Internship: Small object detection in aerial images and ground photos: application to manhole cover detection

Level of qualifications required: Master's or equivalent

Fonction: Internship Research

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

Knowledge of urban sewerage and drainage networks is essential for the rational management of natural resources (pollution transfer), flood control and transportation network management. Acting as rainwater collectors, drainage networks can overflow at certain points and exacerbate flooding. However, most hydraulic models do not take into account the drainage network, which is assumed to be rapidly saturated during a flood event. However, this is not due to a limitation of the models, but to a lack of knowledge of the characteristics of the networks. In fact, in many countries, whether developed or emerging, maps of networks or diagrams of structures are not widely available or are highly imperfect.

In France, local authorities are now responsible for wastewater treatment and must draw up a detailed description of wastewater and rainwater collection and transport facilities. But the maps available are still not very accurate, not very detailed and sometimes in analog format.

Image processing methods based on a geometric filter and a deep learning approach have demonstrated to be effective for detecting manhole covers on very high spatial resolution aerial images [2, 4, 5]. These works leveraged an early convolutional neural network model, AlexNet, to detect manholes from images at 5 cm spatial resolution acquired over two communes near Montpellier. The initial results showed that the manhole covers could be detected with an accuracy of 72% and a recall of 54% (which could be as high as 60%). Beyond the use of aerial imagery, several works have demonstrated that street-level imagery can be of great interest to detect and locate road objects [7]. The joint exploitation of aerial and street-level imagery has also been recently explored for enhancing aerial image segmentation [6], land use mapping for urban settlement [3] and traffic signs detection [1].

Several avenues of research could be explored to improve current manhole detection results, more precisely i) evaluate more recent deep learning frameworks for both semantic segmentation and object detection and ii) integrate street-level imagery in a multi-modal analysis in order to assess the added value of this complementary information source for the process of manhole detection and location.

Assignment

The aim of the internship will be to build upon our previous work on the detection of manhole covers through very high spatial resolution images using modern deep neural networks.

Main activities

The aim of the internship will be to build upon our previous work on the detection of manhole covers through very high spatial resolution images using modern deep neural networks. More specifically, it will involve:

- Carrying out a bibliographical study of recent advances on the subject, in order to determine the current deep learning architecture(s) best suited to the problem.
- Train and validate a network on the images available (and if possible, on other images of lower resolution) for detecting manholes.
resolution, available in open source).

- Reduce as much as possible possible false positives by verifying the actual presence of manhole covers detected on street-view images.

Skills

- Master 2 in computer science or signal processing, with good knowledge on machine learning and/or image analysis.
- Tools and programming language : Python (preferably) and familiarity with some deep learning library (PyTorch, Tensorflow).

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 : Earth, Environmental and Energy Sciences
  Scientific computing (BAP E)
- Town/city : Montpellier
- Inria Center : Centre Inria d’Université Côte d’Azur
- Starting date : 2024-02-01
- Duration of contract : 6 months
- Deadline to apply : 2024-02-14

Contacts

- Inria Team : LEMON
- Recruiter : Delenne Carole / carole.delenne@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

More information can be found on this pdf file

Supervision:

0. Evergreen : Diego Marcos Gonzalez
1. Lemon : Carole Delenne

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.