Philips Research Paris - Internship Offers 2021 – Deep learning and AI for medical imaging applications

Duration

5 to 6 months

Preferred start date:

from March 2022 or later

Localization:

Suresnes (92)

How to apply?

Contact Caroline Raynaud caroline.raynaud@philips.com with CV. Specify for which internship(s) you are applying. You can also add a cover letter

Philips Research Paris

Philips is a health technology company focused on improving people's lives through meaningful innovation across the health continuum – from healthy living and prevention to diagnosis, treatment and home care. Applying advanced technologies and deep clinical and consumer insights, Philips partners with customers to deliver integrated solutions that address the Quadruple Aim: improved patient experience, better health outcomes, improved staff experience, and lower cost of care.

***Philips Research Paris* is an R&D lab based in Suresnes (92) and is dedicated to medical image processing. The team, with about forty researchers and engineers, is focused on delivering the most innovative solutions in the domain and is in close contact with famous universities and clinical sites in France and abroad.**

Internship Offers

Candidate profile

- Third year of engineer school / Master 2 Recherche, with specialty in machine learning, image processing or applied mathematics
- Solid knowledge of statistics, machine learning, deep learning, image processing
- Experience in Python, Tensorflow/Keras/Pytorch
- English speaking, reading and writing is mandatory
- Good communication skills and ability to work in a team

Internship 1: Self-supervised learning for device pose estimation in multi-view video frames

Internship description

Philips recently developed a product for optical guidance during surgical minimally invasive procedures. In this setup, the system relies on a constellation of cameras monitoring the operation to guide the surgeon to the correct location. For this type of problems, deep learning techniques achieve state-of-the-art performance, but training such deep neural networks requires a very large amount of data and the corresponding annotations.

Annotation of such data is extremely time-consuming and laborious. Accordingly, we would like to reduce the annotation effort by using self-supervised learning (e.g. contrastive learning). Indeed, this family of techniques learn representative features of the data without annotations, which can be served as a better initialization of the neural network for the downstream task (3D pose estimation). This should help to achieve better performance than random initialization while reducing the dependency to annotated data.

Unlike most problems in the literatures, our data are synchronized multi-view video frames, which are strongly correlated. So defining positive and negative pairs in a contrastive learning framework maybe challenging. In addition, specifically for our application, some synthetic data with automatic annotations are also available. Therefore, a combination of self-supervised learning and domain adaptation between synthetic data and real data could also be explored by the candidate.

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Internship 2: 3D Polygonal Mesh Prediction Using Adversarial Graph Neural Networks for Kidney Segmentation in 3D Ultrasounds

Internship description

Kidney segmentation from 3D ultrasound images is a challenging task due to low signal-to-noise ratio and low-contrasted object boundaries. Recently proposed "U-Shaped" CNNs perform pixel-wise classification, which fail to produce regularly shaped segmentation masks. In this internship, we propose to build upon recent advances in Graph Convolutional Networks [1] to learn high-level topological shape information to constrain the object segmentation results to possible shapes.

The trainee will start by familiarizing with an in-house implementation of a deforming network that transforms a polygonal 3D mesh to better-fit kidney boundaries in 3D US images. Second, the trainee will study ways to improve the current approach by considering for instance adversarial loss functions. Depending on the progress of the internship, further improvements would be investigated by considering integrating Transformers networks.

