# GENERALIZABILITY OF ARTIFICIAL INTELLIGENCE MODELS FOR CHEST-RELATED MULTI-DISEASE DIAGNOSIS ASSISTANCE FROM BIOIMAGERY

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**Context:** Since 2020, research works in biomedical imagery have been intensified for analyzing chest-related diseases, notably in reason of pneumonia caused during the COVID-19 pandemy. In this context, our team, which investigates the area of image recognition from Convolution Neural Networks (CNNs) since 2016, contributed to the worldwide efforts towards designing efficient pneumonia detection models by exploiting chest X-ray images.

**Background**: Our first investigations [1] were focused on exploiting our image classification skills and approaches for training various deep learning models over publicly available chest X-rays (normal and pneumonia cases). Although the quantity of labeled COVID-19 X-rays were initially limited for the community, we tailored efficient pneumonia classification models.

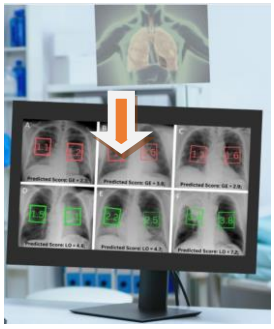

*Figure 1: Intelligent analyzer of infection severity level for right and left lung parts from an X-ray. Infection scores range in [0;10] from normal case to high infection (Project: https://github.com/hammoudiproject/ViTReg-IP-lung-analysis-architecture).*

In a second time, we proposed a new family of image augmentation approaches [2] for overpassing training limitation due to low availability of specific data. It opened new experimental directions for increasing model performances by generating new contour-aware and salient images from original images. Besides, we designed a competing chest X-ray multi-scoring model which finely determines the severity of infection from transformer with a regression head [3] (see Figure 1).

**Objectives:** The PhD topic we propose aims at generalizing chest analysis models for performing **multi-task operations** (e.g. by unifying priorily developed classification and regression architectures [1,3]), **multi-modal data analysis** (e.g. by conjoint training over open-source chest X-rays and CT scans, and augmenting images [2]) towards **chest-centered multi-disease diagnosis** (simultaneous detection of pneumonia, tumor detection, structural abnormality). Such a generalized architecture should speed-up diagnosis of chest diseases in order to reduce the time-to-treatment of patients. The potential collaborators on these topics are from Strasbourg and Lille Hospitals, UPV/IKERBASQUE Spain and Harvard Medical School.

**Keywords:** chest disease diagnosis, bioimagery, image recognition, AI, CNN, deep learning.
**Requirements:** MS degree in Computer Science or closely related fields, solid programming skills in C++/python, theoretical/applied background in computer vision and deep learning.

[1] **K. Hammoudi**, H. Benhabiles, **M. Melkemi**, F. Dornaika, I. Arganda-Carreras, D. Collard, A. Scherpereel. *Deep Learning on Chest X-ray Images to Detect and Evaluate Pneumonia Cases at the Era of COVID-19*, Journal of Medical Systems, Springer (2021) [Impact Factor: 5.3, rank **Q1**].
[2] **K. Hammoudi**, A. Cabani, B. Slika, H. Benhabiles, F. Dornaika, **M. Melkemi**. *SuperpixelGridMasks Data Augmentation: Application to Precision Health and other Real-world Data.* Journal of Healthcare Informatics Research, Springer (2023) [Impact Factor: 5.9, rank **Q1**].
[3] B. Slika, F. Dornaika, **K. Hammoudi**. *Multi-Score Prediction for Lung Infection Severity in Chest X-ray Images*. IEEE Transactions on Emerging Topics in Computational Intelligence, 2024 [to appear, Impact Factor: 5.3, rank **Q1**].