WinASEAN 4.0 - AN IMAGE ANALYSIS PACKAGE FOR ENVIRONMENT MONITORING AND NATURAL RESOURCE MANAGEMENT

Nguyen Dinh Duong

Department of Environmental Information Study and Analysis
Institute of Geography, Hanoi, Vietnam
Fax: 84-4-8361192, Phone: 84-4-7562417, Email: duong.nd@hn.vnn.vn

ABSTRACT

WinASEAN 4.0 – Windows based Advanced System for Environment ANalysis with remote sensing data version 4.0 is follow up product of WinASEAN 3.0 which was developed by the Department of Environmental Information Study and Analysis(EISA) and has been used for hands-on-training in the framework of the annual Regional seminar on Earth observation for tropical ecosystem management organized jointly by NASDA and UN ESCAP since 1993 to 2000. The WinASEAN runs on most of the latest MS Windows like Windows 2000 and Windows XP. The WinASEAN 4.0 features new functions such as:

+ *Modeler: advanced inter channel and inter image analysis function based on FORTRAN programming language*
+ *Hyperspectral image visualization: new false color composite technique for image with spectral channels more than 3*
+ *Image mosaicking: easy-to-use function for mosaicking geo-referenced images*
+ *Virtual reality display: combination of image and DEM data to create virtual reality image*

The WinASEAN 4.0 can handle 2 byte data processed by computers with different CPU systems. The WinASEAN can be used for both practical usage and educational purpose.

1. INTRODUCTION

The WinASEAN software (*Windows based Advanced System for Environment ANalysis with remote sensing data)* is well known through series of the Regional Seminar on Earth Observation for Tropical Ecosystem Management organized by the National Space Development Agency of Japan (NASDA) and UN ESCAP from 1992 to 2000. This package has been awarded a Silver Prize by ISPRS during the 18th Congress held in Vienna, Austria, 1996. The WinASEAN 3.0 includes basic image analysis functions suitable for training and educational purpose. Since then the WinASEAN has been updated by adding new functions and improvement of algorithm so that the system can handle 16 bits data generated by various processor system. The WinASEAN 4.0 is now in development ending stage and will be available for remote sensing research community by the end of this year. This paper is focused on giving information of new functions of the WinASEAN 4.0 and algorithm of some advanced modules.

2. STRUCTURE OF WinASEAN 4.0

The structure of WinASEAN 4.0 follows the one of the previous version. The system is divided in to main groups: *Preprocessing, Image display, Classification, Post classification, Geometric correction, Change analysis, Bird's eyes view, Image overlay* and *Utilities.* Layout of structure of the WinASEAN 4.0 is given on Table 1. The names in italics and blue color are new functions.

Table 1. Layout of structure of the WinASEAN 4.0

Preprocessing	Image Display	Classification
Data Conversion CD-ROM Utilities Window Cutting Out Histogram Calculation Image Enhancement Image Encoding Vegetation Index Calculation Arithmetic Calculation ***Modeler*** Principal Component Analysis Optical Image Filtering SAR Image Filtering Hyperspectral Image Compression	False Color Image Display Pseudo Color Image Display Classified Image Display Image Display and Print	Training Area Selection Training Area Redisplay Training Data Statistics Calculation Training Address Modification Maximum Likelihood Classification
Post Classification	**Geometric Correction**	**Change Analysis**
Classified Image Filtering Area Measurement Class Code Change and Merge	Ground Control Point Selection Image Control Point Selection Coefficient Computation and resampling ***Image Mosaicking***	Plural Image Display Generation of Change Matrix Visualization of the Change Matrix Masking by two Classified Images
Bird's Eye View	**Image Overlay**	**Utilities**
DEM Data Conversion Bird's Eye View Generation Bird's Eye View image Display ***BEV Image Sequence Generation*** ***Virtual Reality Display***	Image Overlay	***File Information*** ***Conversion of MIF to CLS*** ***Geometric Correction of Vector GIS*** ***Ground Truth Photo Database***

