Philips Research Paris - Internship Offers 2021

Duration

5 to 6 months

Preferred start date:

from March 2021 or later

Localization:

Suresnes (92)

How to apply?

Contact Caroline Raynaud caroline.raynaud@philips.com and Hernan Morales hernan.morales@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 Paris Research is based in Suresnes (92) and is dedicated to medical image processing. The team, with about thirty 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

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Internship 1: Intraventricular flow reconstruction

Internship description

Medical imaging techniques allow the investigation of anatomical and functional aspects of the heart and enable pathology diagnosis, quantification of indicators of interest and more generally better patient care.

Color-Doppler imaging refers to a specific image acquisition technique that uses ultrasound waves to produce an image on which a gray-scale image of the solid tissue and a color-coded image of fluid velocities are superimposed. However, physical constraints only allow a partial quantification of the velocity vector field: only the component of the velocity aligned with the ultrasound beam can be quantified.

The objective of this internship will be to work on the reconstruction of the intraventricular blood flow from 3D Color-Doppler images. Leveraging a pre-existing reconstruction technique, which combines physical constraints to the image information, and which has already been evaluated on synthetic datasets, the student's objective will be to reconstruct the blood flow in the context of real images. Through the confrontation with real data, the student will be required to propose, implement and evaluate technical solutions to overcome potential obstacles and improve the results of the reconstruction.

Candidate profile

- Education : 3rd year of engineer school / Master 2 Recherche, specializing in image processing, numerical optimization and more generally applied mathematics
- Experience in Matlab (or, if not, versatility and general ease with programming languages)
- Interest in the medical field
- English speaking, reading and writing is mandatory
- Good communication skills and ability to work in a team

Internship 2: Self-supervised learning in 3D fetal US

Internship description

Ultrasound (US) imaging is the modality of choice for fetal screening. In many countries, the US exam performed between 18 and 22 weeks of pregnancy is used to assess the development of the fetus by performing some biometry measurements, both in 2D and 3D.

Deep learning techniques have reached state-of-the-art performance for automation of those measurements. However, they require large amount of data and annotations, which may be hard and costly to obtain, especially in the medical field.

One method to improve the algorithms performance is to transfer weights coming from another task (*transfer learning*), which is dependent on the availability of such weights. In 2D, it is common to use networks pre-trained on large natural images databases (*e.g.*, imagenet). However, in 3D, such pre-trained networks may not be available, and it is hard to build a large database with annotations for the pre-training step.

In this internship, we will address this issue by studying self-supervised techniques for the pre-training step. It consists it generating annotations automatically, in order to make a network learn a representation of the data, with no annotation effort. Self-supervision is a very active field of research, and the applications to 3D medical data are still rare.

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 Python; knowledge of the Tensorflow/Keras framework;
- English speaking, reading and writing is mandatory;
- Good communication skills and ability to work in a team.

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Internship 3: 3D Polygonal Mesh Prediction Using Convolution 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 segmentation CNNs (Unet, DeepLab…) perform pixel-wise classification, which fail to produce regularly shaped segmentation masks. In this internship, we propose to use CNNs to learn high-level topological shape information in order to constrain the object segmentation results to possible shapes.

The trainee will start by familiarizing with mesh-based 3D deep learning libraries (pytorch3D, Kaolin…). At a second stage, the trainee will implement a deforming network [1] that transforms a polygonal 3D mesh to better-fit kidney boundaries in 3D US images. Depending on the progress of the internship, further improvements would be investigated by considering graph convolutional network and adversarial loss functions.

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

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 Matlab and/or Python
- English speaking, reading and writing is mandatory
- Good communication skills and ability to work in a team

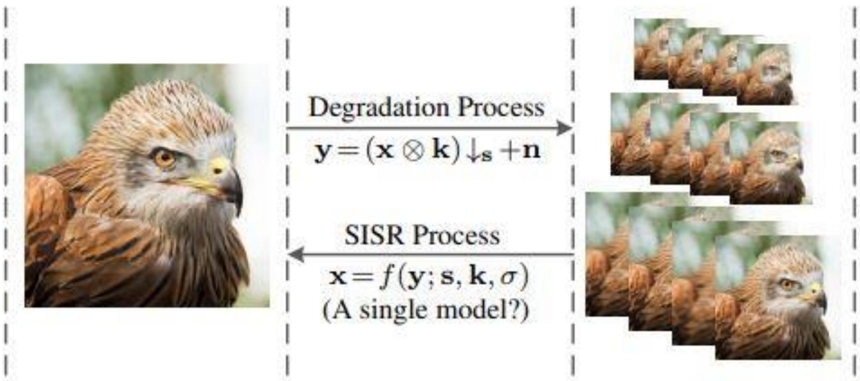
Internship 4: Deep Learning based Single Image Super Resolution (SISR): HQ Zooming for Ultrasound

