Coral Reef Species Recognition and Whale Individual Recognition

Context and challenges

- Exponential growth of sea-related multimedia data in the forms of images/videos/sounds
  - Fish biodiversity monitoring
  - Marine resource sustainability
  - Fishery
  - Educational purposes
- Analysis of such data is very time-consuming for human operators

Objectives

- Develop automated multimedia analysis methods for making sense of massive sea-related data collected by either human operators (volunteers) or imaging devices

Tasks

SeaCLEF 2016 features two tasks:

- **Coral Reef Species Recognition**: video-based identification of fish species.
- **Whale Individual Recognition**: image-based matching of caudals of same individual whales.

Coral Fish Species Recognition: Task description

The goal is to analyze underwater videos and identify coral reef fish and recognize their species.

Correctness metric is per-species individual count.

Coral Fish Species Recognition: Dataset

- 700,000 10-minute underwater videos (about 250 TB) recorded from Taiwan's coral reefs
- One of the largest biodiversities in the world: 3,000 fish species
  - *http://shdb.sinica.edu.tw*

Coral Fish Species Recognition: Training set

- 20 manually-annotated videos with bounding boxes and species names
  - More than 9,000 bounding box + species annotations
- 15 fish species
  - For each species, a set of sample images is provided (20,000 in total)
  - *fishbase.org* links, with information and additional images, are provided.

Coral Fish Species Recognition: Training set

- Unbalanced dataset
  - 3165 instances of *Dascyllus reticulatus*
  - 72 instances of *Zebrasoma scopas*
- Annotation performed on a single-frame basis
  - Tracking is out of the scope of the task
  - Temporal consistency was not exploited by annotators

Coral Fish Species Recognition: Training set

XML Annotation format:

```xml
<?xml version="1.0" encoding="utf-8"?>
<video id="0b21f0579d247c855e05405d3ed805c1#201205251240" location="NPP3" camera="4">
   <frame id="0">
      <object fish_species="Dascyllus Aruanus" h="68" w="87" x="322" y="233"/>
   </frame>
   <frame id="1">
      <object fish_species="Dascyllus Aruanus" h="68" w="87" x="319" y="230"/>
   </frame>
   <frame id="2">
      <object fish_species="Dascyllus Aruanus" h="68" w="87" x="342" y="231"/>
   </frame>
   <frame id="391">
      <object fish_species="Plectrogly-Phidodon Dickii" h="50" w="35" x="271" y="336"/>
      <object fish_species="Plectrogly-Phidodon Dickii" h="41" w="29" x="339" y="375"/>
   </frame>
</video>
```

Coral Fish Species Recognition: Training set

Fish species distribution in training set:

Fish Species ID	Fish Species Name	Occurences in the GT
1	Abudefduf Vaigiensis	132
2	Acanthurus Nigrofuscus	294
3	Amphiprion Clarkii	363
4	Chaetodon Lunulatus	1217
5	Chaetodon Speculum	138
6	Chaetodon Trifascialis	335
7	Chromis Chrysura	275
8	Dascyllus Aruanus	894
9	Dascyllus Reticulatus	3165
10	Hemigymnus Melapterus	242
11	Myripristis Kuntee	214
12	Neoglyphidodon Nigroris	85
13	Pempheris Vanicolensis	999
14	Plectrogly-Phidodon Dickii	737
15	Zebrasoma Scopas	72

Coral Fish Species Recognition: Test set

- 73 manually-annotated videos

Fish Species ID	Fish Species Name	Occurrences in the GT
1	Abudefduf vaigiensis	93
2	Acanthurus nigrofuscus	129
3	Amphiprion clarkii	517
4	Chaetodon lunulatus	1876
5	Chaetodon speculum	0
6	Chaetodon trifascialis	1317
7	Chromis chrysura	24
8	Dascyllus aruanus	1985
9	Dascyllus reticulatus	5016
10	Hemigymnus melapterus	0
11	Myripristis kuntee	118
12	Neoglyphidodon nigroris	1531
13	Pempheris vanicolensis	0
14	Plectrogly-phidodon dickii	700
15	Zebrasoma scopas	187

Coral Fish Species Recognition: Run submission

- Participants can submit up to three runs
- Each run submission is an XML file in the same format as the training ground-truth
- Fish with species not present in training set should be labeled as “Unknown”

Coral Fish Species Recognition: Metrics

Counting score:

$$CS = e^{-\frac{d}{n_{GT}}}$$

- Computed per species
- *d* is the difference between counted fish in the submission and ground truth count
- Does not take into account bounding-box matching correctness

Coral Fish Species Recognition: Metrics

Precision:

$$Pr = \frac{TP}{TP + FP}$$

- Computed per species
- Bounding box match if “intersection over union” greater than 0.3.
- Shows accuracy in identifying the correct species of each bounding box

