LIA for Win32 (LIA32) release 0.377e(English version)

User's manual

I. About LIA32

LIA for Win32 (the following, LIA32) is an image analysis software intended to use in the forest science and ecology. The main features of LIA32 are as follows:

(1) Correspondence to various image formats by using Susie Plug-in
(2) Correspondence to various binarization methods (manual, statistical, and so on)
(3) Capability to classify an image using the supervised classification technique
(4) Capability to measure length of line or polyline within an image
(5) Capability to measure the area of objects within an image
  i) Capability to automatic labeling to the objects within an image
  ii) Capability to count the objects within an image
  iii) Capability to calculate the information about object feature
(4) Capability to calculate the statistics for color information within an image
(5) Capability to analyze hemispherical image
  i) Correspondence to the various fish-eye lens and converter with distortion correction
  ii) Capability to estimate leaf area index (LAI) from the procedure same as that of HEMIPHOT
  iii) Capability to estimate sky factor (reference 6)
  iv) Capability to estimate photosynthetically active radiation (PAR) at various periods or intervals

II. Install

1) System Requirements

Operating System:

Microsoft Windows Me/2000 or more later version.

Memory (RAM):

Minimum: 64MB RAM, but larger images require more RAM.

Storage (hard disk):

Minimum: 1.5 MB of free space.

Video Display:

Minimum: 24-bit true color depth with display adapter for hardware acceleration.

2) Installing or Removing LIA32

LIA32 does not have an installer. Unpack all files within a downloaded file into same folder. To remove LIA32, only remove the folder. If you want to use the image format other than Bitmap (*.BMP), you must download and install the Susie Plug-in for the image format you want to use (e.g., JPEG, TIFF, ...). Please thaw the *.SPI file within the archive file of Plug-in into the same folder as LIA32. The official Susie Plug-in Library is distributed at http://homepage3.nifty.com/~takechin/archives/spi32008.lzh (JPEG / GIF /TIFF /Pi/ PIC/ Pic2/ XLD4/ MAG/PICT/ LHA/ Zip), and other Plug-ins are distributed at

JPEG: http://homepage3.nifty.com/~takechin/archives/ifjpg033.lzh (Official latest Plug-in for JPEG)
TIFF: http://www.asahi-net.or.jp/~DS8H-WTNB/software/ifTIF043.lzh
GIF : http://www.asahi-net.or.jp/~DS8H-WTNB/software/ifGIF012.lzh

III. Menu

1) [File] menu

[Open]

An image file is read. Since the file selection dialog opens, please choose a image file. In Default, LIA32 only support a bitmap image format. But by preparing the Susie 32bit Plug-in corresponding to required image format, you can use the various image format.

[TWAIN input]

A image is read from a TWAIN-enabled device (a image input cannot be performed unless a maker's TWAIN driver is installed).

[Save Image(DDB Format)]

Save the currently active image to file in Bitmap(DDB) format.

[Close]

Close the currently active image.

[Exit]

Exit LIA32.

2) [Edit] menu

[Copy]

[Classification]

A classification result is copied to a clipboard (comma delimiter).

[Gap Analysis]

A Gap estimation result is copied to a clipboard (comma delimiter).

[Copy Image]

The currently active image is copied to a clipboard in Bitmap(DDB) format.

[Pasete Image]

The image file in a clipboard is opened in a new window.

3) [Display] menu

[Zoom In]

Zoom in the image.

[Zoom out]

Zoom out the image.

[Original]

It returns to the state immediately after reading image.

4) [Processing] menu

[Filtering]

[Setting]

Set up the spatial-filter matrix. A value is inputted into a matrix by the keyboard after choosing filter size. Only an integer value can be set to a matrix. It is a column beside [lower] [Filterx1/] and please set up the value of a denominator to use a real numerical value. The value of / denominator turns into a pixel value of an output image as a result of matrix operation.

Moreover, filter setting of text form can be read with the button of <reading>. The text form which can be read is as follows.

The 1st line: Filter size (integer)

The 2nd line: The line of the beginning of a filter matrix (the delimiter between sequences is a space)

:

The last line: The value of a denominator

Example (in the case of a 3x3 smoothing filter) :

```
3
1  1  1
1  1  1
1  1  1
9
```

[Do Filtering]

Filtering will be performed if setting of a spatial filter is completed. A spatial filter will be performed, if the file name (be sure (to set an extension) to BMP) of an output image (Bitmap form) is inputted in a dialog and the [OK] button is clicked.

[Correction]

[Distortion]

This is the impliment of ppmdistort ver.0.3 (Dr. Masahide Kashiwagi). The parameter for distortion correction can be specified the value ranging from -100 to100.

[Full image]

The whole original image comes to appear. However, a blank (it smears away black) will be made in the direction of the end of a screen.

[Adjusted Image]

The domain which does not contain a blank is expanded to the size of an original image. Although a blank is not made in a image, the information in the direction of the end of an original image will go out.

[Geometric correction]

Perform geometric correction by the affine transformation.

[Set Control Points]

[Afin-transformation] dialog box appear on the screen. Click at the positions those coordinates (Col and Row) are well-known in advance on the image, and then input the coordinate values of output image (X and Y) by keyboard at [GCP setting] page (four or more points are required also only for the primary formula of affine transformation).

If finished the setting of control points, select the degree of the conversion formula of an affine transformation and click the [Analyze] button. Since the presumed error of each point is displayed to the [GCP setting] page, and then check the conversion accuracy. The conversion formula is as follows (in the case of primary).

$X = a_1 + b_1 Col + c_1 Row$

$Y = a_2 + b_2 Col + c_2 Row$

However, a_i, b_i, and c_i (i = 1 and 2) are the parameters estimated by the regression.

Next, set up the coordinates of four corners of output image in the [Output setting] page of [Afin-transformation] dialog box by the keyboard. Furthermore, input the size of 1 pixel of an output image by the keyboard, and select the units (mm, cm, etc.) . If all settings finished, click [Calc Image Size] button in the [Output setting] page.

[Do Correction]

Perform the affine transformation if setting of a control point is completed. Input the file name of an output image (only support Bitmap format) on the dialog box and click the [O.K.] button.

[Measure]

[Length between 2 points]

The distance in a straight line for two arbitrary points is measured. