

Easylandscape - a GIS package

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I. Abstract

GEO-INFORMATION SYSTEM or GIS - A computer system capable of holding and using data describing places on the earth's surface in a better analytical manner.

ILWIS stands for INTEGRATED LAND AND WATER INFORMATION SYSTEM . It is a Geographic Information System (GIS) with Image Processing capabilities ILWIS has been developed by the International Institute for Aerospace Survey and Earth Sciences (ITC) , ILWIS stands for INTEGRATED LAND AND WATER INFORMATION SYSTEM . It is a Geographic Information System(GIS) with ImageProcessing capabilities

This paper discusses the application of ILWIS by giving it a fully automated user-friendly interface **EasyLANDSCAPE** and implement it for GIS purposes by calculating select Landscape Parameters .

II. Outline

EasyLANDSCAPE – name given to this Project is a new way to look at GIS Operations .

Earlier we had powerful tools like ILWIS , ArcView etc. which had tremendous capabilities of GIS , but a few constraints existed Determination of certain typical Parameters required many commands / operations to be done on the Map which sometimes became cumbersome to users who just had to look up their values to be used elsewhere . Also it required extensive knowledge of all ILWIS commands and functions to obtain results.

EasyLANDSCAPE is a step in automating the long process User just has to select the Map / Table etc . and click on the parameter to be determined and enter any information needed if any With the help of Client – Server model the Interface automatically performs the required operations on ILWIS and the result is displayed. In this Project around thirty parameters referred from the FragStats manual and certain

Morphological Watershed Parameters have been successfully implemented

III. i l w i s –concepts and applications

ILWIS stands for INTEGRATED LAND AND WATER INFORMATION SYSTEM . It is a Geographic Information System (GIS) with Image Processing capabilities

ILWIS has been developed by the International Institute for Aerospace Survey and Earth Sciences (ITC) , Enschede , The Netherlands

As a GIS package , ILWIS allows you to input , manage , analyze and present geographical data . From the data you can generate information on the spatial and temporal patterns and processes on the earth surface . Geographical Information Systems are nowadays indispensable in many different fields of application to assist in the decision making process . Most decisions are influenced by some facts of geography. What is at a certain location? Where are the most suitable sites? Where, when and which changes took place?

Some examples

- In land use planning, GIS is used to evaluate the consequences of different scenarios in the development of a region
- In Geology, GIS is used to find the most suitable places for mining , or to determine area subject to natural hazards

Area that may be affected by pollution are analyzed using GIS functions . Extensions of cities are planned , bases on analysis of many spatial and temporal patterns etc

IV . What is a GIS?

A Geographic Information System, or GIS, is an organized collection of

computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information. Or, in simple terms:

A computer system capable of holding and using data describing places on the earth's surface in a better analytical manner.

Questions a GIS can answer

1. Location: What is at a given location?
2. Condition: Where does something occur?
3. Trends: What has changed since ...?
4. Patterns: What spatial patterns exist?
5. Modeling: What if ...?

V . Interlinking Ilwis And Visual Basic

A. ILWIS as DDE Server

ILWIS can act as a DDE (Dynamic Data Exchange) Server . This implies that ILWIS can receive input from other DDE supporting packages like Visual Basic or Delphi based systems. In this package we have created a user-friendly GUI (Graphical User Interface) which run the command required to obtain a certain result by performing certain operations on ILWIS. The user need not type in all the commands or perform other operations on ILWIS, all this is done automatically by the interface. The user is required to enter the file to be operated upon and the desired parameter to be obtained.

Example:

```
Private Sub Command2_Click()
Command1.Caption = " OPENING ...."Dim ret
ret = Shell("C:\ilwis22\ilwis.exe", 6)
```

```
If ret > 0 Then AppActivate ret
If IlwCmd.LinkMode = NONE Then
IlwCmd.LinkTopic = "ilwis\system"
IlwCmd.LinkItem = "execute"
IlwCmd.LinkMode = 2
IlwCmd.LinkTimeout = 100
```

```
IlwCmd.LinkExecute "[ " +
Dialog.Drive1.Drive + "]" +
IlwCmd.LinkExecute "[cd" +
Dialog.Drive1.Drive + "]" +
IlwCmd.LinkExecute "[cd" +
Dialog.File1.Path + "]" +
IlwCmd.LinkExecute "[run
c:\ilwis22\data\usrguide\chap07\clsore.isl " +
CommonDialog1.FileName + "]" +
End Sub
```

B. Visual Basic as DDE Client

1. Link Topic Property

For a destination control – returns or sets the source application and the topic (the fundamental data grouping used in the application) . Use Link Topic with the Link Item property to specify the complete data link.

