Middle-East Journal of Scientific Research 24 (S1): 224-228, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.S1.44

Improving Resolution in Measurement of Water Depth by Using 3D Wavelet Transform

[1]*K. Varatharaj and* [2]*Mrs. S. Sri Shanmugapriya M.E.*

[1]ME Applied Electronics, Department of Electronics and Communication Engineering,
V.S.B Engineering College, Karur Tamil Nadu, India
[2]Assistant Professor, Department of Electronics and Communication Engineering,
V.S.B Engineering College, Karur Tamil Nadu, India

Abstract: Benthic habitats (habitats occurring at the bottom of a water body) and coral reef ecosystems provide numerous functions. Currently, though, global coral reefs are vulnerable by a number of factors and are degrading rapidly.An optimal atmospheric modification sculpts, as fit as an enhanced algorithm for sun glint removal based on combined physical and image dispensation techniques. Then, with the corrected multispectral statistics, an efficient multichannel physics- based algorithm has been implemented, which is competent of solving during optimization the radiative transfer model of seawater for bathymetry repossession, unmixing the irrigateessential optical properties, profundity, and seafloor albedo offerings. Lastly, for the mapping of benthic skin texture, a supervised organizationmethod has beimplementing, combine seafloor-type normalized indexes and hold vector contraption techniques. Results of extraordinaryvariation, isolated bathymetry, and benthic habitat mapping of shallow-water environments have been validated with in situ data and available bionomic profiles providing excellent accuracy. The main advantage of this method is that the marine habitats identified at specified locations by the field survey can be extended to a large area with the help of image processing of remote sensing data which can minimize the field survey to a considerable extent.

Key words: Atmospheric model · Bathymetry mapping · Benthic habitat mapping · High-resolution multispectral imagery · Physical and image processing techniques · Sunglint · WorldView-2 (WV2)

INTRODUCTION

Benthic habitats vary widely as a function of geographic location, environmental characteristics and water depth, and are characterized according to their dominant structural features and biological communities. One method for classifying benthic habitats is based upon the overlying water depth: the hadal zone (over 6,000 meters deep), the abyssal zone (2,000 to 6,000 meters), the bathyal zone (200 to 2,000 meters), and the near shore and estuarine zones (less than 200 meters). Estuarine and near shore benthic habitats, which could be monitored using satellite remote sensing, can be further divided into categories such as submerged mudflats, sand flats, rocky hard-bottom habitats, sea grass beds, kelp forests, shellfish beds, and coral reefs. These habitats support a wide diversity of marine life by provided that spawning, playgroup, sanctuary, and foraging foundation for fisheries class. They provide an important function in nutrient cycling, as well as contributing to the removal of contaminants from the water. Benthic organisms within these habitats are important members of the inferior food web, intensenaturalmaterial and phytoplankton and helping as food source for higher-level consumers. Benthic habitats also serve up as protection, and givetempestdefense by buffering wave action along coastlines.In fact, reflectance of the objects recorded by satellite sensors is generally low and affected by atmospheric absorption and scattering, sensor-target-illumination geometry, and sensor calibration. In the neareffort, the dangerous preprocessing ladder has been enhanced to properly use the multispectral data.

Hence, atmospheric correction in the littoral zone was advanced through new capabilities added to the Second Simulation of a Satellite Signal in the Solar Spectrum (6S) atmospheric correction method. During this study, we

Corresponding Author: K. Varatharaj, ME Applied Electronics, Department of Electronics and Communication Engineering, V.S.B Engineering College, Karur Tamil Nadu, India.

compared the adapted 6S model with coincident ground-based reflectance measurements, in the selected area, analyzing detailed the correlation between the reflectivity values obtained by in situ measurements (spectroradiometer Vis/NIR), and the corresponding values acquired by atmospheric processing of the eight multispectral satellite channels.

Related Works: In [1] Abdolrassoul S. Mahiny and Brian J. Turner et al presents, Four atmospheric rectification methods, two comparative and two unqualified, were compare in this learning. Two of the methods (PIF and RCS) were relative approaches; COST is an absolute image-based technique and 6S, acomplete modeling system. The methods were applied to the hazy bands 1 through 4 of a Land sat TM scene of the year 1997, which was being used in a modifyuncoveringscheme. The belongings of corrections were intentional in forest patches. Three criteria, namely (a) image attributes; (b) image classification results, and (c) landscape metrics, were used for comparing the performance of the correction methods.

In [2] ARKO LUCIEER*† and LOURENS VEEN *et al* presents, Uncertainty and vagueness are important concepts when dealing with transition zones between vegetation communities or land-cover classes. In this study, classification uncertainty is quantified by applying a supervised fuzzy classification algorithm. New visualization techniques are proposed and presented in order to come to a better understanding of the relationship between uncertainty in the spatial extent of image classes and their thematic uncertainty. The thematic extent of a class is visualized as a three-dimensional (3D) class cluster shape in a feature space plot, and the spatial extent of the class is highlighted in an image display based on a user-defined uncertainty threshold. Changing this threshold updates both visualizations, showing the effect of uncertainty on the spatial extent of a class and its shape in feature space.

