (e.g. interpolating between surface-resolutions of $5km^2$ to $100m^2$ or even $10m^2$).
- Verification and Optimization of the "SIMPLER" Algorithm (used for Thermodynamics) to simulate fluids, gases, and other pressure-based systems.
- Writing a scientific master thesis (including related work/background literature research and a detailed evaluation and comparison of the work).

Recommended Prior Knowledge:

- Programming in Python, C#, or FORTRAN.
- Interest in physical simulations and thermodynamics.
- Experience with fluid simulations/dispersion models/finite element method.

Start: a.s.a.p.

Duration: 6-12 months

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