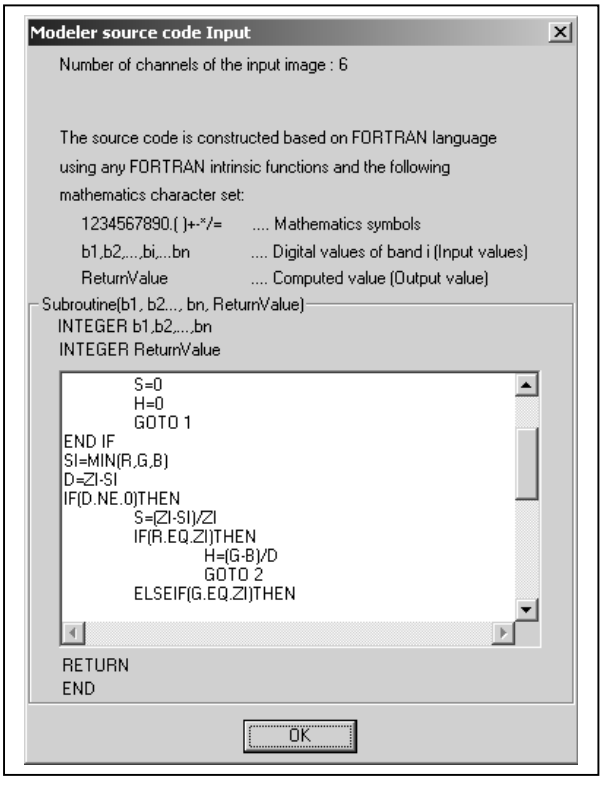


Figure 1. Modeler source input window

3. NEW MODULES AND FUNCTIONS

Due to limitation of paper volumes, only new functions will be introduced.

The most advanced module is *Modeler*. This module allows complex manipulation among channels of one or more images. It accepts both original image and classified data. Number of images allowed in inter image operation is up to 10. This module requires operator with skill on FORTRAN programming. A processing model is input in form of FORTRAN program which can be loaded from library or typed in a text window. The FORTRAN source code can be written using all program statements and functions except graphic utilities. This module provides the most advanced capability for data integration, logic selection decision or

simple classification. Example of input window of the Modeler module is shown on Figure 1. On figure 2 is demonstration of Modeler for cultivated land extraction from SPOT image. The left image is the false color composite and the right one is classified image of cultivated land.

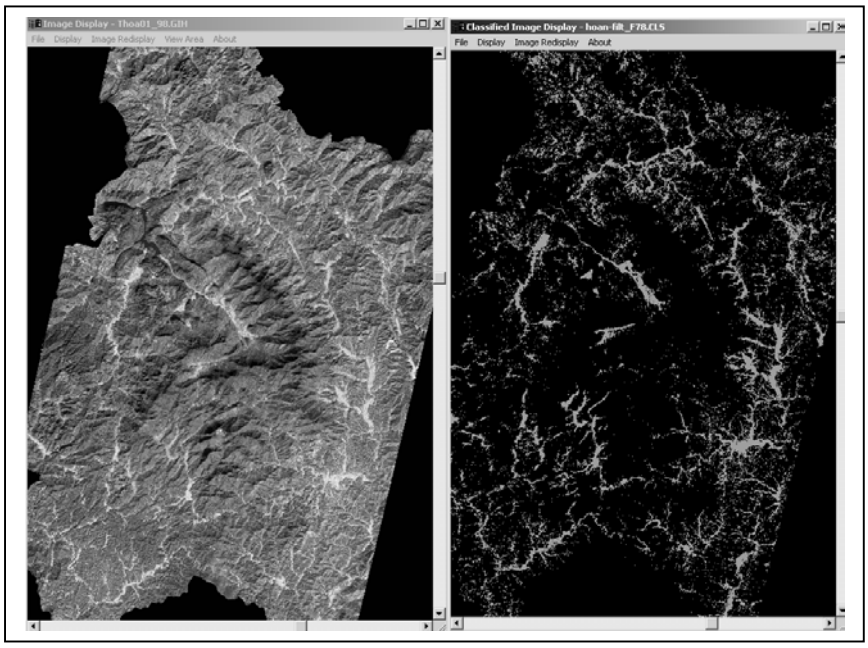


Figure 2. Extraction of cultivated land using modeler function (left)

Hyperspectral image compression is a module which allows color composite of more than 3 spectral channels. This is actually an mapping from n to 3 dimension space. The algorithm has been developed by the EISA and had been successfully applied for TM, SPOT 4 and ASTER data. On figure 3 is shown standard false color composite of ASTER data (left image) and new color composite after compression of 6 ASTER channels into 3. On this composite, by inclusion of short wave infrared channels, many more details on vegetation as well as water bodies are visualized better than on the conventional RGB composite using green, red and infrared channels. The new color composite is called as quasi true because vegetation is displayed in green and water in blue color.

Figure 3. Comparison of standard (left) and new color composite (right)

Image mosaicking is the next new function of WinASEAN. This function allows to mosaic georeferenced images that are in the same coordinate system and observed by the sensors which have the same spatial and spectral resolution . This is easy to use function allowing fast and accurate mosaicking. On figure 4 is mosaic of Vietnam by MOS-1 and TM images.

The Low cost virtual display is composed of two functions: *BEV image sequence generation* and *Virtual reality display*. The BEV (Bird's eye view) image sequence

generation produces a set of 3D view using satellite image and DEM of interest area. The Virtual reality display shows the set of 3D images in all rotation angles defined in the BEV image sequence generation.

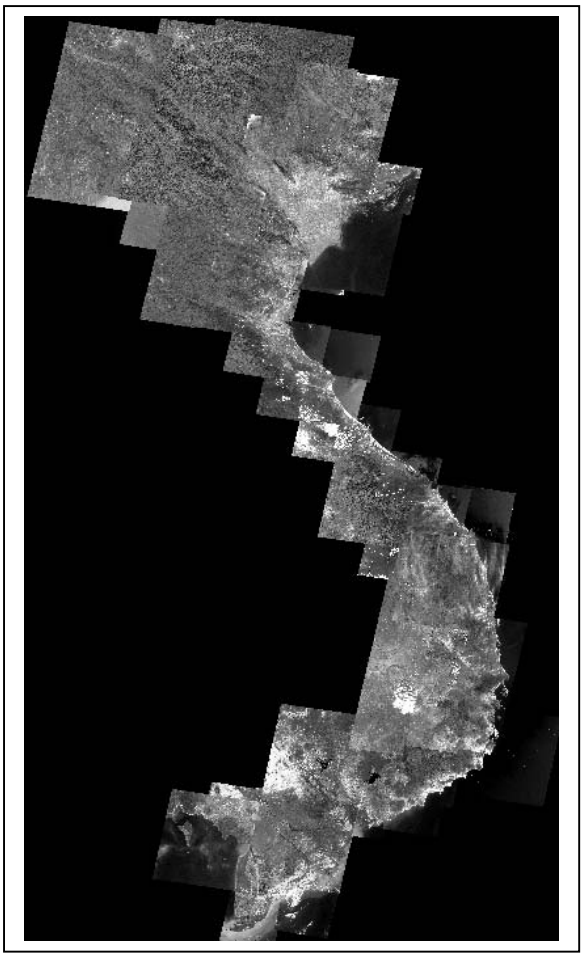
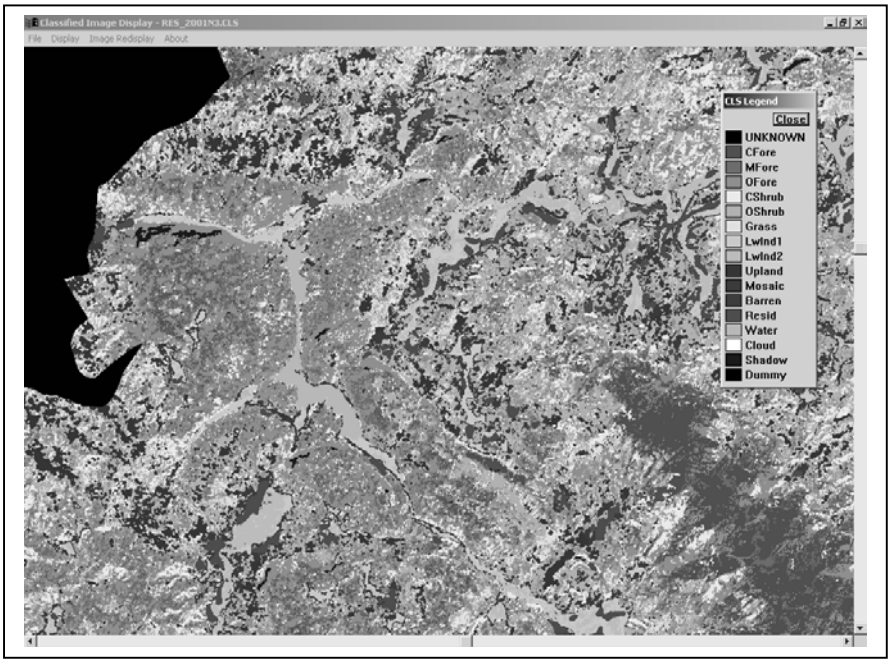