A large dataset of annotated Kidney 3D ultrasound volumes is available for training

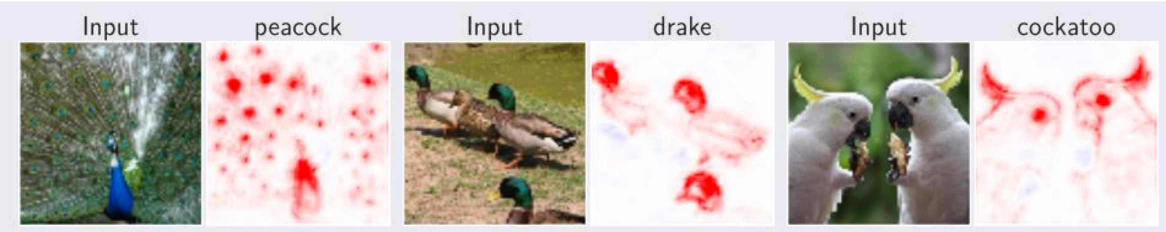
[1] Mesh R-CNN Georgia Gkioxari, Jitendra Malik, Justin Johnson ICCV 2019

Internship 3: Dynamic alignment networks for interpretable classification

Internship description

It has become a cliché to dispraise convolutional neural networks (CNN) for being performant black boxes offering few insights into their decision taking. Many lines of work have been undertaken in recent years to propose concrete solutions for producing meaningful weight maps that capture the contribution of each image part to the decision. The most well-known of those techniques, however, only produce very coarse, “regional” maps.

Recently, a paper [1] showed that an unconventional network architecture based on dynamic filters, minimizing a specific alignment loss, could produce weight maps with details of a yet unseen precision, offering a strong and straightforward insight into which parts of the image contributed to the decision.



It should be obvious how this kind of visualization would be beneficial to a clinical decision taking on medical images, in particular for the physician to review the image features leading to the diagnosis, and more generally, to build up confidence in the decision process.

During this internship, we will deep-dive into such kind of visualization. We will start our journey by evaluating the potential of dynamic networks to medical images, compare with established state-of-the-art techniques, and propose improvements.

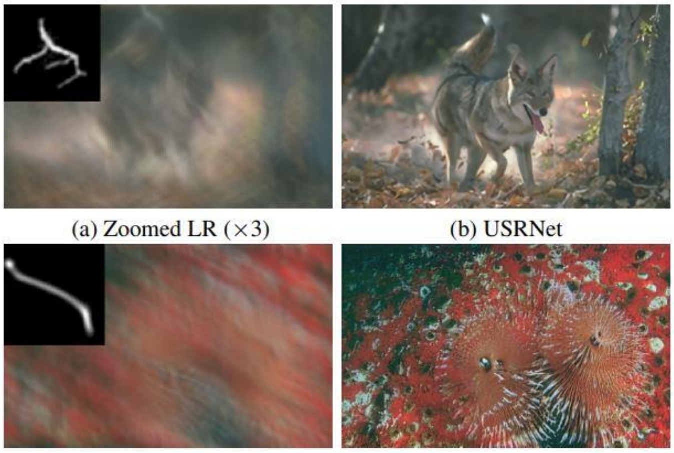
[1] Convolutional Dynamic Alignment Networks for Interpretable Classifications, Böhle *et al.* CVPR 2021.

Internship 4: Deep Learning based Single Image Super Resolution (SISR)

Internship description

The purpose of this internship is to develop a deep learning based single image super resolution method as part of the ultrasound (US) image quality (IQ) challenges - scan conversion, zooming or upsampling - in a clinical setting.

Specifically, the final use case at the end of the internship should be the following: starting from a US sequence previously acquired by the clinician, the designed algorithm will provide high-resolution IQ i.e., without any degradation while maintaining the sharpness of the high frequencies of the image. An example of our expectation for the zooming application is shown below:



(a) Zoomed LR (×3) (b) USRNet

(c) Zoomed LR (×3) (d) USRGAN

References

- Zhang, K *etal*. Deep Unfolding Network for mage Super-Resolution. CVPR, 2020
- Wang *etal*. ESRGAN: Enhanced Super-Resolution Generative Adversarial Networks. ECCV, 2018
- Tan, M *etal*. MnasNet: Platform-Aware Neural Architecture Search for Mobile. CVPR, 2019
- Sushko *etal.* You Only Need Adversarial Supervision for Semantic Image Synthesis. ICLR 2021