Computer Vision for Analysing Medical Images of Atlantic Salmon Gills.

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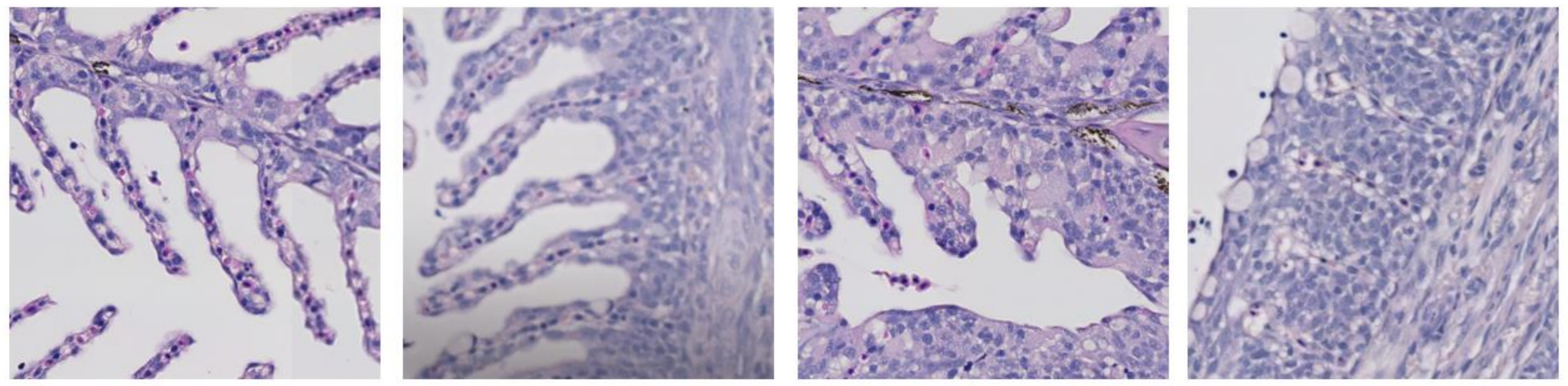
Background

Fish tissue samples obtained post-mortem offer insights into the animal's condition. Histopathology examines tissue changes microscopically. In Gills, this highlights lesions such as epithelial hyperplasia, a key indicator of local irritation, infection, or poor water quality.



Healthy **Mild** **Moderate** **Severe**

Figure 1: Tiles from Atlantic salmon gill histology images, exhibiting varying severities of epithelial hyperplasia.

Our tool provides histopathologists with severity percentages, distribution metrics (focal vs. diffuse), and heatmap visualizations of Whole-Slide Images (WSI) to pinpoint regions of interest (ROIs). This tool ensures 100% repeatability and transparency, making it a reliable and understandable aid in histopathological analysis.

Methods

We divide the WSI into tiles before applying stain normalisation. We automatically eliminate tiles when there is insufficient tissue for classification. We then use an anomaly detection-inspired technique to disregard tiles from regions irrelevant to hyperplasia analysis.

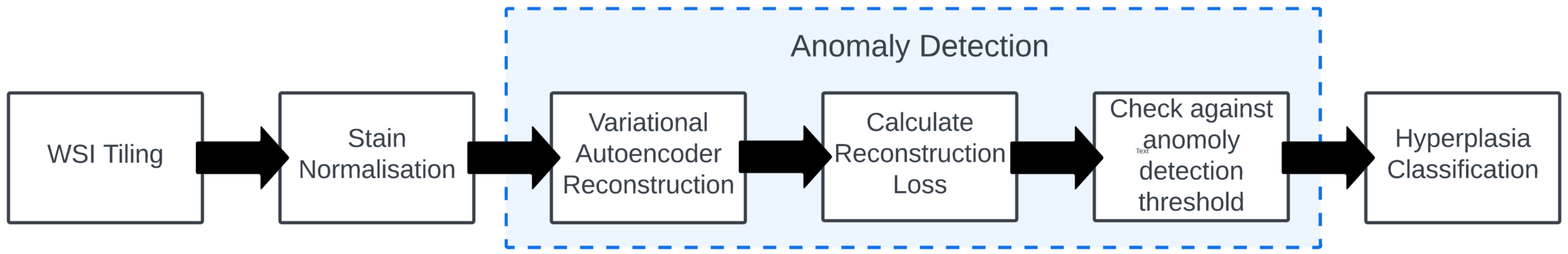


Figure 2: Our pipeline for predicting severity of epithelial hyperplasia, including preprocessing, and identification of salient regions using anomaly detection.