Coral Fish Species Recognition: Metrics

Normalized counting score: $NCS = CS \cdot \mathrm{Pr}$

- Combines counting accuracy with bounding box matching accuracy

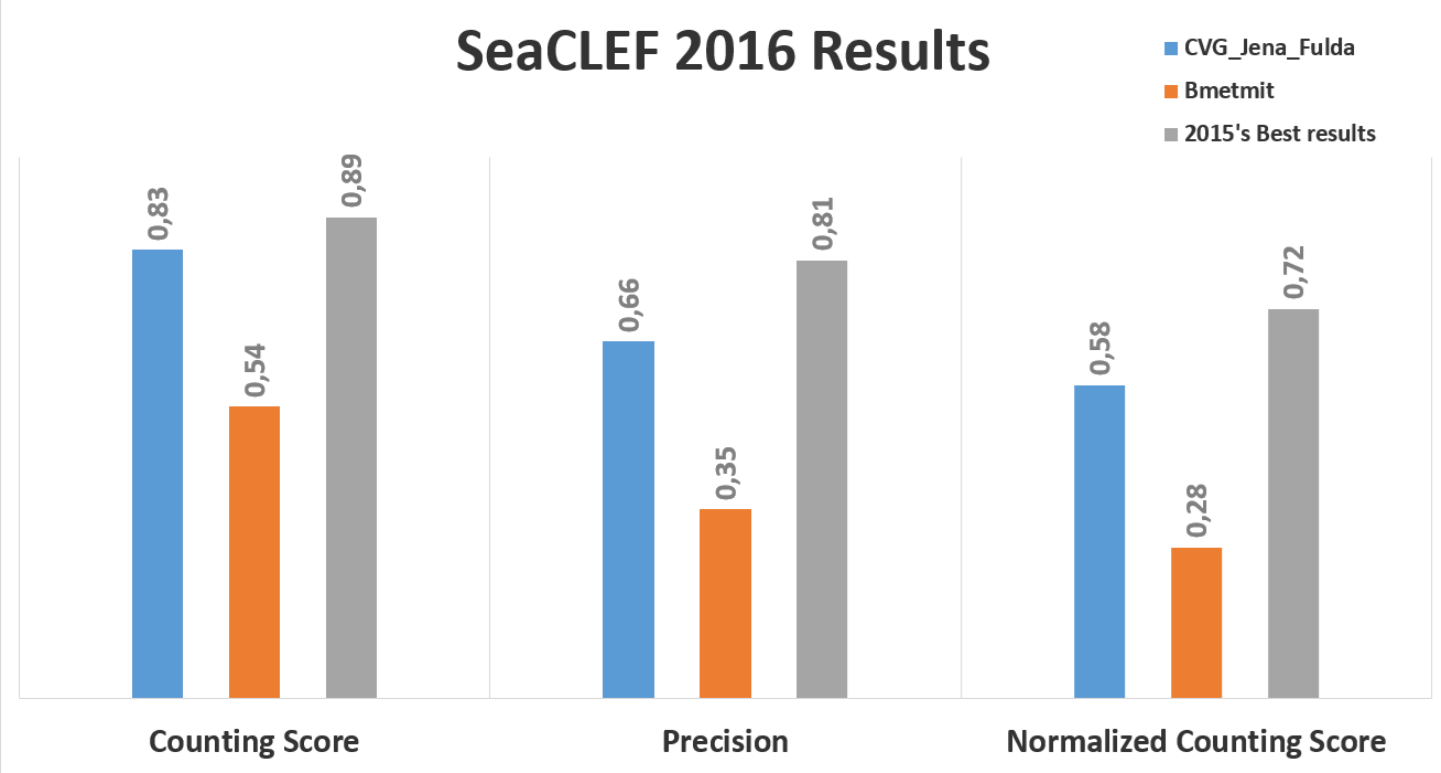
Final submission score is computed by averaging NCS over all species.

Coral Fish Species Recognition: Participants

Teams:

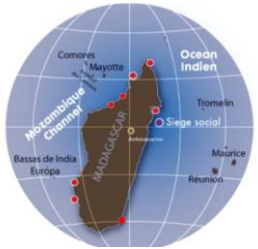
- CVG_Jena_Fulda
- Bmetmit

Coral Fish Species Recognition: Results



SeaCLEF: whales

Concetto Spampinatto, univ. of Catania
Julien Champ, Inria
Simone Palazzo, univ. of Catania

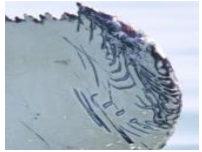


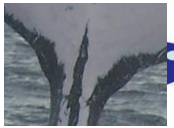
Context: CetaMada NGO

- Whale's watchers volunteers
- Madagascar area
- Manual photo-identification thanks to biomarkers

Objective: given thousands of whale's caudal pictures, find the ones belonging to a same individual (*photo-identification*)

- **Unsupervised identification** (no training data to recognize each of the 1000's of individuals)
- Thanks to biomarkers (spots, scars, etc.)

