

# Deep Learning based diagnosis of Gougerot-Sjörén syndrome using In Vivo Confocal Microscopy.

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## Purpose

- Gougerot-Sjörén syndrome (SS) can lead to severe ocular pain (corneal inflammation and alterations of the sub-basal plexus nerve).
- SS is hard to diagnose as it requires invasive exams (e.g. salivary glands biopsy)[1].
- In Vivo Confocal Microscopy (IVCM) offers to assess corneal nerve fibers in non-invasive way.

## Solution

Use CNNs in a Multiple Instance Learning setting to help diagnose Gougerot-Sjörén syndrome from IVCM images.

## Material

- Cohort of 80 patients from 15-20 hospital (17 healthy volunteers, 63 patients with SS), splitted between the training set and the test set.
- Hundreds of IVCM images per patient, acquired and pre-selected by the ophthalmologist and clinical data. See figure 1.

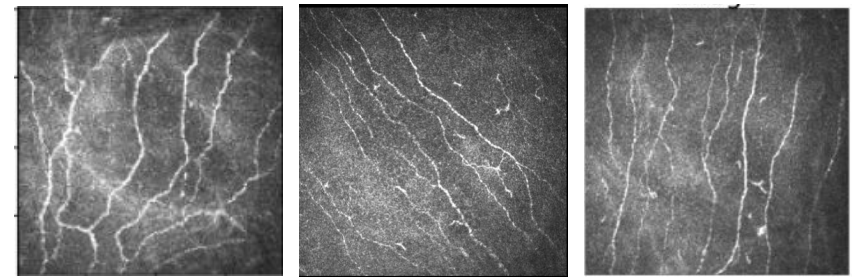


Figure 1: Samples of In Vivo Microscopy Images (HRT)

# AI to help diagnosing Gougerot-Sjörén syndrome in a non invasive way thanks to Deep Learning and In Vivo Confocal Microscopy



## Method

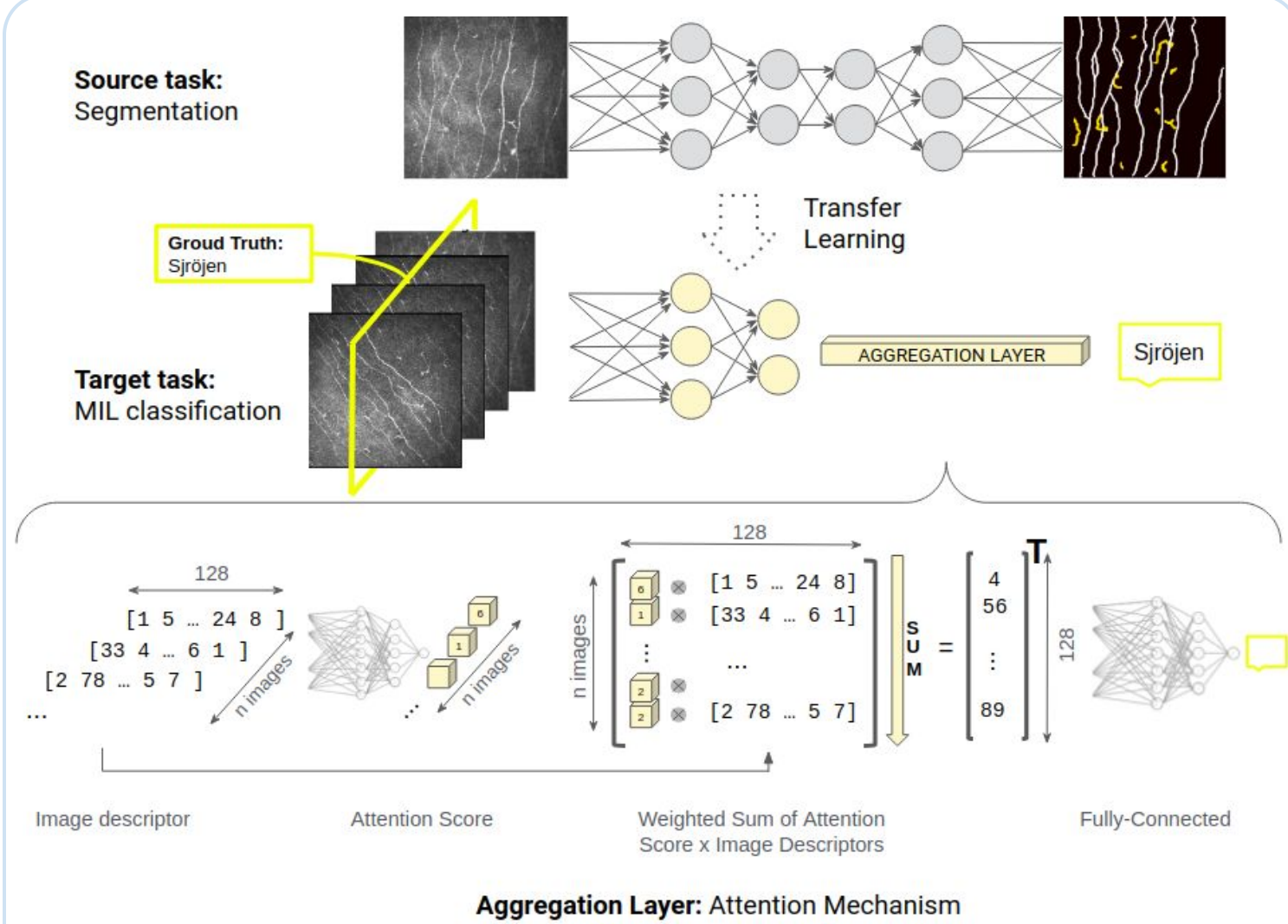
### Step 1 - Transfer Learning

- Segmentation of nerves, inflammatory cells and neuromas (U-Net [1] on 200 IVCM images).

### Step 2 - Automated Diagnosis

- Multiple Instance Learning (MIL) Classification → model benefits from multiple images available per patient.

- 1) **Feature extractor:** extract meaningful vector from original image
- 2) **Aggregator** (Attention mechanism [2]): combine scores of all the patient images to perform prediction.



## Results

The model demonstrated an accuracy of 81.1 % and an average ROC AUC of 0.69, as well as the ROC Curve for the SS class on the test set.

	C	SS
Ground Truth	3	2
SS	5	27
	C	SS
	Predicted label	

Figure 2: Confusion Matrix on the test set

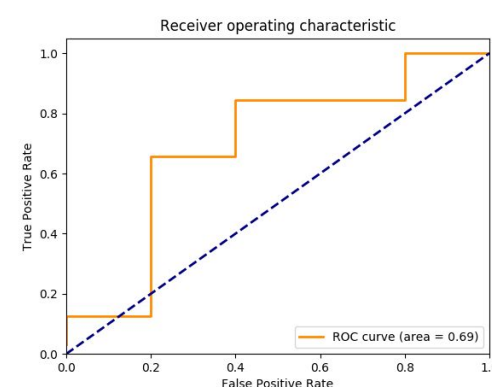


Figure 3: ROC Curve

## References

- [1] Ronneberger, O., Fischer, P., & Brox, T. (2015, October). U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.
- [2] Ilse, M., Tomczak, J. M., & Welling, M. (2018). Attention-based deep multiple instance learning. arXiv preprint arXiv:1802.04712.