For a source form – returns or sets the topic that the source form responds to in a DDE conversation.

Syntax: object. LinkTopic [value]

To activate the data link set within Link Topic, set the Link Mode property to the appropriate non zero value to specify the type of link you want. As a rule, set the Link Mode after you set Link Topic. For a destination control, changing the Link Topic breaks as existing link and terminates the DDE conversation. For a source form changing the Link Topic breaks all destination links that are using that topic. For these reasons, always set the Link Topic for a destination control, you must set LinkMode to 1 (Automatic) , 2 (Manual) , or 3 (Notify) to establish a connection .

2. Link Item Property

Returns or sets the data passed to a destination control in a DDE conversation with another application.

Use LinkItem in a combination with the Link Topic property to specify the complete

data link for a destination control to a source application . TO activate this link, set the LinkMode property. You set the LinkItem property only for a control used as a destination. Setting a permanent link at design time with the Paste Link command from the Edit menu also sets the LinkMode, LinkTopic, and LinkItem properties. This creates a link that is

saved with the form. Each time the form is loaded, Visual Basic attempts to re-establish the conversation.

3. Link Timeout Property

Returns or sets the amount of time a control waits for a response to a DDE message.

Syntax: object.LinkTimeout [=number].

By default, the LinkTimeout property is set to 50 (equivalent to 5 seconds). You can specify other settings in tenths of a second.

4. Link Execute Property.

Sends a command string to the source application in a DDE conversation, doesn't support named arguments.

Syntax: object.LinkExecute string

V. LANDSCAPE PARAMETERS

1 Area Parameters

- a) AREA – Calculates the Area of a Patch in Square metres
- b) AREAHA – Calculates the Area of the Patch in Hectares This is the Area of the Patch in Hectares
 $AREAHA = AREA (sq m.) / 10,000$
- c) LSIM - Landscape Similarity Index , describes the similarity in the Landscape
 $LSIM = AREA / Total AREA \text{ multiplied by } 100$
- d) CLASS AREA - Calculates Area of a Class
- e) PLAND- Percent of Landscape
 PLAND is the sum of area (sq m) of all patches of the corresponding patch type , divided by the total Landscape Area
- f) TA- Total Area of the Landscape
- g) LPI – Largest Patch Index
 $LPI = \text{Largest Patch Area of the corresponding Patch divided by the total Landscape Area expressed as a percentage}$

2 Patch Density , Size and Variability Parameters

- a) NP – Number of Patches
 Number OF Patches of a corresponding Patch type .
- b) PD – Patch Density
 It is the number of Patches of the corresponding patch type divided by the total landscape area multiplied by 10,000 and 100 .

- c) MPS – Mean Patch Size
 It is the sum of the area of all patches of the corresponding patch type , divided by the total number of patches of the same type, divided by 10,000
- d) PSSD – Patch Size Standard Coefficient Of Deviation It is the root mean squared deviation from the mean patch size
- e) PSCV – Patch Size Coefficient of Variation
 $PSCV = PSSD / MPS \text{ expressed in Percent}$

3 .Shape Parameters

- a) SHAPEI - Shape Index
 it is the Patch Perimeter divided by the square root of the patch Area (sq m)
- b)FRACT- Fractional Dimension
 This is two time s the logarithm of the patch perimeter divided by the logarithm pf patch area (sq m)
- c) LSI – Landscape Shape Index
 This is the sum of the landscape Boundary divided by the square root of the total landscape area (sq m)
- d) MSI – Mean Shape Index
 It is the sum o the patch perimeter divided by the square root of the patch area for each patch
 $MSI = Average (SHAPEI)$
- e)DLFD – Double Log Fractal Dimension
 It is
 $DLFD = 2 / ((Log (Patch Area) / Log (Perimeter))$
- f) MPFD – Mean Patch Fractal Dimension
 $MPFD = 2 * SUM (LOG (Patch Perimeter) / LOG(Patch Area) / Number Of Patches$

4. Core Area Parameters

- a) CORE – Core Area in square meters
 Area within the patch that is further than the specified edge distance from the patch perimeter , divided by 10,000
- b)NCORE – Number of Core Area
- c) CAI- Core Area Index
 It is Patch Core Area / Total Patch Area
- d) CLAND – Core Area Percent of Class Landscape It is the sum of the core areas of each patch type , divided by the total Landscape area expressed in Percentage
- e) TCA- Total Core Area
 Sum of the core Areas of each patch
- f) NCA- Number Of Core Areas

