

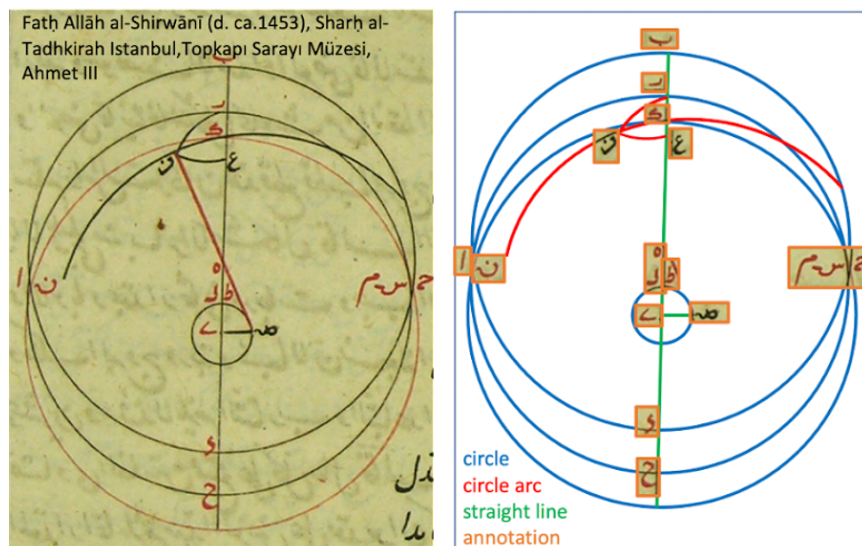
2023 Internships at IMAGINE

We are looking for motivated candidates for research internships on computer vision (which may lead to PhD positions). Project topics are listed below together with the respective supervisors. Strong skills in programming and applied mathematics are required. To apply, send your documents (CV, transcripts, reference letters etc.) to the contact person of the project.

List of topics (more topics will be announced soon):

- [1. Analyzing historical astronomical diagrams \(Mathieu Aubry\) \[already filled\]](#)
- [2. Alignment and change detection between historical maps, recent ones and satellite images \(Mathieu Aubry, Loic Landrieu\) \[already filled\]](#)
- [3. Visual dictionaries using generative models \(David Picard\)\[already filled\]](#)
- [4. Capturing walking feet dynamics from multiview cameras on a treadmill \(Gül Varol\) \[already filled\]](#)
- [5. Cross-modal geospatial contrastive learning \(Loic Landrieu\)](#)
- [6. HistoNERF: Synthetizing New Views From 100 Years of Archival Aerial Images \(Loic Landrieu\)](#)

1. Analyzing historical astronomical diagrams (~~Mathieu Aubry~~)



The goal of this internship is to automatically analyze the visual elements of astronomical diagrams. The first step will be to run text detection (e.g. <https://github.com/mlpc-ucsd/TESTR>), contour extraction and test classical baselines for geometrical elements detection (e.g. Hough transform based). The final goal is to develop analysis-by-synthesis methods for this task, in the spirit of <https://www.tmonnier.com/DTI-Sprites/> to discover and model more complex elements.

This internship is part of the starting ANR EIDA program, in collaboration with historians at Observatoire de Paris, and would ideally be the start of a PhD at Imagine.

Contact: Mathieu Aubry mathieu.aubry@enpc.fr

2. Alignment and change detection between historical maps, recent ones and satellite images ([Mathieu Aubry](#), Loïc Landrieu)



(a) Cassini, 1700s.



(b) "État Major", 1850s



(c) IGN, 1950s



(d) IGN, present-day



(e) Orthophotography

Given coarse alignment between historical maps, recent ones and satellite images (e.g. as downloaded from the IGN webpage) our goal will be to improve alignment quality and detect changes. We will explore several approaches, e.g. learning self supervised correspondences via cycle consistency, or discriminative approaches trained using synthetic data obtained via style transfer.

Contact: Mathieu Aubry mathieu.aubry@enpc.fr , Loïc Landrieu loic.landrieu@ign.fr

~~3. Visual dictionaries using generative models ([David Picard](#)) [already filled]~~

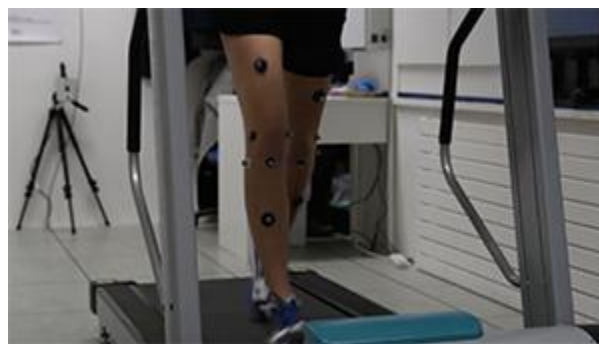


Deep generative models (VAE, GAN, normalizing flows, diffusion models) are now able to generate images with stunning realism both visually and in terms of content. Recent methods like diffusion models show promising composability properties (ie, the ability to blend together different elements), which indicates that they are able to structure their latent representation to encode high-level information (semantic, instance, etc). We thus want to investigate the use of generative models to uncover “visual dictionaries” in an unsupervised way. We will start with simple images like the ones shown above of [Iznik pottery](#), which clearly show a “pattern composition” aspect. We have two goals: First, to uncover the dictionary of visual patterns that compose the images ; second, to see how much controllable the generation process can be thanks to the dictionary structure.

This internship can be continued for a full year (ideally predoc).

