# Coral Reef Image Classifications

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***Abstract*: This chapter presents various classification methods for resolving the coral reef which exhibit vital within-class variations, complicated between-class boundaries and discrepant image clarity. This makes coral classification a difficult task. In this paper we examine the recent activity of image classification approaches and techniques. Image classification is a difficult process which depends upon various factors. Here, we deliberate about the current procedures, obstacles as well as prospects of image classification. This main attention will be on advanced classification techniques which are used for improving classification accuracy. Additionally, some important problems relating to classification performance are also discussed. The aim of this paper is to report an illustrative and comparative study of the most popular feature extraction methods which are generally used for classification.***

***Index Terms: coral reef, classification, SVM, KNN, Decision Tree, Neural Network.***

## I. INTRODUCTION

The coral reefs are marine invertebrate animals. Coral reefs are one of the most diverse ecosystem goods and services they provide to marine tropical and subtropical nations. Human impact on coral reefs is significant. Coral reefs have risen global prominence in terms of their quantities to act as early caution for universal climate change. Increased water temperatures are responsible for bleaching and death of corals [1],[2].Image analysis which was conducted manually, was both time consuming and prone to error. It proposed novel algorithm using texture and colour descriptors over multiple scales that outperforms commonly used techniques from the texture classification literature. Water turbidity can affect dramatically between sites and years due to plankton algal blooms, etc. affecting ambient light and image colors.

The exploration of underwater images is an inspiring computer vision problem. There are many coral reefs monitoring methods exist. Among them are by using remote sensing, hydro-acoustic sensing, manual diving and perhaps the most accurate method is by using video transect monitoring technique. The supervised and unsupervised classification techniques have been widely used for coral reef mapping. These include neural networks, decision tree classifiers, and random forest and support vector machines. In addition to these habitat classification approaches, many studies employ a range of species distribution modelling techniques. These methods are more able to predictchange but require significant methods employed to set up the models.

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## II. CLASSIFICATION METHODS

Image classification could be complicated and difficult task. There are several classification methods. The two main classifications methods are supervised and unsupervised.

Supervised Classification

The image analyst or user oversees the classification methods in supervised classification. The user specifies the assorted pixel values or spectral signatures be related to every category. This is done by choosing representative sample sites of better known from coaching sites or areas. The computer system then uses the spectral signatures from these coaching areas to classify the complete image. Ideally the classes mustn't overlap or should minimally overlap with other classes. In supervised classification the mainstream of the effort if done prior to the actual Classification. Once the classification is run the output may be a map with classes that are labelled and correspond to data classes or land cover varieties. Supervised classification can be much more perfect than unsupervised classification, but be contingent heavily on the training sites and the spectral clarity of the classes. If the training data is deprived or not representative the classification results will also be poor.

B.Steps in Supervised Classification:

Training Data by user. Specification of training sites given by user for classification. Based on training data computer assign pixels closest to the class Results are evaluated Unsupervised Classifications

Unsupervised classification is where the results are grouped with the common characteristics of pixels. Computer itself evaluates the sample pixels of the image without user stipulations.Techniques are used by the computer to relate the pixels to their corresponding classes. The system examines the corresponding classes of pixel and labels them using the algorithm specified by the user. However, the user should have awareness of the realm being classified. Once the grouping of pixels with common characteristics made by the computer need to be associated with actual options on the bottom(such as wetland, developed areas, evergreen forests,etc Compared to supervised classification, unsupervised classification generally entails only a minimal amount of initial input from the predictor.

D.Steps in Unsupervised Classification.

1) Classes are specified by the user.

2) Pixels are clustered by the computer in to spectral classes.

3)Clusters are labeled to informational classes.

4)Results are Evaluated.

