Saving the Whales using Image Processing

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Motivation

As we speak, only 500 North Atlantic right whales are left in the world. To ensure the survival of this endangered species, marine biologists are tracking all of them to know their status and health at all times. However, manual recognition is tricky and very few researchers can perform it on the fly.
In this project, we implement a whale recognition system that allows researchers to reliably identify the whales from aerial photographs.

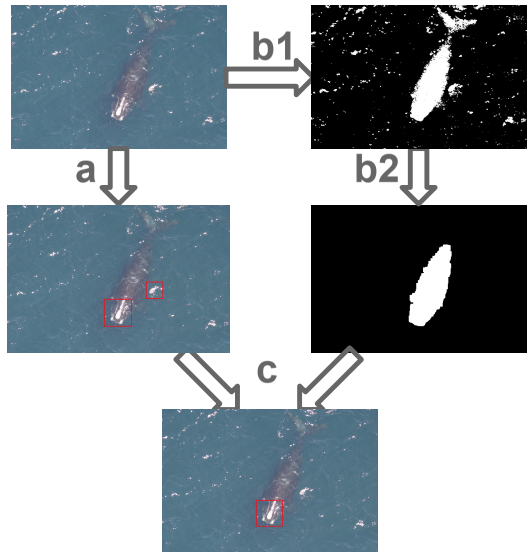
Proposed Methodology

The whale recognition system relies on a 2-step algorithm. First, we detect the whale's head using a combination of Haar cascades[1] and K-means[2] based filtering. Then, we match the detected head against our labeled database using SURF[3].

References

1. Viola and Jones, "Rapid object detection using a boosted cascade of simple features", Computer Vision and Pattern Recognition, 2001
2. Chen, Tse-Wei, Yi-Ling Chen, and Shao-Yi Chien. "Fast image segmentation based on K-Means clustering with histograms in HSV color space." *Multimedia Signal Processing, 2008 IEEE 10th Workshop on*. IEEE, 2008.
3. Bay, Herbert, Tinne Tuytelaars, and Luc Van Gool. "Surf: Speeded up robust features." *Computer vision–ECCV 2006*. Springer Berlin Heidelberg, 2006. 404-417.

Head Detection



Algorithm:

a) Haar cascade classifier for object detection. High recall but many FP due to the water reflection and grayscale (Haar)

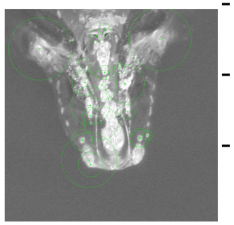
b1) K-means on the HSV version of the image to detect the whale in the water

b2) Morphological transformations to get rid of the noise and keep only the whale shape

c) Use the mask generated in b2 to filter FP boxes

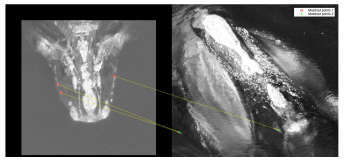
Head Matching

Detect SURF features from all images

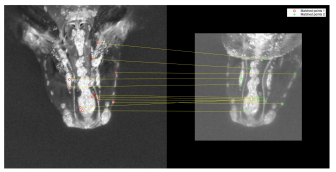


- Detect features from all bounding boxes
- Use SURF for speed due to large query set
- Cross-validation finally to optimize SURF parameters

Match features and count



Different whale



Same whale

Output probabilities

- Each image is assigned probabilities for each unique whale based on number of matched SURF features
- Final error is calculated as log-loss from the probabilities