Figure 4. Color composite of Vietnam by MOS-1 images (left)

For better integration of GIS and remote sensing data, the WinASEAN 4.0 is equipped with two new modules: *Geocor* and *Mif2Cls*. The first one allows geometric correction of MapInfo MIF and AutoCAD DXF files. The second one is used for conversion of MIF file into WinASEAN classified image. This is in fact vector to raster conversion program. All polygon or region objects are converted into raster data with predefined georeference information (coordinates of window corners) and spatial resolution. Due to integer computation some rounding error can occur in size of classified image (number of columns and rows) which results inconsistency in a dataset, the Mif2Cls allows to tuning input data to achieve given image size. This is very useful function for combination of GIS data to improve accuracy in image classification. On figure 5 is shown result of result of combined classification using Maximum likelihood classification, Modeler function and Mif2Cls function. Residential area in MapInfo is buffered by 250 m and converted into CLS file. Then by Modeler function, upland crop and grassland in buffer zone are assigned to lowland mosaic. As a result a land use map with residential area, lowland mosaic, upland and grassland is created. This land use map cannot be achieved without combination of GIS data.



On figure 5, red color is residential area, blue color is lowland mosaic which was taken from buffer zone of residential area.

Figure 5. Land use map with residential area and its buffer taken from MIF file.

The next new module of WinASEAN 4.0 is *GPS photo database*. This is very unique module available only in WinASEAN 4.0. The module is

composed of two components: GPS photo database and image display function. GPS photo is taken by Konika LandMaster camera which has built-in GPS chip allowing registering geographical coordinates on the photo. Each photo therefore contains information on time, location and bearing angle. Using geographical coordinates the photo can be registered over image geocorrected either in geographical coordinates or map projection. When a database and image are opened, place where is available GPS photo is marked by one dot and by click on the dot the program will show list of GPS photos which can be displayed in separate image window. By that way, a link between false color composite or classified image and GPS photo is established. This module is useful not only for training sample selection, validation of classification result but remote sensing training as well. On figure 6 is shown example of using GPS photo database for training sample. Green dots show location with GPS photo. In the info window are displayed name of GPS photo file, date of observation, geographical coordinates and bearing angle. The bearing angle is marked by red line in orientation circle for easier interpretation. The GPS photo is shown in picture window that can be enlarged in case of detailed study. The analogue color film is scanned by film scanner with resolution of 1400 dpi which guarantees high quality of the ground photo.

