**TEMPORAL UNETs**

Excessive Central Airway Collapse (ECAC) is a condition where the main airways narrow excessively during exhalation. The diagnosis of ECAC relies on dynamic bronchoscopy, which involves inserting a flexible bronchoscope to visualize the airways in real-time. However, this diagnostic procedure is prone to variability due to subjective visual estimation by clinicians, leading to potential misdiagnosis or inappropriate treatments. To address these limitations, computational methods have been developed to automate and enhance the precision of airway lumen assessment during the breathing cycle.

Previous works within the Interactive Augmented Modelling (IAM, iam.cvc.uab.es) Group of CVC have focused on enhancing the automatic evaluation of airway obstruction using a U-Net model. This deep learning architecture, widely used for image segmentation tasks, was trained to segment the lumen in bronchoscopy images. While the U-Net demonstrated high accuracy, it faced several challenges, including temporal instability in segmentations across consecutive frames and misidentification of inner lumens at bifurcations instead of the outermost lumen.

To address the first limitation, we proposed integrating ConvLSTM (Convolutional Long Short-Term Memory) cells in the U-Net architecture. ConvLSTM models are designed to capture both spatial and temporal dependencies, which could reduce temporal inconsistencies in segmentations. By combining ConvLSTM cells into the U-Net, a spatiotemporal segmentation framework can be developed, which may reduce the noisy fluctuations over frames. In this project, the student will evaluate the performance of four different placements of ConvLSTM cells within the U-Net model:

1. After the U-Net output.
2. In the bottleneck, replacing the original convolutional layer.
3. Within each skip connection.
4. In each encoder and decoder block, replacing the original convolutional layers.

Models will be trained using different combinations of cross-entropy and DICE losses with weights adjusted in a HPO phase, which wil also include sequence length and architeture. The same architectures will be used in an end-2-end system for the prediction of the dynamic grade of obstruction,