The final model then predicts whether tiles are considered healthy or exhibit signs of mild, moderate, or severe hyperplasia. A separate calibration dataset was used to determine the threshold value for identifying salient regions.

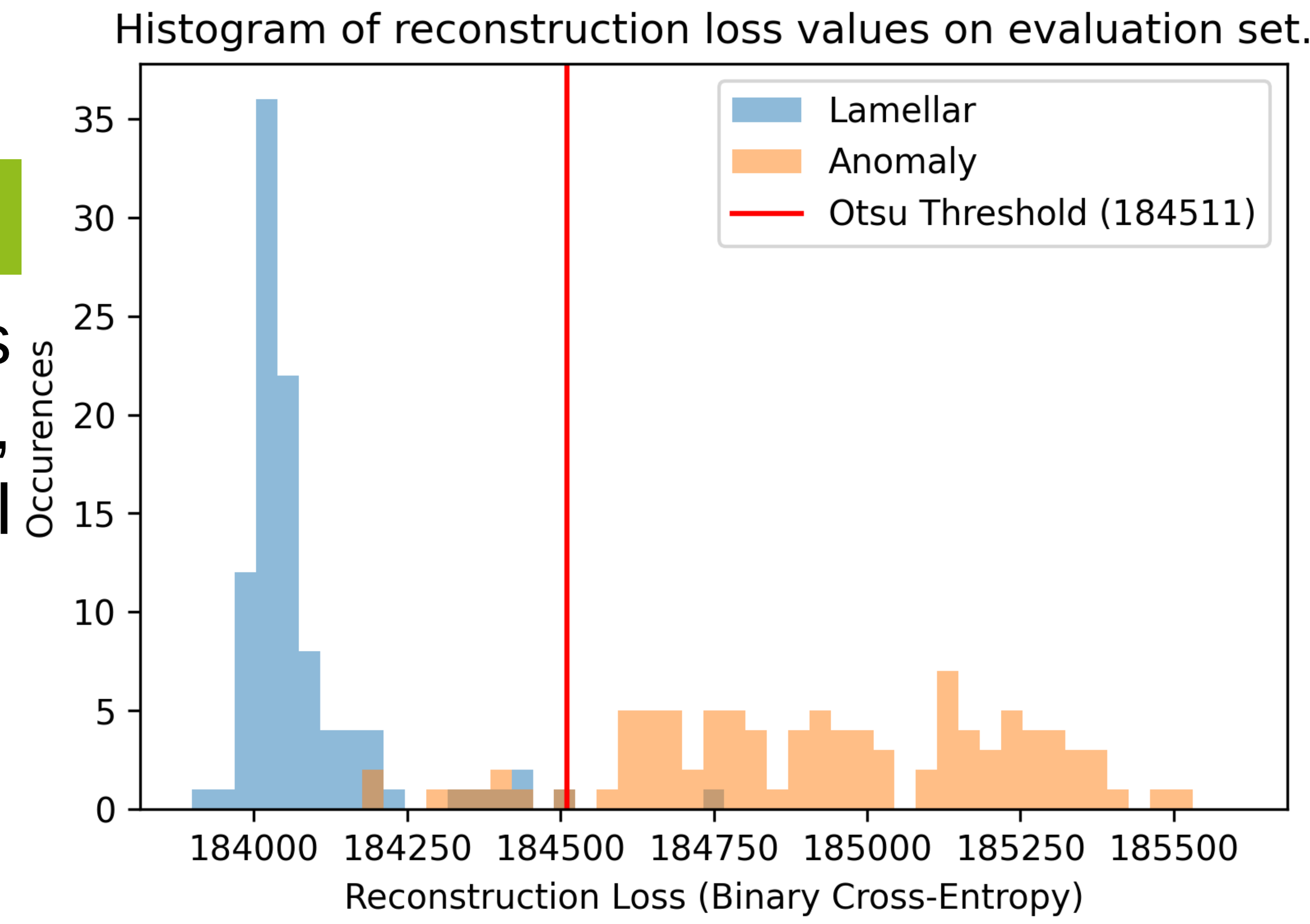


Figure 3: A histogram showing the reconstruction losses associated with both salient tissue (lamellar), and anomalous tissue (irrelevant for the task of hyperplasia analysis)

Methods (cont.)

For the task of hyperplasia classification, we used deep learning approaches such as ResNet18 and InceptionV3, as well as our approach, based on a signal processing method known as the Empirical Wavelet Transform (EWT). Classified tiles can then be aggregated to produce visualisations, and hyperplasia severity metrics.