In [3] Katiegrace Youngsma et al presents,This research focuses on developing a mathematical model and then building a simulation to verify the model for a single leg for this platform. The robot platform is modular in the sense that leg modules can be removed and added to predetermine ports on the robot framework. The modularity of a legged machine is animportantprogression in mobile robotics technology as it enables a single robot to take on different body configurations depending on circumstances and environment to attain its goals. It as well poses a confront in conditions of generally design as it requires autonomous operation of the leg. The goal for this research is to in part fulfill the need for a mathematical model for an autonomous leg.

In [4] Todd Updike, Chris Comp et al presents, In general, conversion equations are to be applied on all pixels in a given band of a WorldView-2 image and should use 32-bit floating point calculations. At the alternative of the purchaser, the ensuingsuspended point standards of band included radiance or spectral radiance may be rescaled into a desired 16-bit or 8-bit range of brightness as may be required for handling by an image dispensationstructure. When liability this, it is optional that the purchaser keep track of subsequent conversions so that there is a known relationship between any new image DNs and the band integrated radiance or spectral radiance of the pixel for the given band.Topography, BRDF, and distinctivebelongings can be unnoticed for simple radiometric balancing. Consequently the major difference between two scenes of the same area is the solar geometry.

In [5] Steven M. Adler-Golden, Prabhat K. Acharya, Alexander Berk et al presents, An efficient, physics-based remote bathymetry method for the littoral zone is described and illustrated with applications to Quick Bird, Littoral Airborne Sensor: Hyper spectral (LASH), and Airborne Visible/Infrared Spectrometer (AVIRIS) spectral imagery. The method combines atmospheric correction, water reflectance spectral simulations, and a linear unmixing bathymetry algorithm that accounts for water surface reflections, thin clouds, and variable bottom brightness, and can incorporate blends of bottom materials. Results include depth maps, bottom color visualizations, and in favorable cases, approximate descriptions of the water composition.

WV2 Data Processing Strategy: A multichannel physics-based algorithm to obtain high-resolution remote sensing bathymetry of shallow coastal waters. Hence, the innovation of the phantom capabilities of WV2 multispectral imagery is fully exploited for bathymetry retrieval. Incorporation of accurate bathymetric information is fundamental in benthic habitat modeling. Integrated spatial and spectral processing techniques were identified as an alternative method for mapping benthos types, extent, and density from WV2 satellite images of the Canary Islands coastal area. A combination of water column correction, seafloor-type normalized indexes, and supervised classification techniques provided the benthic habitat map with high spatial detail and accuracy.

In our context, the supervised classification method selected was the support vector machine. The SVM was applied to WV2 corrected channels and benthic indexes previously estimated. The training classes were clearly defined, and a separability assessment was conducted using the Jeffries–Matusita distance. Finally, performance evaluation was accomplished using the confusion matrix and the kappa coefficient.

Pre-Processing of Imagery for Benthic Mapping: A critical step of remote sensing imagery analysis for benthic habitats classification is the pre-processing of the descriptions. This involves radiometric happinessexchange of the image from digital numbers to spectral radiance, atmospheric correction, sun glint removal, and correction for the water column. The pre-processed images can then be used for the classification and for bathymetry derivation.

There are a variety of methods for atmospheric correction above the sea surface. These, however, usually require some input parameters concerning atmospheric and sea water conditions that are difficult to be obtained. Therefore, many researchers used the simplified method of dark pixel subtraction for this kind of application. Some studies have concluded that correcting the atmosphere through the empirical dark object subtraction procedure led to improved bathymetry retrievals. In the method of dark pixel subtraction the value of an object with zero reflectance, e.g. deep water, is subtracted from all pixels to remove the effect of atmospheric scattering.

Benthic Habitat Mapping: Benthic habitat maps are an important and essential means of providing marine resource assessments for coastal management and ecological analysis. There is an overlap between management and ecological analysis, the main difference is spatial scale and amount of detail, but of course they are closely related. Seafloor mapping is critical to improve our understanding of ecosystems dynamics and relationships between biota and habitats. Without details of the near seafloor, local, state and federal resource managers are poorly equipped to make decisions about the effects of different activities on marine habitats

Shallow Water Process: The canonical (Pekeris) shallow-water acoustic waveguide2 has a steady noise velocity, reflect likeness at the outside, and a grazing-angle-dependent reflectivity at the ocean bottom. The classic plane-wave Rayleigh-reflection coefficient, used to describe electromagnetic waves at a dielectric interface, can similarly describe reflection from the bottom interface. That interface has a critical angle qc —typically about 15°, depending on the material there. As shown in the upper panel of the figure, a source in such a waveguide produces a sound field that propagates at angles confined to a cone of 2qc . Within that cone, constructive interference selects discrete propagation angles; outside the cone, waves disappear into the bottom after a few reflections. Separation of variables—range and depth, assuming azimuthal symmetry about z—produces solutions to the Helmholtz equation, which describes waveguide propagation.

Block Diagram

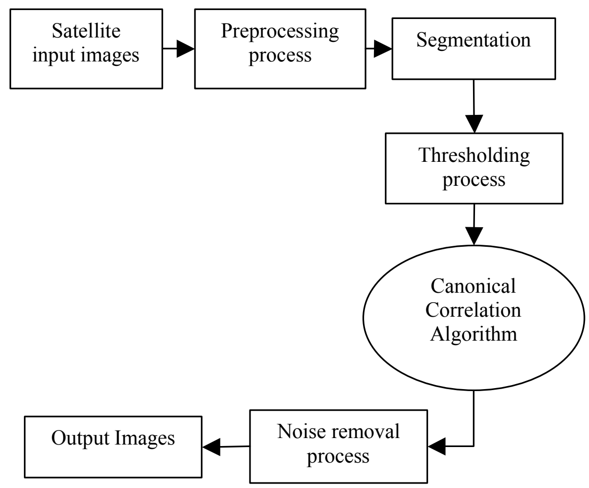


Figure Block diagram

Canonical Correlation Algorithm: Canonical Correlation Analysis (CCA) is a well-known technique in multivariate statistical analysis, which has been widely used in economics, meteorology, and in many modern information processing fields, such as communication theory, statistical signal processing, and Blind Source Separation (BSS). CCA was developed by H. Hotelling as a way of measuring the linear relationship between two multidimensional sets of variables and was later extended to several data sets. Typically, CCA is formulated as a generalized Eigen value (GEV) problem; however, a direct application of Eigen decomposition techniques is often unsuitable for high dimensional data sets as well as for adaptive environments due to their high computational cost.

Classification of Imagery for Benthic Mapping: Image classification assigns the pixels to different thematic classes based on their spectral properties. Supervised classification approach was adopted to produce different habitat classes. This scheme relies on the analyst to define distinct areas with a unique spectral signature or training sites. The accuracy of the classification depends to many an extent on the generation of pure, distinct and accurate signatures for each class. The training sites have been selected from the field data, using this as a seed pixel where polygons are automatically drawn around contiguous area having similar spectral properties. Once the training sites are generated, the similarity of the signatures for each class has been measured using statistical methods. Contingency matrix was generated to test the reliability of the signature representing a particular class. The signatures are finalized when a satisfactory percentage of correctly classified pixels are achieved.

Segmentation Process: Image segmentation divides images into partitions, which is naturally used to know substance or other applicable information in digital images. For processing of remote sensing picture, especially for high-resolution figure, image segmentation is a major tread in categorization or other examination. For illustration, object-oriented cataloging is a vital procedure for a lot of applications counting change discovery and ground cover exploration. High-resolution isolated sensing images express more information of ground objects, and show great diversity of texture features.

