Offer #2023-06968

Internship Research on Joint encoding of multi-spectral images (GEO-ReSeT 1/3)

Contract type: Internship agreement

Level of qualifications required: Graduate degree or equivalent

Function: Internship Research

Level of experience: Recently graduated

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, INSERM ...), but also with the regiona 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

The work will be embedded in a project in collaboration between Université de Paris Cité (team LIPADE, Paris) and Inria (team EVERGREEN, Montpellier).

By using location on the Earth’s surface as the common link between different modalities, a geo-spatial foundation model would be able to incorporate a variety of data sources, including remote sensing imagery, textual descriptions of places, and features in maps. Leveraging the large amounts of available unlabeled geo-spatial data from these different sources, the GEO-ReSeT (Generalized Earth Observation with Remote Sensing and Text) ANR project has the objective to learn a better representation of any geo-spatial location and convey a semantic representation of the information.

Such a foundation model has the potential to revolutionize Earth observation by allowing for few or zero-shot solutions to classical problems such as land-cover and land-use mapping, target detection, and visual question answering. It will also be useful for a wide range of applications with a geo-spatial component, including environmental monitoring, urban planning and agriculture.

By leveraging several data modalities, this foundation model could provide a more comprehensive and accurate understanding of the Earth’s surface, enabling more informed decisions and actions. This will be particularly valuable for new potential users in sectors such as journalism, social sciences or environmental monitoring, who may not have the resources or expertise to collect their own training datasets and develop their own methods, thus moving beyond open Earth observation data and democratizing the access to Earth observation information.

Assignment

The work to be conducted during the proposed M2 internship will contribute to the ambition of the GEO-ReSeT ANR project by studying a model that is robust to different multi-spectral modalities. Different sensors measure different spectral bands, at different spatial resolutions, which can capture different information about the target. For instance, Sentinel-2 (multi-spectral satellite from the Copernicus program of the European Union) measures 13 spectral bands at resolutions ranging from 10 to 60m. On the other hand, Landsat 9 measures 11 bands at resolutions ranging from 15 to 100m. In addition, hyperspectral sensors which measures hundreds of different spectral bands can be used.
Currently, several approaches exist to jointly work on data obtained from different multi-spectral instruments. One of the most classical one is to train different feature extractors for each modality and to fuse the obtained latent representation. Another approach is to fuse the data at the input level. Finally, it is also possible to make a prediction from each modalities and do a fusion at the prediction level. These approaches tend to perform well. However, they require to train one model for each modality, which generally requires an important amount of supervision and is computationally heavy. A different approach is to translate different modalities to the input space of one of them. This approach has the advantage of reducing the number of different models to learn. However, it will also remove the particularities (in our case in both spatial and spectral resolution) of the other modalities. Recent remote sensing based foundation models can be interpreted as from this last category, even though no explicit conversion is performed.

**Main activities**

In this work, our objective is to design and train a model that is able to take as input any multi-spectral acquisition while keeping the physical measurements (i.e. spectral bands and spatial resolution). The work to be performed in this internship will lead to the following three contributions:

- **Contribution A**: the candidate will review the state of the art for the fusion of multi-spectral data and will implement a baseline. Furthermore, the candidate will implement a base line taking a unified representation of different multi-spectral sensors as an input.
- **Contribution B**: the candidate will propose and design an architecture that takes as an input a multi-spectral image and a description of the meta-data of the image (in particular the spectral information and the spatial resolution). For this purpose, a possible research path is to use a transformer-based methodology.% for this step.
- **Contribution C**: the proposed architecture will be compared to the baselines on a downstream task to demonstrate the relevance of the proposed approach.

In this project, we will evaluate the approach on a setting restricted to Landsat 8/9 and Sentinel-2. We will exploit the Harmonized Landsat and Sentinel-2 product for comparison with a method taking as input a unified representation.

**Skills**

- Python programming
- Deep Learning with Python (preferably with Pytorch)
- Experience with Remote Sensing imagery

**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

**General Information**

- **Theme/Domain**: Data and Knowledge Representation and Processing
- **Statistics (Big data)** (BAP E)
- **Town/city**: Montpellier ou Paris
- **Inria Center**: Centre Inria d'Université Côte d'Azur
- **Starting date**: 2024-01-01
- **Duration of contract**: 6 months
- **Deadline to apply**: 2024-01-31

**Contacts**

- **Inria Team**: ZENITH
- **Recruiter**: Marcos Gonzalez Diego / diego.marcos@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**

We are looking for someone with strong competences in Python programming and Deep Learning, ideally with experience with geospatial data.

**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**

Applications must be submitted online on the Inria website. Collecting applications by other channels is not guaranteed.

**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.