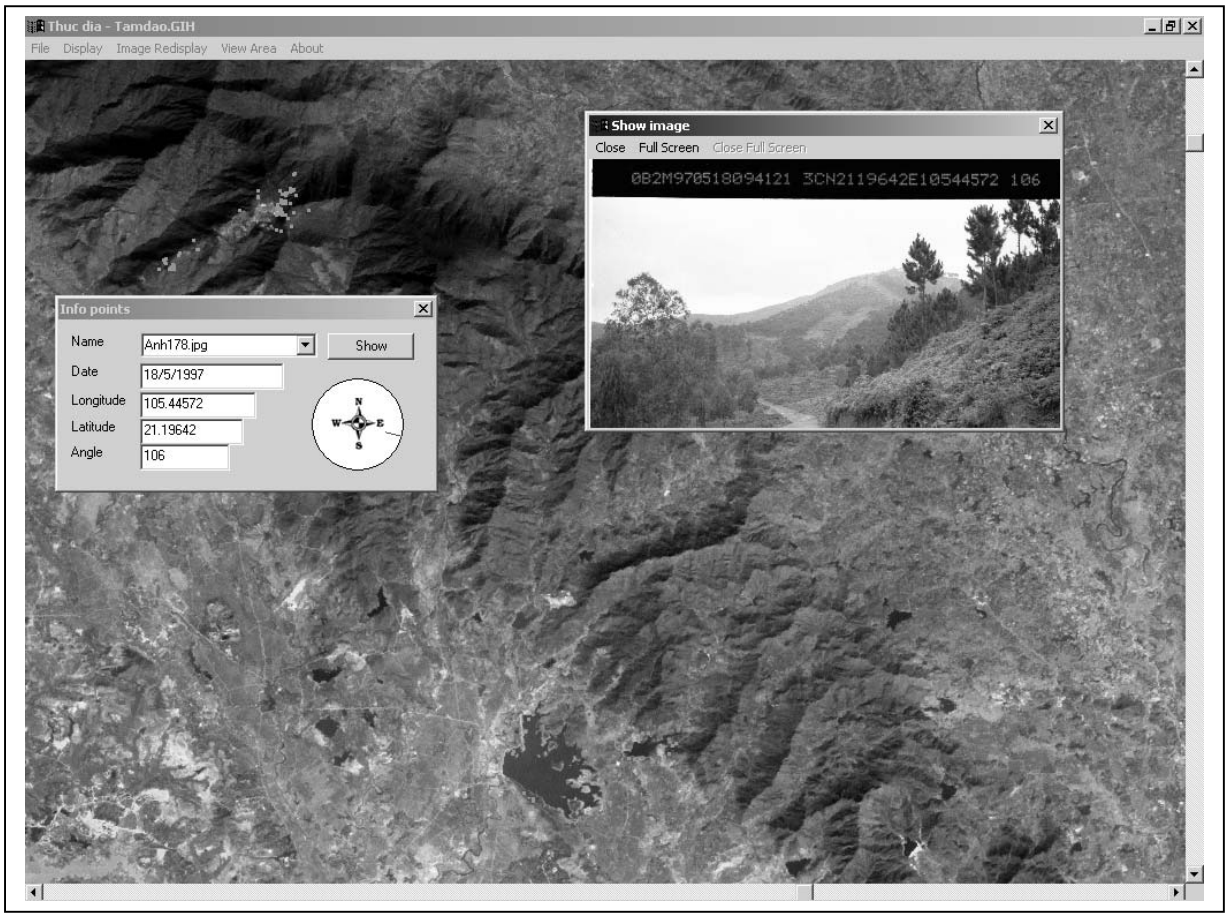


Figure 6. Example of using GPS photo database for training sample selection

The WinASEAN 4.0 has capability to process 2 byte data. This improvement has been involved in all modules including *Image display*, *Histogram calculation*, *Enhancement* and *Maximum likelihood classification* etc. This improvement is useful for processing remote sensing data such as NOAA AVHRR, MODIS, thermal channels of ASTER sensor or the future ADEOS-II GLI. The 2 byte data accepted by WinASEAN can be in little or big endian standard for both byte and bit structure. This capability rises from the fact that today remote

sensing data before going to hand of user could be processed by computers equipped with various processor system as Intel, IBM, Motorola or Compaq Alpha and VAX. On figure 7 is shown some processing results of MODIS data.

