Development of a Deep Learning Model to Diagnose Pulmonary Embolism

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Introduction

- A pulmonary embolism (PE) is a potentially life-threatening obstruction of the pulmonary artery.
- The gold standard diagnostic method for PE is imaging via computed tomography pulmonary angiogram (CTPA).
- The goal of this project was to develop a deep learning model using the RSNA-STR Pulmonary Embolism CT (RSPECT) Dataset to enable more rapid and accurate identification of PE.
- Advancements in the automated diagnosis of PE have the potential to expedite diagnosis, improve accuracy of PE detection, and improve patient outcomes.

Results

Two sets of results are presented:

- **CNN-LSTM model**: Novel model architecture trained on RSNA-STR dataset. Results are on 927 Validation studies. (AUC = 0.75)
- **PENet model**: State-of-the-art model that is clinically relevant. Tested on 3,805 studies. Baseline for CNN-LSTM model. (AUC = 0.65)

![EfficientNet-ResNeXt-LSTM model for study-level PE Diagnosis ROC curve (on validation data)](image)

![CNN-LSTM Model Confusion Matrix](image)

Pulmonary Embolism | Actual | Predicted
--- | --- | ---
+ | 391 | 115
- | 177 | 244

![PENet model for study-level PE Diagnosis ROC curve (on test data)](image)

![PENet Model Confusion Matrix](image)

Pulmonary Embolism | Actual | Predicted
--- | --- | ---
+ | 1125 | 989
- | 1198 | 3493

We have developed a user-friendly clinician-facing interface to display patient data and results for interpretation and triage.

Future Directions

To improve our model, future directions include:

- Training the model on the entire dataset. We were limited by the disk space available on the computing nodes.
- Implementing CAM visualizations for the CNN-LSTM model.
- Joint training of CNN and LSTM.
- Extracting features from 3D CNN model focusing on study level targets for Stage 1.
- Experimenting with more sophisticated models for Stage 2.