Automated whistle extraction for precise scaled annotations

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AUTOMATED WHISTLE EXTRACTION FOR PRECISE SCALED ANNOTATIONS

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CONTEXT

- ➔ To identify and classify whistles from records is a time-consuming and labor-intensive process
- ➔ Available methods for the automated extraction of whistles contours are prone to errors
- ➔ Deep learning models require large quantities of high-quality data to be trained

Objective :
To build an AI model requiring relatively few data to identify the contours of whistles in an audio recording, with enough prediction accuracy to speed up the annotation process.

MATERIAL

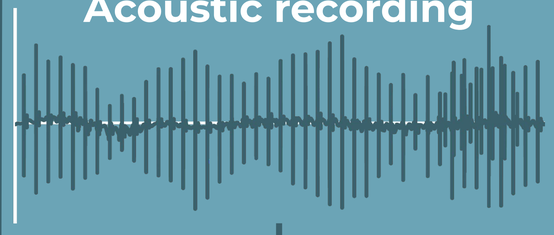
- 43 minutes of recording (~**5%** of our data to annotate)
- **1547 whistles contours annotated**
  ↪ using a custom-made annotation tool[1]

Acoustic data collected in Brittany from experiments with wild short-beaked common dolphins (Delphinus delphis)

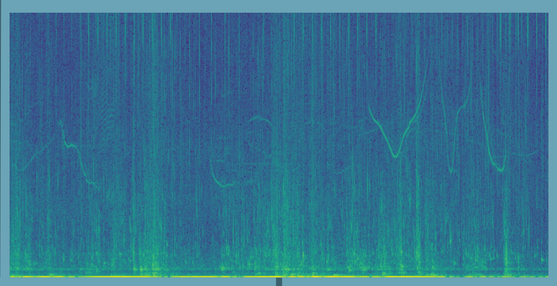
SCAN ME FOR PDF!

MODEL

Acoustic recording



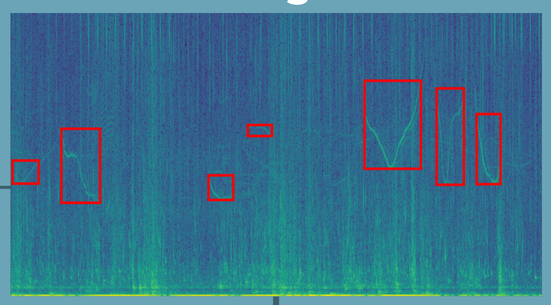
Spectrogram



YOLOv8

Stands for "You Only Look Once". Has proven useful in bioacoustics[5]

Bounding boxes

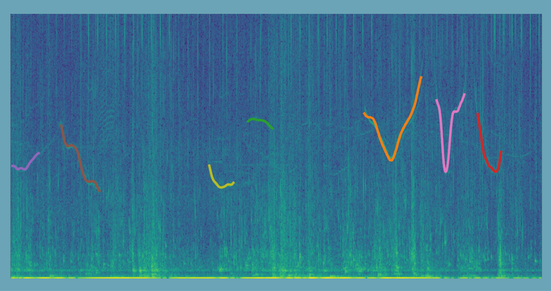


Checking bboxes

New bboxes

CNN regression

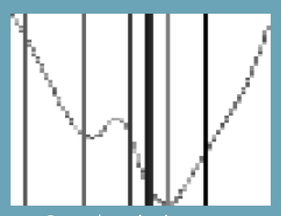
Extracted contours



MANUAL CHECK

After each prediction step, an **interface** can be displayed to allow for the modification of the results

Our contours had limited variations.
To enhance the model's ability to generalize, we added randomly generated images of whistles to the training dataset.



Synthetic image

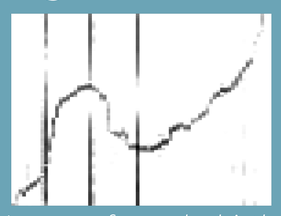


Image of a real whistle

METHODS & RESULTS

YOLOv8[2,3] is the last state-of-the-art model for **object detection**: it predicts bounding boxes (bbox) around the positions of objects in an image.

YOLOv8 is pretrained on COCO dataset : >200k real-life images. To use it on spectrograms, we use transfer learning to train it to recognise whistles only.

Precision	Recall	mAP50	mAP50-95
68 %	69 %	69 %	42 %

Table 1. 8-fold test scores of YOLOv8 on whistle bbox prediction

Overall satisfying scores :
- *Good predictions on isolated whistles*
- *Difficulties with overlapping whistles*

Our **CNN** is simply a pretrained **ResNet18**[4] (used for image classification) whose last layer has been replaced by a dense layer of neurons in order to predict the coordinates of contours within each bbox, instead of a category.

RMSE in % of the bounding box size: Errors are small!

Mean RMSE	Median RMSE
6.1 %	4.6 %

Table 2. 8-fold test scores of the CNN on whistle contour prediction

DISCUSSION

Using a **small portion** of our dataset and pretrained AIs, our model is capable of predicting bounding boxes and contours for **isolated whistles with accuracy.**

However, and as we anticipated, when there is **too much noise**, or when whistles are overlapping, **predictions are not satisfying** enough for further use. To overcome this issue, an interface was implemented inside the prediction process in order to make fast and precise modifications to any errors the model could make.

The model could be further improved with the use of a greater number of overlapping whistles during training, which are the most difficult to extract with accuracy, even for a human annotator.

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