EviRed

PhD offer

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

LATIM

Multi-modal longitudinal follow-up of diabetic retinopathy with deep learning

The laboratory of medical information processing (LaTIM UMR 1101, Inserm) is opening a PhD position on longitudinal follow-up of multi-modal medical images using artificial intelligence.

Context

Statistics from the International Diabetes Federation reveal that the global prevalence of diabetes in 2019 is around 9.3% (463 millions) of the world population and will rise to 10.9% by 2045 (700 millions). As a common and high-risk complication of diabetes, diabetic retinopathy (DR) is a leading cause of visual impairment and blindness worldwide [1]. Although regular screening is crucial for preventing blindness, the expected increase in the number of patients with diabetes means that the burden of screening and follow-up represent a substantial challenge [2].

Standard retinal screening usually employs color fundus photography (CFP) for DR diagnosis by examining the presence of retinal lesions such as microaneurysms, hemorrhages or exudates. For the automatic assessment of DR evolution, emerging imaging modalities could allow a finer analysis. In particular, ultrawide-field CFP (UWF-CFP) gives useful information on the periphery of the retina, not seen on standard photography. Structural optical coherence tomography (OCT) that produces few microns resolution cross sectional imaging can be enriched with angiography (OCTA) to highlight retina vessels non-invasively. Deep learning (DL) applied to UWF-CFP and OCTA longitudinal images represent a promising perspective for DR management [3].

The PhD thesis will take place in the context of the ANR RHU EviRed project[1] whose aim is to develop and validate an expert system guiding ophthalmologists to improve diagnosis, prediction of evolution and decision making during DR follow-up.

Main objective

The main objective is to exploit follow-up UWF-CFP and OCTA examinations to improve DR severity and progression assessment, by taking advantage of both past and current examinations.

In this context, we hypothesize that visual patterns predicting disease progression exist in images and can be extracted through deep learning. Moreover, analyzing follow-up examinations may improve automated grading performance with respect to single-image strategies [4].

Description of work

To jointly analyze follow-up examinations, consecutive images must be put in a common reference frame. Therefore, in addition to OCTA/UWF-CFP multimodal registration, a unimodal registration step will be included. This will allow capturing local changes inside the retina between consecutive examinations. Difference images will be used as additional features for severity assessment and disease progression. Smarter difference operators will have to be designed to avoid the influence of registration errors and illumination variations between examinations [5].

Depending on the investigated representations of multi-modal longitudinal data, appropriate CNN architectures [6] including Siamese [7] or CNN+RNN [8] strategies will be applied to assess and then predict the DR progression. Finally, visualization techniques will be employed for the extraction and analysis of spatio-temporal predictive patterns in follow-up examinations, to elucidate the changes and early-warning signs that should be looked for in examination records.

1. EviRed project, `https://anr.fr/ProjetIA-18-RHUS-0008`

Environment

The PhD student will be hosted in LaTIM[2] which leads AI development in the EviRed project. Born from the complementarity between health and communication sciences, the LaTIM laboratory develops a multidisciplinary research driven by members from IMT Atlantique[3], University of Western Brittany, Inserm and Brest University Hospitals. Information is at the heart of the research project of the unit. Being by nature multimodal, complex, heterogeneous, shared and distributed, it is integrated by researchers into methodological solutions for the sole purpose of improving the actual medical benefit.

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— net salary : ≈1500 €/month

Applications

Applications should be sent by e-mail to `pierre-henri.conze@imt-atlantique.fr` with the following documents :

— a full curriculum vitæ
— recommendation letter(s) from former teacher(s)/advisor(s)
— a cover letter stating your motivation and fit for this project
— grades obtained in M2 and/or engineering school

The following skills are required : strong theoretical/practical knowledge in applied mathematics, image processing, machine/deep learning, Python programming, organizational skills, fluent English for reading/writing scientific articles, interest in the fields of health and artificial intelligence.

Deadline for application : **11th June, 2021**.

Bibliography

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2. Laboratoire de Traitement de l'Information Médicale, `http://latim.univ-brest.fr`
3. `https://www.imt-atlantique.fr/`