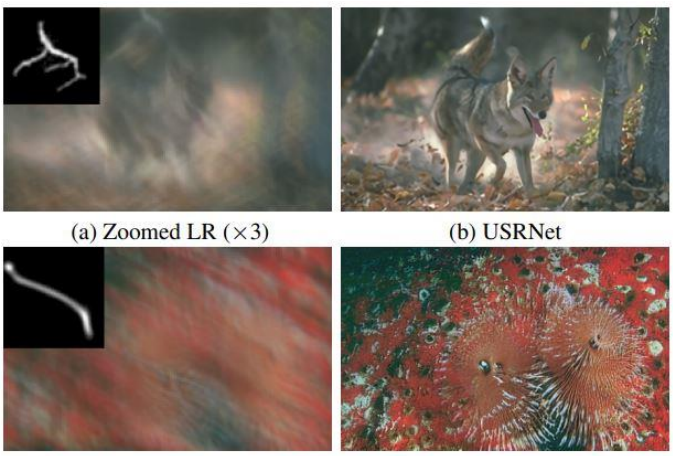
Description du stage

L’objectif de ce stage est de proposer une méthode de super-résolution dans le cadre d’un « *zooming* » de régions d’intérêt des images ultrasons et ce dans un contexte clinique. Plus concrètement, à la fin du stage, le but est - en partant d’une zone préalablement sélectionnée par le clinicien - d’obtenir des images de haute-résolution, c’est-à-dire dépourvues de toute dégradation tout en conservant la netteté des hautes fréquences de l’image.

Dans ce stage, nous nous intéresserons en premier lieu aux techniques d’apprentissage **[1]** qui apprennent le processus des dégradations (comme le bruit, la mise à l’échelle et le flou entre autre) préalablement subies par les images dites *HR* pour générer les images *LR* dans le cadre de l’entrainement du modèle (images ci-dessous). Un intérêt particulier sera porté aux approches flexibles permettant de manipuler - en inférence - de façon interactive les noyaux appris plus tôt dans l’objectif d’amplifier le traitement d’une dégradation sur une autre.

Le deuxième volet du stage portera sur l’exploration du « Generative Adversarial Network » (GAN), **[2]** et de son apport éventuel à l’amélioration des résultats qui auront été obtenus en **[1]**.





(a) Zoomed LR (×3) (b) USRNet

(c) Zoomed LR (×3) (d) USRGAN

Pour finir, on étudiera la possibilité d’avoir un modèle bien plus rapide en mettant en œuvre des stratégies développées pour les modèles sur smartphones **[3]**.

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L'apprentissage se fera dans un premier temps sur les images naturelles provenant de bases publiques (DIV2K et Flickr2K) ou issues de divers challenges (AIM). Une fois les premiers résultats consolidés, des études seront alors menées sur des données disponibles en interne sur divers projets avec la « *business unit* » Ultrasons.

Références

[1] Zhang, K *etal*. Deep Unfolding Network for mage Super-Resolution. IEEE CVPR, 2020.

[2] Wang, X *etal*. ESRGAN: Enhanced Super-Resolution Generative Adversarial Networks. IEEE ECCV, 2018.

[3] Tan, M *etal*. MnasNet: Platform-Aware Neural Architecture Search for Mobile. IEEE CVPR, 2019.

Profil du stagiaire

- Formation : $3^{ème}$ année d'école d'ingénieur ou master, spécialité informatique, traitement d'images, apprentissage automatique ou plus généralement mathématiques appliquées.
- Fort intérêt pour le *Machine Learning* et l'analyse de données.
- Connaissance de Python, Tensorflow/Keras/Pytorch.
- Intérêt spécifique pour le domaine médical.
- Maîtrise orale et écrite de l'anglais.

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Internship 5: Reconstruction of velocity fields from MRI data

Internship description

Magnetic Resonance Imaging (MRI) is one of the most used imaging modalities for the diagnosis of cardiovascular diseases, such as cardiopathies or vascular diseases. MRI does not use ionizing radiations and provides high contrast images with valuable spatio-temporal functional information, such as flow velocity fields. However, to retrieve and visualize this flow data, additional data manipulation is required. The reconstructed velocity field can provide a deeper understanding of the patient pathophysiology, suitable for a variety of application demanding in-vivo velocity data.

In this internship, we propose to develop a method to reconstruct the velocity fields from MRI data for cardiac and vascular applications. The first step will consist in investigating several strategies available to reconstruct the velocity field from MRI data, considering the limitations of this diagnostic technique (sampling limitations, imaging time constraints, aliasing, noise etc.), and the assumptions required to treat the blood flow velocity. Secondly, the candidate will implement the method and assess its capabilities based on real MRI data, improving and enhancing a pre-existing prototype for MRI data processing. Finally, the reconstructed velocity fields will be compared to the ones reconstructed from other imaging modalities, such as Ultrasound Imaging.

Candidate profile

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