Results

We evaluated our classification models on tile-level accuracy. We found that Inception V3 had the highest accuracy of the models tested; however, the long processing time associated with the model suggested that it would be inappropriate in practice. Our EWT-based method performed best when considering both accuracy and runtime.

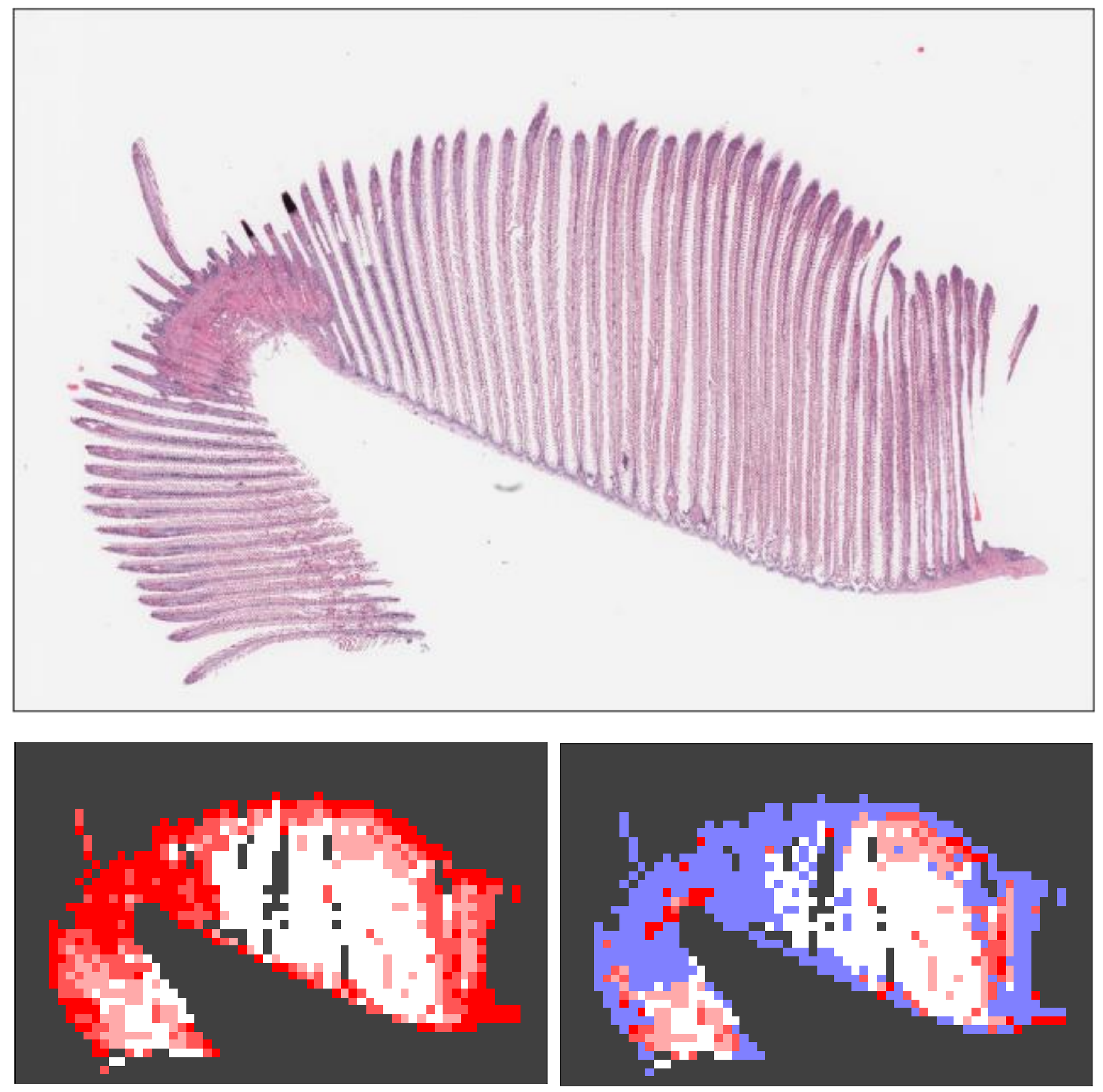


Figure 4: A gill WSI (top) with two heatmap visualisation, where white pixels represent healthy regions, and red pixels represent severe hyperplastic regions. The visualisation on the left does not include the anomaly detection step. The blue pixels on the right-hand visualisation represents tiles removed by anomaly detection component.

Conclusion

Computer vision has already been used extensively in the human medical domain. We have demonstrated that it has significant potential in the aquatic animal health domain as well.

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