2023-06202 - Research on Automatic Differentiation

**Contract type**: Fixed-term contract  
**Level of qualifications required**: PhD or equivalent  
**Function**: Temporary Research Position

**About the research centre or Inria department**

The Inria centre at Université Côte d’Azur includes 37 research teams and 8 support services. The centre’s staff (about 500 people) is made up of scientists of different nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d’Azur, CNRS, INRAE, INSEM -), but also with the region’s economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d’Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

**Context**

Over more than two decades, INRIA has conducted research on Automatic Differentiation (AD) of algorithms. A research team has been studying the models of AD and several ways of improving it, and in parallel developed an AD tool (Tapenade) successfully used by a significant number of academic and industrial users. Tapenade is among the leading AD tools in terms of performance (CPU and memory use) of the differentiated code. This comes from a combination of architectural choices (Source-to-source AD, static data-flow analysis, storage-based data-flow reversal, checkpointing) that are based on research conducted for a significant part at INRIA.

Automatic Differentiation allows one to compute the derivatives of a mathematical function when this function has been implemented as a program. AD transforms or adapts the program itself to make it compute the derivatives. Gradients in particular are a most desired kind of derivatives, central in Scientific Computing (for optimisation, inverse problems, data assimilation), and also in related domains such as a computational finance. Computation of gradients is probably the stronger focus of AD research at INRIA. Recently, AD became a central part of the training algorithms of machine learning, where it is known as backpropagation. This has motivated a surge of new AD tools progressively gaining maturity (Autograd, Tangent, JAX, Enzyme...).

To promote INRIA’s results on AD and to guarantee long-term usage of Tapenade by the industrial partners, INRIA is considering recruitment of a person able to propose new research directions in the thriving field of AD, while maintaining our policy of dissemination of research results through a widely used AD tool.

The environment provided by INRIA allows for research and technology transfer at the highest level. INRIA proposes several recruitment possibilities, long or shorter term, to adapt to the objectives and profiles of applicants. In this context, an applicant who proposes a long term perspective on the future of AD, in line with INRIA scientific objectives, could be proposed a permanent position.

This post will imply a number of travels, to exchange with fellow researchers worldwide and to support collaboration with industrial users.

**Assignment**

The recruited person will be initially helped by the head of the Ecuador team of INRIA. The recruited person will be taken to develop cutting-edge research on Automatic Differentiation, building on the previous/existing research conducted in the Ecuador team and at INRIA, while closely following the evolutions of AD research at the international level in order to identify the most promising novel directions. A key will be to maintain the existing international collaborations at the academic level. Equally important is the sustained development of INRIA’s existing AD tool base, which is a requisite for any industrial application, but also a requisite for validation and experiments of innovative future AD models.

Therefore, in complement to research activity, it is of strategic importance for INRIA to continue and develop industrial collaborations, involving usage of INRIA’s AD tools.

In the medium term, the recruited person will be taken to build their own vision of future research on AD, to defend and promote it among the other researchers and towards industrial users.

For a better knowledge of the research subject:

- The international portal on AD research: http://www.autodiff.org/
- The web page of the INRIA team Ecuador: https://team.inria.fr/ecuador/fr/
- Tapenade open-source repository: https://gitlab.inria.fr/tapenade
- Some browsing using any popular search tool, about key words: Automatic Differentiation, Algorithmic Differentiation, Differentiable Programming, Adjoint Computation, Backpropagation.

**General Information**

- **Theme/Domain**: Architecture, Languages and Compilation  
  Software engineering (BAP E)  
- **Town/City**: Sophia Antipolis  
  **Inria Center**: Centre Inria d’Université Côte d’Azur
- **Starting date**: 2023-09-01  
- **Duration of contract**: 2 years  
- **Deadline to apply**: 2023-08-18

**Contacts**

- **Inria Team**: ECUADOR  
  **Recruiter**: Hascoët Laurent / Laurent.Hascoet@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.

**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.

**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.
Main activities

-- Research on AD models, with a strong focus on adjoint/reverse mode.
-- Research on novel AD approaches to tackle sophisticated constructs (Objects, parallel computation, dynamic languages...)
-- Dialogue with peer academic research teams, at the international level.
-- Collaboration and support of industrial users.
-- Maintenance and further development of the Tapenade AD tool.

Skills

Technical skills required:
-- Compilation
-- Code analysis
-- Static data-flow analysis

Languages:
-- English

Relational skills:
-- Collaborative work, in industrial and academic contexts

Other valued skills:
-- Scientific Computing, Automatic Differentiation
-- Parallel Computing

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 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
- Contribution to mutual insurance (subject to conditions)

Remuneration

Starting Research Position: à partir de 3039€ brut according to experience
Advanced Research Position: à partir de 3668€ according to experience