PhD Thesis Proposal

Neural networks-based restoration, localization and classification of ultrasound images for thyroid cancer diagnosis.

Context and objectives

Thyroid cancer is among the most known cancers [1] and it became important to design automatic Computer-Aided Diagnosis (CAD) system to predict thyroid malignancy. In this context, Ultrasound (US) imaging is a popular imaging modality used to aid the diagnosis of thyroid lesions, allowing to estimate the size, shape and position of thyroid nodules as well as predict the TIRADS (Thyroid Imaging Reporting and Data System) level. Although this imaging modality offers many advantages, real-time localization (segmentation/detection) and classification of thyroid nodules with high accuracy from US images is a challenging task due to the low quality of images, the inhomogeneity of structures, the variability of shapes, contrast and size of nodules. For these reasons, the objectives of this thesis are twofold.

The first part will be devoted to the ultrasound image restoration. Indeed, due to the aforementioned types of degradations that may affect the acquired US images, a pre-processing step is mandatory to enhance their visual quality for more efficient subsequent processing tasks. This will be achieved by effective deep learning model [2] or the combination of wavelet representations and deep learning.

The second part focuses on the analysis of these images for thyroid nodule localization and classification. To this end, a segmentation or detection of the thyroid nodules is firstly performed. The latter are then classified into benign and malignant, or predict the TIRADS levels based on some standards such as EU-TIRADS, ARC-TIRADS or K-TIRADS [3]. Recent works based on neural networks and sparse representation [4][5] could be used as a starting point in order to perform the classification.

While the above sub-tasks will be firstly investigated in an independent way, we will finally focus on the combination of the different designed neural networks and their joint learning in an end-to-end manner.

It should be noted that the proposed algorithms will be evaluated and tested using some public datasets such as the Thyroid Digital Image Database (TDID) [6] and the TN-SCUI 2020 challenge [7].

Research team and supervision: This research project will be supervised by Dr. Mounir KAANICHE (L2TI) and co-supervised with Dr. John CHAUSSARD (LAGA), and Dr. Marie LUONG (L2TI), in collaboration with the Viettel Cyberspace Center, VNU-The Advanced Institute of Engineering and Technology *(*AVITECH*)* (with Dr. Dinh-Hoan TRINH), who will provide support on Image Restoration, Classification and Ultrasound imaging.

Key References

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[7] https://tn-scui2020.grand-challenge.org/

Contacts (superviseurs)

Dr. Mounir KAANICHE, Maître de conférences , HDR
E-mail : mounir.kaaniche@univ-paris13.fr
Affliliation : Laboratoire L2TI – UR 3043
Université Sorbonne Paris Nord (USPN)

Dr. John CHAUSSARD, Maître de conférences
E-mail : chaussard@math.univ-paris13.fr
Affiliation : Laboratoire LAGA – UR 3043, USPN

Dr. Marie Luong, Maître de conférences
E-mail : marie.luong@univ-paris13.fr
Affiliation : Laboratoire L2TI – UR 3043, USPN