## III. LITERATURE REVIEW

Image classification is an essential step in detection and analysis of coral reefs. A lot of image classification techniques have been anticipated till date. Satellites are the wonderful tool for detecting the Earth and Ocean. It is used to analyse the features of the coral reef and also the temperature changes which cause the bleaching of corals. Various studies have been conducted in order to conclude about the best image classification techniques. In this study various classification methods are observed by its results and accuracy which was implemented by various authors..Ezmahamrul freen Awalludin[3] established edge detection techniques for detecting the images of coral. The edge detecting operators which were used namely Robert operator, Prewitt operator, Sobel operator, Log operator and canny operator. In the future, it is proposed to implement the blob processing analysis for coral reef video transects analysis so that a fully automatic analysis of coral reef distribution estimation could be made.Marcos[4] implemented a feed forward back propagation neural network to characterize Coral reef segments in to three benthic classifications living coral, dead coral and sand. Decision-tree algorithms which belong to supervised learning algorithm mainly used for solving regression and classification problems. Local Binary Patterns (LBP) was used for extracting the features of coral. This investigation gives a foundation for benthic characterization and mapping using simple reef transect video. For further classification, e.g. genera or species level, additional.research on suitable image features and classifier design is necessary.Paul Anton Letnes [5] monitored tropical corals using multi or hyper spectral imagery from satellite and aeroplanes. Health status of coral is evaluated by using underwater hyper spectral imagery. Large scale image classification of coral is carried out by machine learning method. It utilize scikit-learn software packages for PLS and SVM classification algorithm.Mehta [6] analyse the texture of coral reef using Support Vector Machines (SVM) classifier. Radial Basis kernel function is used here for better performance. Plans for future work include the advancement of automatic underwater image mosaicing for generation of large area analysis and the improvement of suitable representations for texture and illumination that should improve the results of our algorithm.Pizarro [7]presents apreliminary investigation in to using a state-of-art object recognition system to classify marine habitat imagery based on labelled examples. Automated underwater vehicles [8] designed for benthic imagings are capable of gathering large amounts of high-resolution survey dataM.D.Stokes and G.B.deane [9] proposed an automated computer algorithm is used for the classification of coral reef benthic organisms. In this study it use normalized color space and discrete cosine transforms as a textural descriptor in a statistical distance-based classification scheme to identify reef benthos from images collected during a photo quadrat sampling survey typical of ecological studies. [10] proposed LBP (CLBP) method and Binary pattern (LBP) operator for the classification of texture.O.Beijborn [11] state that picture investigation which was directed physically was both tedious and inclined to mistake. Water turbidity affect ambient light and image colors so filter banks are widely used first step for many problems in computer vision. Filters used in this research are maximum response filters, Laplacian and Gaussian filters. The LIBSVM implementation was used throughout this work.Shihavuddin [12] presents a novel image classification scheme for benthic coral reef images. The proposed method uses local binary pattern(CLBP),grey level co-occurrence matrix(GLCM),Gabor filter response, and opponent angle and hue channel color histograms as feature descriptors and for further classification K nearest neighbour(KNN),supportvectormachine(SVM),probability density weighted mean distance(PDWMD),neural network (NN) is used. The blend of features and classifiers that attains the best results is presented together with the guidelines for selection.Edardo Tusa [13] proposed computer vision system for coral detection using supervised machine learning. Gabor wavelet filters for feature extraction. Decision Tree algorithm is implemented for fast and accurate performance. Future work is the linking of Coralbot througha test system of marine robots, called UWSwim to test visual servoing calculations.Nurhalis[14] objective was to define accuracy values of coral reef habitat classification based on OBIA algorithms such as Support Vector Machine(SVM),Random Tree, Decision Tree(DT),Bayesian and k-nearest neighbour(KNN).Accuracy of coral reef benthic habitat mapping classifications are handled by Landsat 8 OLI image.Mohamed [15] proposed a machine vision algorithms to support and underwater robot to locate a coral reef. CNN which is a supervised deep learning method used for coral classification. Texture features and shapes of coral are extracted using Weber Local Descriptor (WLD), Phase congruency (PC) and Zero Component Analysis (ZCA).It implement state of art preprocessing algorithms for image enhancement, color normalization, and color conversion adjustment. It finally mentioned well defined future research vision in under water imaging using deep learning methods.MirceaCimpo [16] recognises the material, texture and scene using Convolutional Neural Network (CNN) filter bank with fishing vector pooling.Mahmood [17] state that coral reefs exhibit substantial with in class variations and unreliable image clarity. This makes coral classification a challenging task. Well known labeling techniques cannot be applied due to water turbidity.VGG Net which is an image classification convolutional neural network used for object recognition. The introduction of a local Spatial Pyramid Pooling based technique to improve feature extraction from point annotations. Handcrafted features such as SIFT and HOG are used to encode different aspects of data. The combined CNN based features and hand crafted features for a better classification performance. [18] aims to describe a supervised texture classification method for automatic classification of coral reef image. It classified every picture of coral reef element in image per Category by the support vector machine classifier. The inaccuracies caused by the unclear point sampling approaches will be inspected in future work on segmentation. Jean-Nicola Blanche [19] presented classifiers such as nearest neighbors and neural networks. However promising

