Offer #2021-03355

Post-Doctoral Research Visit F/M Data-driven machine learning techniques for wind farm scale flow simulations

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : Recently graduated

About the research centre or Inria department

We aim at a step change in numerical modeling for science and engineering. We do that by developing two fundamental enablers: reduced-order models and monolithic numerical models on hierarchical Cartesian grids. Thanks to these enablers it will be possible to transfer complexity handling from engineers to computers, providing fast, on-line numerical models for simulation.

Context

This position is open for 18 months. The candidate should have defended his PhD thesis after September 2019. He/she will be based in Bordeaux and work within the Memphis Team at Inria Bordeaux – Sud Ouest in collaboration with IFPEN. Short stays and visits will also be planned within the Applied Mathematics and Fluid Mechanics departments at IFPEN in Rueil-Malmaison.

Assignment

In order to better understand the flow physics in a wind farm, detailed flow simulations need to be computed with enough precision. Currently, only high-fidelity Navier-Stokes based Large-Eddy-Simulation (LES) solvers are able to accurately compute such flows and are therefore used rather extensively in the wind energy community. However, due to their high computational cost, only canonical cases are considered (a single to a few turbines). Full wind farm simulations have only been performed either for demonstration purposes or by employing mesh resolutions that are not sufficient to accurately represent the flow physics.

The aim of this post-doctoral work is to investigate the potential of model-based machine-learning techniques to reduce the computational cost of high fidelity, wind farm scale simulations. We will in particular study how model reduction techniques can be coupled to LES flow simulations to lower the computational cost while maintaining the accuracy of the results. The main idea is to assemble a farm simulation by collating several single wind turbine models and an appropriate propagation model that can be a full high-fidelity LES model where, however, the relevant physical scales are significantly larger compared to the phenomena taking place near the windmill. This approach has been explored in the literature and it has the potential to scale up to complex time-dependent 3D applications [1-4].

[1] M.R. Buffoni, H. Telib, A. Iollo. Iterative methods for model reduction by domain decomposition. Computers & Fluids. Vol. 38, pp. 1160-1167, 2009.

[2] M. Bergmann, A. Ferrero, A. Iollo, E. Lombardi, A. Scardigli, H. Telib. A zonal Galerkin-free POD model for incompressible flows. Journal of Computational Physics, Volume 352, pp. 301-325. 2018.

[3] A. Ferrero, A. Iollo, F. Larocca. Global and local POD models for the prediction of compressible flows with DG methods. International Journal for Numerical Methods in Engineering, DOI: 10.1002/nme.5927, 2018.

[4] S. Riffaud, M. Bergmann, C. Farhat, A. Iollo, Grimberg. S. The DGDD Method for Reduced-Order Modeling of Conservation Laws. Submitted.

Main activities

The post-doc should initially focus on one single wind turbine interacting with the atmospheric boundary layer, using the SOWFA library (OpenFOAM) to generate high-fidelity LES simulations along with an actuator-line model for the wind turbine. Then a predictive model for this single unit will be trained using realistic environmental conditions and validated in the fully coupled configuration to serve

a base for the farm configuration.

Skills

Technical skills and level required : A strong background in applied mathematics, scientific computing and fluid mechanics is expected. Good programing skills are required

A first experience in software development in the field of wind energy would be appreciated.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

2653€ / month (before taxs)

General Information

- **Theme/Domain :** Numerical schemes and simulations
  Scientific computing (BAP E)
- **Town/city :** Talence
- **Inria Center :** Centre Inria de l'université de Bordeaux
- **Starting date :** 2021-09-01
- **Duration of contract :** 1 year, 6 months
- **Deadline to apply :** 2021-07-31

Contacts

- **Inria Team :** MEMPHIS
- **Recruiter :**
  Iollo Angelo / Angelo.Iollo@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Thank you to send :
- CV + list of publications
- Cover letter

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.