Deep Learning

Transformer-Based Detection of B-Lines in Lung Ultrasound

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OBJECTIVES

B-lines are artifacts commonly displayed in Lung UltraSounds, that have a high correlation with lung infections, and it served as an important parameter in the detection and classification of COVID-19, before the normalization of PCR tests.
Our objective is to use state-of-the-art transformer architectures to improve B-line Classification, against Deep Learning Benchmarks.

DATASET

We used the BED-LUS dataset of Lung Ultrasounds, comprising of a series of tests on **113 patients** admitted to the Boston Emergency Department, in late 2020. The data was annotated by 2 experts, regarding the existence of B-lines.

METHODOLOGY

We ran 3 different transformer models on the dataset:

- Vision Transformer (ViT)
- Data Efficient Image Transformer (DeiT)
- **Swin Transformer (Swin)**

And analysed F1 score, and the Area Under the Curve.

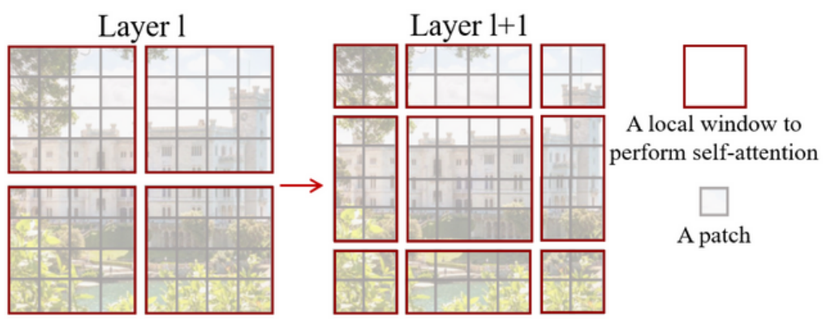

Fig 3 - The shifed windows technique used in Swin Transfomer

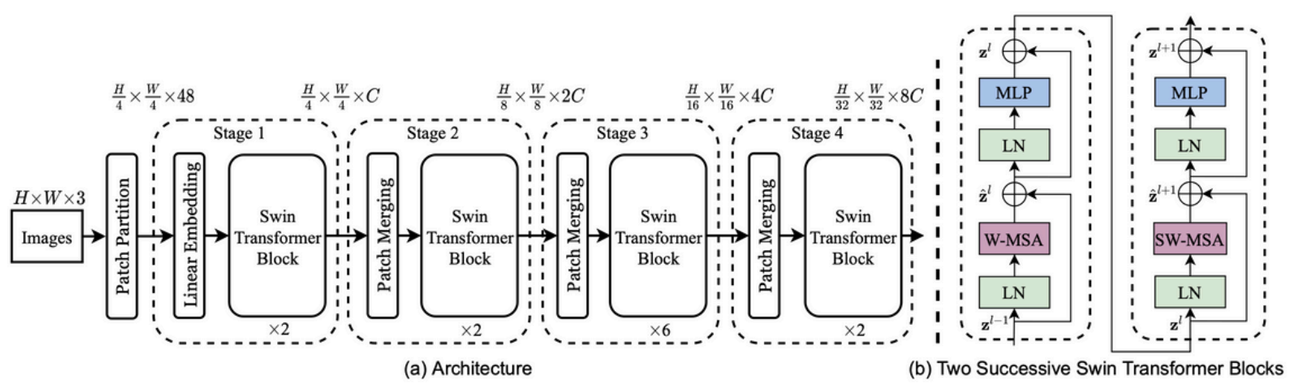

Fig 4 - a) The architecture of a Swin Transformer; b) two successive Swin Transformer Blocks. W-MSA and SW-MSA are multi-head self attention modules with regular and shifted windowing configurations, respectively

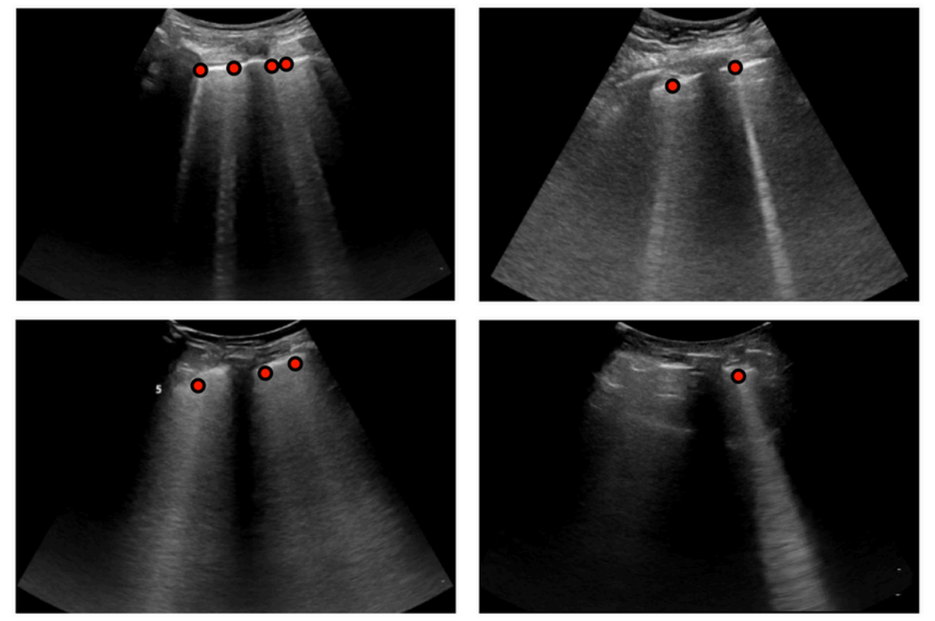

Fig. 1. Example LUS frames from the curated dataset with corresponding expert annotations of B-line origins as red points.

RESULTS

	F1-Score	SD	AUC	SD
Baseline [1]	0.849	0.012	0.918	0.005
ViT	0.849	0.016	0.916	0.01
Swin	**0.864**	0.009	**0.934**	0.008
DeiT	0.853	0.01	0.929	0.007

Fig 2 - F1-score and Area Under the Curve metrics achieved by BM - Benchmark in [1]; ViT - Vision Transformer (tiny variant); Swin - Shifted WINdow Transformer; and DeiT - Data-efficient information Transformer. All these results were ran 5 times, with cross-validation, and calculated the average, and standard deviation.

CONCLUSIONS

Using state-of-the-art transformer models, we managed to achieve better classifications of B-lines, using the Swin Transfomer model, than the previously built deep learning benchmark.

REFERENCES

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