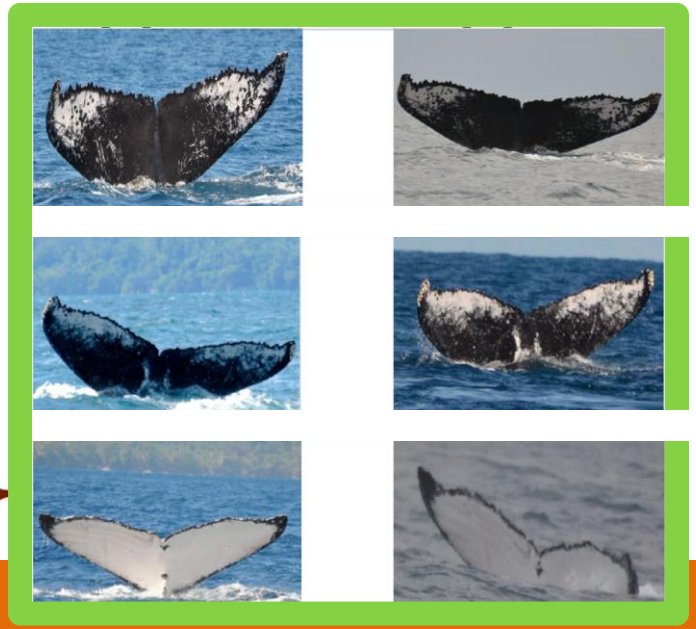




SeaCLEF: whales

Spot the difference game !

Good matches (very few)



Bad matches (a lot !)

SeaCLEF: whales

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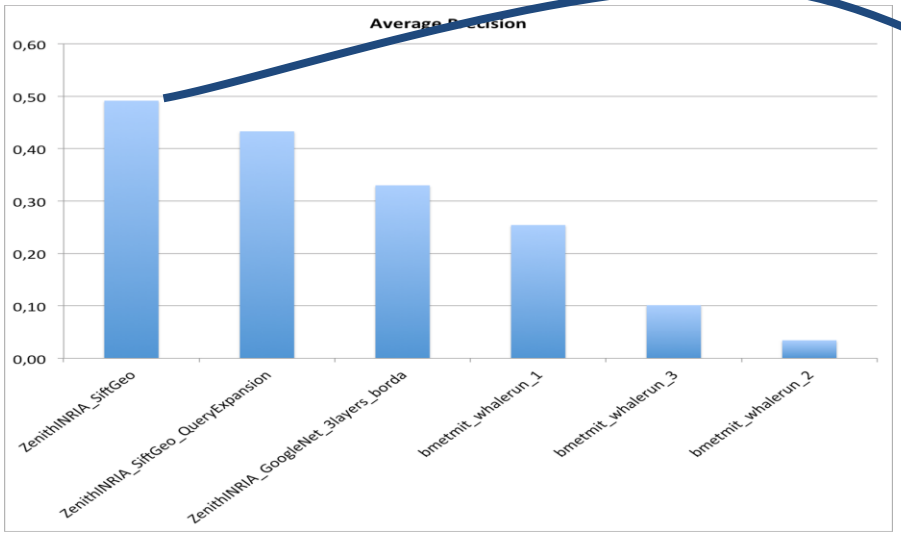
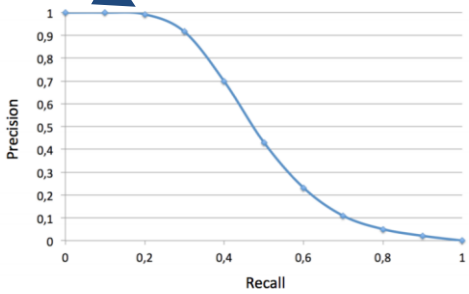


- The use of rigid epipolar geometry allows rejecting false alarms
- Hash-based indexing allows breaking the quadratic complexity



Conclusions and future directions

- Effective approaches for both video-based fish counting system and whale individual identification
- Low participation due to the high complexity of the tasks, which mainly pertain computer vision (loosely related to multimedia)
- Extend past editions by:
  - Increasing the tackled marine organisms species (from fish to salmon to whales to seabeds, etc.)
  - Enriching the visual data modalities (not only 2D images, but also thermal and stereo images as well as audios) for supporting the analysis, thus making them proper multimedia analysis tasks.