Collection and Analysis of Two Complex Ecological Datasets

Robert B Fisher
University of Edinburgh
rbf@inf.ed.ac.uk

Abstract

The talk will present an overview of the data acquisition and analysis from the ChiRoPing and Fish4Knowledge EU funded research projects.

Categories and Subject Descriptors

I.2.10 Vision and Scene Understanding (I.4.8, I.5): Video analysis, 3D/stereo scene analysis
I.4.8 Scene Analysis: Time-varying imagery, Object recognition

Keywords

Biological video analysis; bat tracking; fish detection and recognition

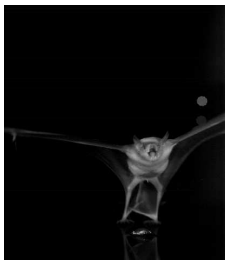
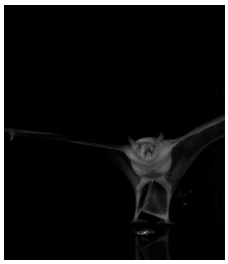
ChiRoPing

ChiRoPing[1] investigated how to develop a better robot acoustic sonar sensor, and one foundation of the investigation was based on the acoustic performance of 4 different bat species. Data collection was in Denmark and Panama, and recorded acoustic, large scale video and high speed (500 fps) close up stereo video. Data analysis investigated the linkage between acoustic and physical events. While the data quantity was not large, acquiring, analysing and linking the audio and video was complicated.

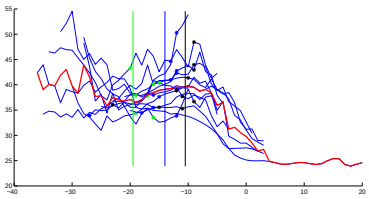
A view of the acoustic and video capture setup is here:

[1]Funded by the EC's IST programme, STREP project 215370, in the ICT Challenge 2: "Cognitive Systems, Interaction, Robotics".

An example of a stereo pair from the video is here:

The red line in the following image shows the median ear tip separation of a *Noctilio leporinus* bat over 13 runs, normalised to prey contact at time 0. What we observe is the ears start to lift as the bat starts to make new new search calls (vertical black line is median search first call times (black dots)).



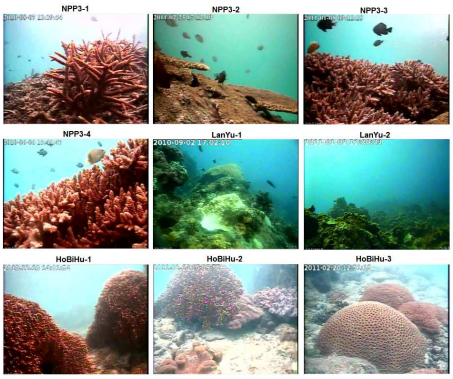
For more information, see: `www.chiroping.org`

Fish4Knowledge

Fish4Knowledge[2] collected and analysed subsea video from about 10 cameras off the coast of Taiwan, which were observing coral reef fish. Over 100 million fish were detected and analysed from about 100K hours of video, with 23 species recognised. Developing mechanisms to acquire, analyse and present results over such a large dataset was the major challenge of the project.

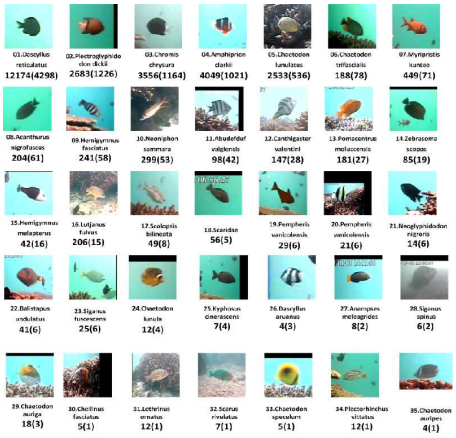
See below for an example view from 9 of the cameras:

[2]Funded by the European Union Seventh Framework Programme [FP7/2007-2013] under grant agreement 257024.



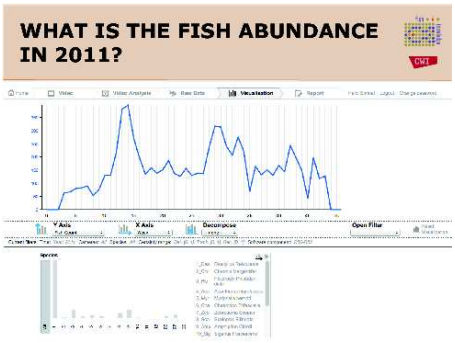
Video capture uses a data network based in Taiwan, attached to the Taiwan National Center for High-Performance Computing. NCHC stores the videos recorded from 12 hours per day over 3 years (about 150 Tb). The videos are processed on a supercomputer there (up to 1000 cores), with the detection and recognition results stored for user query (c. 50 Tb). The project uses a combination of dynamic video and background modeling techniques to detect the fish in 320x240, 5 fps video, which are then tracked. After descriptive shape, colour and texture features are extracted, a hierarchical classifier identifies the species. About 80% of fish are detected with about 10% false detection rates. Recognition rates over the (highly unbalanced) dataset is about 95%.

Here is a summary of the ground truth for the top 35 species of fish:



35 species 27470 fish (8780 trajectory)

Users are able query the database by using a set of selective facets, covering species, time period, analysis certainty, camera location, etc. An example of the prototype interface is here:



For more information, see:
`homepages.inf.ed.ac.uk/rbf/Fish4Knowledge`