Offer #2023-07018

Neural Galerkin scheme for Water wave simulations.

Contract type: Internship
Level of qualifications required: Graduate degree or equivalent
Fonction: Internship Research

Context

This internship will be in the INRIA team TONUS in Strasbourg for a period of 6 months. The developments will be realized in the Scimba code which implement some neural methods using PyTorch framework.

Assignment

In this internship, we propose to study the resolution of Shallow Water equation which can model the water wave propagation.

For this type of simulation, we need an accurate solver, able to deal with discontinuous topography and which preserve the steady state of the model. Indeed if the steady state are not well preserved by the solver the simulation can be deteriorate by spurious waves. The method which preserved this steady state are called: Well-Balanced and are well studied and understood in the finite volumes community.

Here, we propose to investigate a new method called « NEURAL GALERKIN ». This method use a neural network to approximate the solution in space and make involve the weights of the neural network to capture the time dynamic. These type of approach is less accurate than the classical but could use less degree of freedom in large dimension, are mesh-free and able to deal with parametric PDE.

In a first part, we propose to apply the method to 1D Shallow Water equations with continuous and after discontinuous topography. For this two case we will investigate the ability of the method to preserve the steady state, how initialize the method, the structure of the networks and develop an adaptive sampling algorithm. We will also investigate which prior on the solution we can incorpore into the network.

In the second time, we will extend this work in 2D on the sphere and add, if possible, the Coriolis effect. The objective will be to simulate tsunami type problem.

Main activities

Main activities:

- state of the art on Neural Galerkin method
- developpement of the 1D code
- developpement of the 2D code and study the steady state linked to the coriolis effect
- validation
- redaction

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- 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

4.05 per hour of training

General Information
**Contacts**

- **Inria Team:** TONUS
- **Recuriter:** Franck Emmanuel / emmanuel.franck@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.

**The keys to success**

For this internship we look for candidate with a Master in applied mathematics, PDE modeling and numerical analysis. Basics knowledge on neural networks will be appreciated be is not necessary. A good knowledge of the python language is important.

**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**

**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.