- g) CAD – Core Area Density (#100 ha)
It is the number of disjunct core area within each patch type , divided by the total landscape area , multiplied by 10,000 and 100
- h) MCA1 – Mean Core Area per Patch
It is the sum of the core area divided by the number of patches , divided by 10,000
- i) CASD1 – Patch Core Area Standard Deviation
It is the root mean squared deviation of each patch core area from the mean core area per patch
- j) CACV1- Patch Core Area Coefficient of Variation
It is the standard deviation in core area of patches divided by the mean core area per patch of the corresponding patch type expressed in percentage
- k) MCA2- It is the sum of the disjunct core areas of each patch type divided by the number of disjunct core areas of disjunct core areas each
- l) patch type divided by the number of disjunct core areas
- m) CASD2- Disjunct Core Area Standard Deviation
It is the root mean squared deviation of each disjunct patch core area from the mean disjunct core area per patch
- n) CACV2- Disjunct Core Area Coefficient of Variation
It is the standard deviation in disjunct core area of patches divided by the mean disjunct core area per patch of the corresponding patch type expressed in percentage
- o) TCAI- Total Core Area Index (%)
It is the sum of the core area divided by the sum of area of each patch type expressed in percentage
- p) MCAI – Mean Core Area Index (%)
It is the Core Area divided by Area of that patch divided by the number of patches multiplied by 100

5. Diversity Parameters

- a) SHDI- Shannon's Diversity Index
SHDI = - SUM (proportional abundance of each patch type of that proportion)
- b) SIDI – Simpson's Diversity Index
SIDI = 1 – SUM (square of proportional abundance of each patch type)
- c) MSIDI – Modified Simpson's Diversity Index
MSIDI = - LOG (Sum of proportional patch abundance

6. Morphometric Watershed parameters

Morphometry deals with the measurement and mathematical analysis of the configuration of the earth's surface and of the shape and dimensions of it's landforms

The study employs status of small watersheds and their analysis

- a) MEAN STREAM LENGTH – The relationship between cumulative mean stream length and stream order reveals more or less straight line regression of positive exponential form
- b) BIFURCATION RATIO - This is the ratio between the total number of stream of one order to that of next higher order in a drainage basis
- c) WEIGHTED MEAN BIFURCATION RATIO – It is used to provide a more representative and clear picture of the bifurcation ratio for the whole basin
- d) STREAM LENGTH RATIO – It is the ratio between the mean length of the streams of any two consecutive orders which tends to be constant through out the successive order of a watershed
- e) ELONGATION RATIO - It is the ratio of the diameter of the circle having the same area as that of the basin.
- f) FORM FACTOR - It is the ratio of the Area of the basin to the length of the basin

VI . Ilwis Scripts

In order to execute commands with variables we employ the use of Scripts Tool in ILWIS where predetermined Procedures are written and stored and can be used to determine parameters whose calculation involves combination of in-built and user-defined functions

Some of them are mentioned below

Class Core Area

rem ILWIS Script

```
TabCalc %1 MCA1 = Sum( Corearea) /
(NCore *10000)
TabCalc %1 dev= SQ(Area - MCA1)
TabCalc %1 CASD1= SUM(dev)/10000
TabCalc %1 dev2=SQ(CASD1-MCA1)
TabCalc %1 CACV1 = SUM(dev2)*100
Open %1
```

Landscape Shape Index

```
rem ILWIS Script
TabCalc %1 LSI = Sum(perimeter) /
SQRT(Sum(Area))
TabCalc %1 temp=1
TabCalc %1 Number=SUM(temp)
TabCalc %1 MSI = Sum(Shapel)/Number
Open %1
Where %x is the variable object to be
operated
```

VII. Conclusion

This application is aimed at user who does not want to get into the detailed and cumbersome procedure to perform selected features on ILWIS
 A user friendly GUI interface has been provided to provide quick and easy access to a few GIS and RS results without actually performing required operations on ILWIS
 The aim of this software is to enhance and simplify the use of ILWIS through a User Interactive Interface

VIII. References

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 - b) www.itc.nl/ilwis Official Site for ILWIS
 - c) www.gis.com Official site for GIS
 - d) www.isro.org Official site for ISRO
 - e) www.esri.com Official site for ESRI
 - f) www.fragstats.com Site for FRAGSTATS manual

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A resident of Dehradun, Siddharth Sharma is currently pursuing B.E. in Information Technology from Dehradun Institute of Technology , Dehradun and is currently in his Final Year of the Degree Program .
 He is also pursuing B.C.A. from Indira Gandhi National Open University (IGNOU) , New Delhi and has appeared for the Sixth (Final) Semester of the Degree Program.
 Siddharth has worked as a Research Assistant at the Indian Institute of Remote Sensing (NRSA) Dehradun and worked on giving an interface to some GIS software and other GIS Projects on ILWIS , ArcView etc.
 He is also active in various co-curricular activities including Event Management, Anchoring, Presentation, etc.