Contact: David Picard david.picard@enpc.fr

~~4. Capturing walking feet dynamics from multiview cameras on a treadmill ([Gül Varol](#)) [already filled]~~



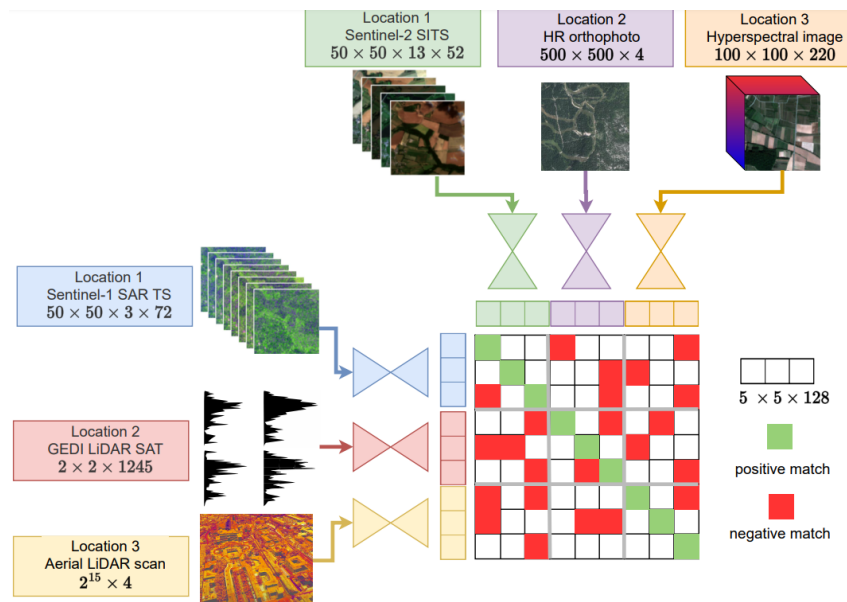
The project is a collaboration with [Institut National de Podologie](#) (INP) to develop automatic tools to help diagnose walking anomalies. The project will first start with a literature review to build an inventory of publicly available datasets recording walking videos (e.g., gait recognition) or radiographic images (e.g., keypoint detection for measuring angles between bones) or pressure sensors data (e.g., foot steps). We will then analyze the data provided by INP where there will be a data collection phase between Feb-Mar 2023 to record videos of subjects' feet while walking on a treadmill. The goal of the project is then to prepare the data for anomaly

classification, such as detecting varus/valgus/normal categories, which refer to the geometric properties of the feet when stepping on the floor (i.e., tilted towards inside/outside). In parallel, we will investigate the usability of 3D reconstruction methods for this problem. The student will be based in Imagine, but there may be occasional visits to INP, especially if new data needs to be collected.

This project is suitable for both M1 and M2 internships; however, it is unlikely (though not impossible) to lead to a PhD.

Contact: Gül Varol gul.varol@enpc.fr

5. Cross-modal geospatial contrastive learning ([Loic Landrieu](#))



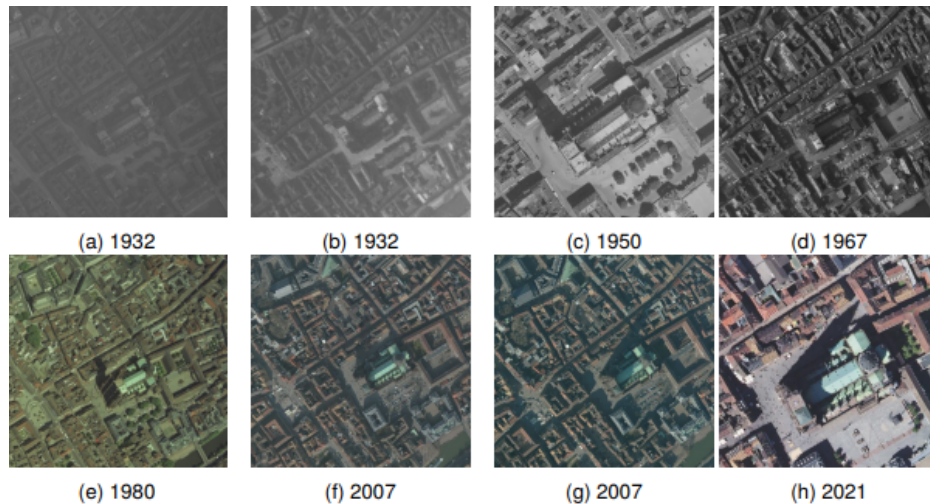
We propose to exploit the natural alignment between Earth Observation data to learn robust features without labels. By harmonizing the descriptors obtained from different sensors (satellite images, time series, LiDAR, RADAR), we will simultaneously train several models to extract the semantics of the scanned areas. The difference in nature and resolution of the sensors as well as the high volume of available data makes this task both challenging and impactful.

This internship can lead to a doctorate on a similar topic.

[More details.](#)

Contact: Loic Landrieu loic.landrieu@ign.fr [to be updated]

6. HistoNERF: Synthetizing New Views From 100 Years of Archival Aerial Images ([Loic Landrieu](#))



This internship aims to adapt the current NeRF-based methods to temporal sequences of aligned aerial images taken with various sensors across the last century. The goal is to generate new views of French cities through space and time. This poses two main challenges:

- (i) the last century saw dramatic technological advances in photography, resulting in high variability in the radiometric quality across acquisitions;
- (ii) sequences of images spanning a century are subject to complex temporal dynamics, such as illumination and seasonal changes, transient objects (cars, pedestrians), and urban evolution (vegetalization, densification).

We propose reformulating the Neural Radiance Fields equations as an inverse problem and considering relevant spatio-temporal information (position of the sun, season, etc).

[More details.](#)

Contact: Loic Landrieu loic.landrieu@ign.fr [to be updated]