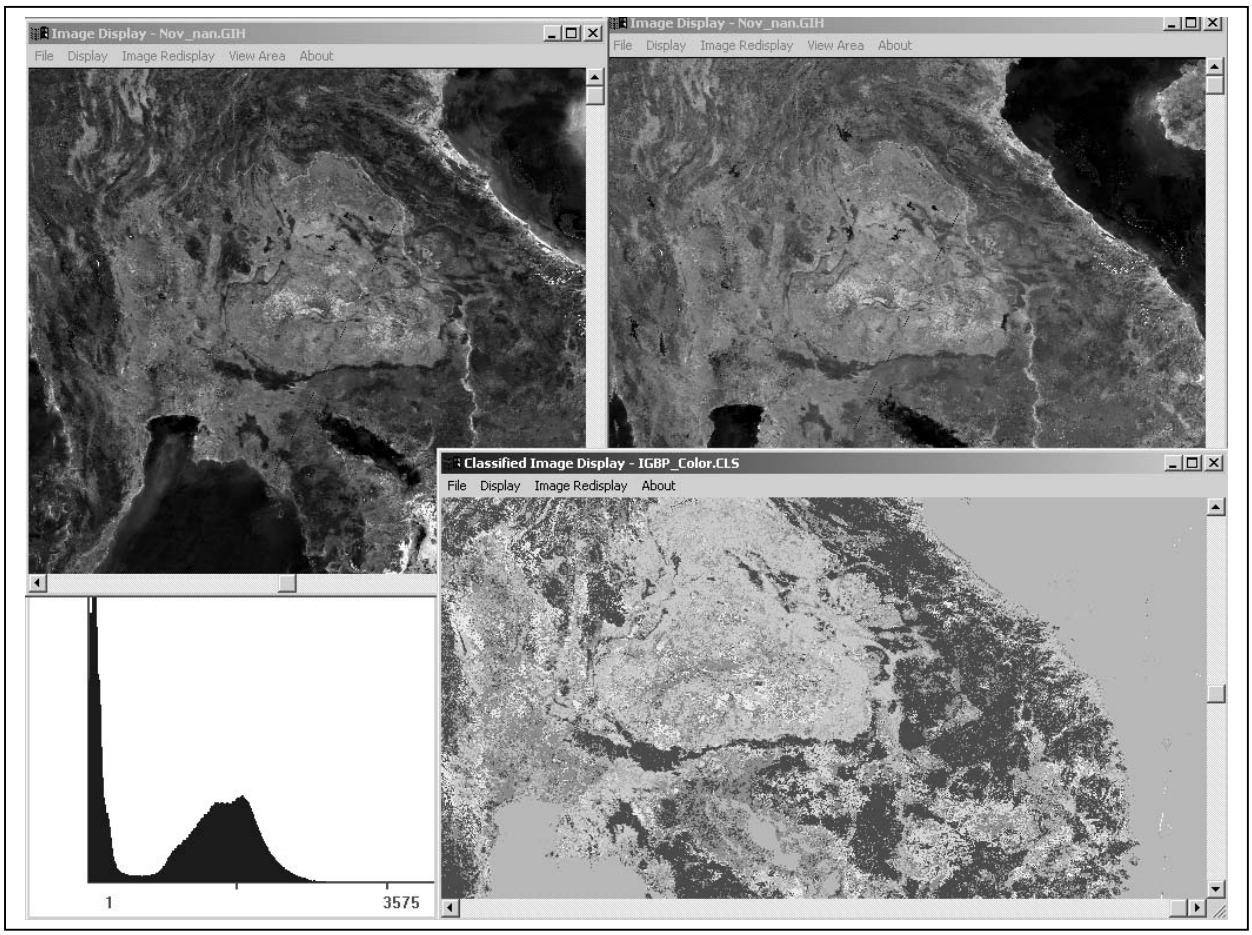


Figure 7. Processing of MODIS data: true color composite display(left top), Standard false color composite (right top), histogram computation (bottom left) and classification (bottom right)

4. CONCLUSION

The WinASEAN 4.0 is the next milestone in the WinASEAN software development. Apart from the basic modules and functions the version 4.0 is now equipped with advanced ones which provide capabilities in processing various remote sensing data types, easy integration with GIS data and add-in programming tools. This software is excellent tool for remote sensing education and training as well as practical use. In the EISA, almost all research has been conducted with support of WinASEAN 4.0. It involves research under NASDA research announcement for ADEOS, ADEOS-II and ALOS satellites.

REFERENCES

Nguyen Dinh Duong, Takeuchi, S. 1997. *WinASEAN for Remote Sensing Data Analysis*. Photogrammetry & Remote Sensing 52 (1997), Elsevier