

# Feature Extraction for Content-Based Image Retrieval in DARWIN (Digital Analysis and Recognition of Whale Images on a Network)

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## 1. POSTER DISCUSSION

Researchers involved in the study of dolphin biology, such as migrations, ranging patterns and social association patterns, frequently use photo-identification techniques to identify individual dolphins based upon natural markings on the dorsal fin. Although effective, the manual photo-identification process can be extremely time consuming and visually stressful particularly with large collections of dorsal fin images. The large quantity of image data and the somewhat constrained properties of the dorsal fin images makes the photo-identification problem a feasible and appealing task for automation.

DARWIN is a software system which allows marine scientists to maintain information for the study of various behavioral and ecological patterns of bottlenose dolphins, *Tursiops truncatus*. The software provides a graphical user interface to access a collection of digital dorsal fin images along with textual information which describes individual animals as well as relevant sighting data. Users may query the system with the name of a specific individual or the entire collection may be sorted and viewed based upon sighting location, sighting date or damage category. Alternatively, the researcher may compare the dorsal fin image of an unknown individual against a database of images of previously identified dolphins in order to identify those fins which it most closely resembles. A modified mean squared error is used as a measure of similarity and those images which are identified as most similar are presented to the researcher in rank order.

In order to perform the comparison, an outline of the dorsal fin is generated using a semi-automated sketch based query mechanism. The user traces a rough outline of the dorsal fin and active contours [?] are employed to move the points comprising the outline from their initial locations to the actual edge of the fin. Next, a one-dimensional repre-

sentation of the outline is created for efficient comparison against the outlines of images in the database.

Several complications exist with the registration and comparison of dorsal fin outlines. The beginning and ending points of the outlines may be difficult to determine due to partial obstructions or an insufficient initial trace and the tip of the fin may be missing or somewhat modified. To automatically identify the starting point of the outline at the base of the leading edge, the absolute angles between successive points along the edge are examined. A threshold angle value is selected to maximize between class variance of the angles which comprise the leading edge of the fin [?]. Line segments at the left edge of the outline are discarded if their angles diverge significantly from the predominant orientation of the edge, accurately identifying the point at which the fin meets the dolphin's back. In instances where this junction is occluded or where an insufficient portion of the outline is included in the initial trace, the initial point of the leading edge is selected. The ending point is identified by locating a prominent inflection point in a smoothed version of the trailing edge of the outline. In order to identify the tip of the dorsal fin, a wavelet decomposition of the chain of angles comprising the fin outline is computed. The largest positive maxima value in a coarse level representation of the outline indicates the position of the point which corresponds to the fin tip [?]. These techniques provide feasible solutions for the automated extraction of feature points in the outline of the typical dorsal fin and perform adequately for dorsal fins whose shape is moderately altered.

## 2. ACKNOWLEDGMENTS

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## 3. REFERENCES

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