

# Emboli detection in CT pulmonary angiogram for COVID-19 prognosis

## Context

Pulmonary embolism (PE) refers to a blood clot partially or completely blocking a pulmonary artery. This blockage may lead to ischemia (low oxygenation of cells and organs), blood pressure disorders and heart failure. Early diagnosis and treatment are crucial to avoid high morbidity and mortality rates, however PE diagnosis is a complex and tedious task which requires a trained radiologist to examine each slice of a 3D CT pulmonary angiogram (CTPA). Computer aided detection (CAD) algorithms have been proposed to help radiologists diagnose PE. The classic approach is based on the detection of potential PE regions using voxel-based features, followed by the classification of these regions as PE or non-PE [1]. Recently, end-to-end deep learning models have shown promising results[2]–[5].

The COVID-19 pandemic has caused thousands of deaths worldwide and is still ongoing. In absence of an effective treatment, the scientific community has joined forces in an unprecedented effort to help physicians diagnose and treat COVID-19 patients. Recent studies suggested that COVID-19 patients have a high risk of PE [6] and that the position of the emboli in the pulmonary vascular tree could be correlated with the patient prognosis. The goal of this internship is to develop tools to automatically detect and localize PE events in regards to the pulmonary vascular tree from CTPA. Such tools could help physicians save precious time in diagnosis and provide prognosis information crucial for treatment planning.

## Subject

The intern will develop an embolism detection method based on the recent research literature. This method should provide PE localization information in relation with the pulmonary vascular tree. To this end, a graph-based modeling of the vascular network will be built based on already developed vascular segmentation methods. This vascular model could be included in the PE detection method or be used as an independent step to validate and improve the detection method.

## Profile

We are looking for a student motivated by image processing with a particular interest in deep learning applications. A background in medical imaging and/or an experience with Pytorch are a plus.

## Internship information

- 6 month internship starting in September/October 2020
- Location: [Creatis Lab](#) at La Doua/INSA Lyon Campus.
- Advisors: Dr. Odyssee Merveille, Dr. Carole Frindel
- Applications should be sent by mail to [odyssee.merveille@creatis.insa-lyon.fr](mailto:odyssee.merveille@creatis.insa-lyon.fr) with a detailed CV.

## References

- [1] N. Tajbakhsh, M. B. Gotway, and J. Liang, “Computer-Aided Pulmonary Embolism Detection Using a Novel Vessel-Aligned Multi-planar Image Representation and Convolutional Neural Networks”, in *Medical Image Computing and Computer Assisted Intervention*, vol. 9350, 2015, pp. 62–69.
- [2] Y. Lin, J. Su, X. Wang, X. Li, J. Liu, K.-T. Cheng, and X. Yang, “Automated Pulmonary Embolism Detection from CTPA Images Using an End-to-End Convolutional Neural Network”, in *Medical Image Computing and Computer Assisted Intervention*, vol. 11767, 2019, pp. 280–288.
- [3] X. Yang, Y. Lin, J. Su, X. Wang, X. Li, J. Lin, and K.-T. Cheng, “A Two-Stage Convolutional Neural Network for Pulmonary Embolism Detection From CTPA Images”, *IEEE Access*, vol. 7, pp. 84 849–84 857, 2019.
- [4] D. Rajan, D. Beymer, S. Abedin, and E. Dehghan, “Pi-PE: A Pipeline for Pulmonary Embolism Detection using Sparsely Annotated 3D CT Images”, in *Workshop NeurIPS*, 2020, p. 13.
- [5] S.-C. Huang, T. Kothari, I. Banerjee, C. Chute, R. L. Ball, N. Borus, A. Huang, B. N. Patel, P. Rajpurkar, J. Irvin, J. Dunnmon, J. Bledsoe, K. Shpanskaya, A. Dhaliwal, R. Zamanian, A. Y. Ng, and M. P. Lungren, “PENet—a scalable deep-learning model for automated diagnosis of pulmonary embolism using volumetric CT imaging”, *NPJ Digital Medicine*, vol. 3, no. 1, p. 61, 2020.
- [6] F. Grillet, J. Behr, P. Calame, S. Aubry, and E. Delabrousse, “Acute Pulmonary Embolism Associated with COVID-19 Pneumonia Detected by Pulmonary CT Angiography”, *Radiology*, p. 201 544, Apr. 23, 2020.