results are yielded by the radial basis function and kernel support vector machines. Future work will inspect segmentation as a consideration.VGG Net is used for classification problems.YAN Guoqiang [20] implemented Support Vector Machine (SVM) to classify four types around zhaoshuisland that is coral reef, coral bleaching, coral sand and sea water.Healths of coral reefs are monitored using these high resolution images.M.Bennamoun [21] presented deep residual networks as the state-of-the-art architecture in image classification and object detection. It is worth to further investigate the prospective applications of Resfeats for other computer vision tasks such as object localization, image segmentation, instance retrieval and attribute detection. The image representations mined from the deeper layers of a CNN capture greater level features and rise the classification performance.AniBrownMary [22] proposed Improved Local Derivative Pattern (ILDP) for feature extraction and classification.ILDP feature descriptor achieves the highest overall classification accuracy with minimum execution time when compared to other state-of-the-art methods. In future, ILDP approach is to be used in the real time submarine coral reef videos for feature extraction. InigoAlonso [23] presented state-of-the-art encoder-decoder CNN models for semantic segmentation.Superpixels SLIC-GT, SEEDS-GT used for better segmentation. As future steps, is to explore other state-of-the-art CNN architectures for semantic segmentation.Awalludin[24] extract the features of coral reef using Bloob processing techniques. Edges of the coral reefs are detected using modified canny edge detector. For future work is to extend its work to classify the components of coral reef automatically. Lian Xu [25] applied CNN and VLAD for coral image classification. The combined features of FC and CONV are used in coral image classification. The overall accuracy of image classification is achieved by combining the features of convolution and fully connected layers.Dianpeng [26] proposed LiDAR bathymetry (ALB) bottom waveform and bathymetric feature data for identifying coral reef. Support Vector Machine is used for classification.Anabel [27] proposed CNN with Inception V3, ResNet, and Dense Net for coral image classifications. It not only classify the texture of coral but also the structure of coral images. Data Augumentation techniques, CNN architecture, and transfer learnings are analysed.ShinyaOdagawa [28] proposed Hyper spectral BI imagery and SVM regression model for mapping the bottom types of coralreefs.Wavelength dependency can be reduced effectively using BI imagery.[29] proposed a deep learning method to analyse the population of coral. Resfeats and convolutional neural network are used to classify corals from non coral. Future work is to generate coral species over spatial and temporal map distribution.[30] implemented convolutional networks for deep visual representation of coral species.Importance of depth in visualising the coral reef is essential is confirmed by this method.Excellent performance is achieved using ConvNets.

TABLE I: COMPARISION OF VARIOUS CLASSIFICATION METHODS

| References | Classification methods | Dataset | Acurracy in % |
|---|---|---|---|
| [4] | Neural Network classifier(NN) | Great Barrier Reef | 86.5 |
| [11] | LIBSVM | MLC dataset | 83.1 |
| [17] | VGGNET | Benthoz15 dataset | 95 |
| [14] | SVM | Morotai Island dataset | 73 |
| [19] | ResFeats-152 | Caltech | 92.6 |
| | | MIT dataset | 73.0 |
| | | MLC dataset | 80.0 |
| [12] | KNN,NN,SVM, PDWMD | MLCdataset | 85.5 |
| | | Red seamosaic image | 83.7 |
| [22] | ILDP | EILAT | 97.5 |
| [20] | SVM | Zhaoshu island | 95.28 |
| [16] | Local SPP and CNN features combined features(CF) | MLC dataset | 84.5 |
| [26] | CONV3 and FC6 | EFC dataset | 91.4 |
| [28] | Waveform and Bathymetry | Yuanzhi island | 93.57 |
| [29] | CNN and ResFeats | Benthoz15 dataset | 81.1 |


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## IV. CONCLUSIONS

This study helps imminent scientists and researchers for determining a suitable classification procedure in their specific study. In our presentation we have focussed broadly on the work done by various researchers to classify coral reef. Various classification methods are discussed based on accuracy. Among all the classification technology ILDP acquires high accuracy compared to Resfeats, SVM, CNN, KNN etc. Supervised and unsupervised classifications are also discussed

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