Flow Chart

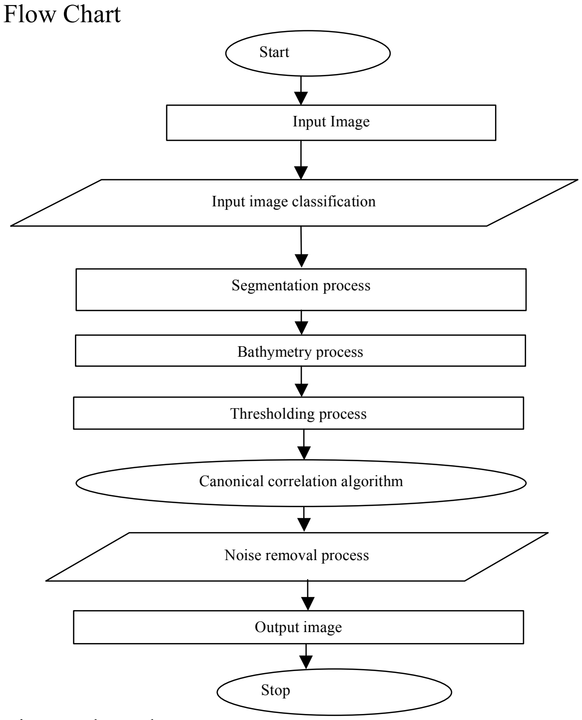


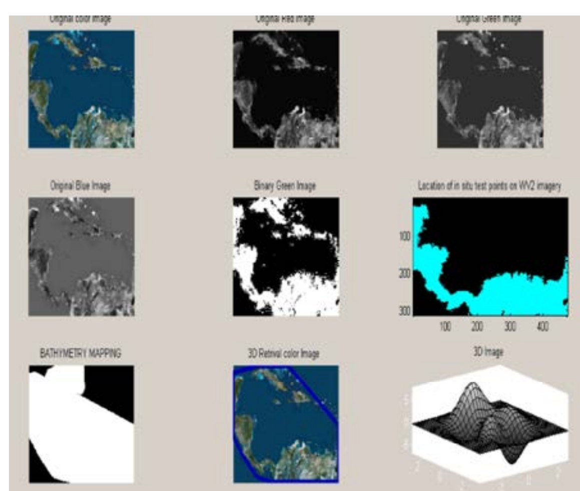
Figure Flow chart

Thresholding: Thresholding is the method of eliminating the noise pixels based on a fixed threshold value. Pixels having the value above the fixed value will be considered as foreground pixels and the remaining as background pixels. The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and k-means clustering

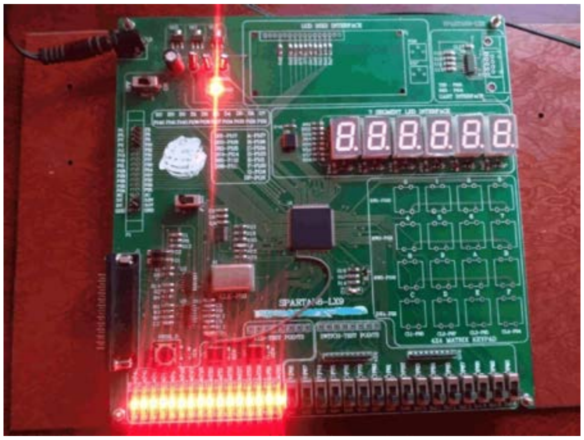
3D Reconstruction Application: As example of a possible application, we have processed an image set of an underwater finding with our method in order to obtain the 3D reconstruction by using structure-from-motion software. The dataset has been taken in the archaeological site of Kaulon in Monasterace (Calabria - Italy), capturing a remainder of an ancient pillar. The dataset is composed by 45 images with resolution of 980 x 1479 pixels.

We have pre-processed all the images with our method and then input in a structure-from motion algorithm. The result of color correction and the 3D model obtained by the corrected dataset is shown in Figure 9. As an alternative we can process directly the texture applied on the 3D model and obtained by UV mapping.

SIMULATION RESULTS



KIT SNAPSHOT



CONCLUSION

The remote sensing of marine habitats is always very complex because of the optically similar behavior of the habitats, the influence of the atmosphere and the water column and association of two or more habitats in the nature. However, remote sensing based methods can be quite effective in identifying the habitats through multispectral classification in conjunction with field survey data. For the high spatial resolution WV2 data preprocessing strategy, this study affirms that atmospheric correction and deglinting methods should be applied to WV2 imagery prior to the development of bathymetric and benthic maps, in order to increase the accuracy of the final products. Preprocessing methods alter the estimated radiance and reflectance values to account for known sources of error in the data, resulting in values that more closely estimate the true radiance and reflectance. The most common method for evaluating atmospheric correction is to compare the retrieved reflectance from satellite images with ground-based measurements for a variety of targets.

For bathymetry retrieval, an efficient multichannel physics based model has been implemented. The sophisticated model developed and evaluated in this study expands the ratio algorithm model, allowing for the increased amount of information provided in WV2 imagery to be included in the retrieval of water depth. The enhanced capacity provided by the WV2 imagery, coupled with the new model presented herein, has a greater precision in water-depth retrievals. While the developed model reproduced depths up to approximately 25 m, a threshold (mask) around 25–30 m indicated failure of the prediction. These results suggest excellent retrieval of bathymetry from high-resolution multispectral remote sensing imagery. The remote sensing method offers a unique large scale synoptic data to contribute to the needs of management of coastal areas.

REFERENCES

1. Wang, Y., 2010. Remote Sensing of Coastal Environments, Taylor and Francis Series in Remote Sensing Applications. Boca Raton, FL, USA: CRC Press,
2. Richards, J.A., 2013. Remote Sensing Digital Image Analysis. Berlin, Germany: Springer-Verlag,
3. Miller, R.L., C. Del Castillo and B. McKee, 2005. Remote Sensing of Coastal Aquatic Environments. New York, NY, USA: Springer-Verlag,
4. Green, E.P., P.J. Mumby, A.J. Edwards and C.D. Clark, 2000. Remote Sensing Handbook for Tropical Coastal Management. Paris, France: UNESCO,
5. Abdolrassoul, S., B. Mahiny and J. Turner, 2007. A comparison of four common atmospheric correction methods," Photogramm. Eng. Remote Sens., 73(4): 361-368.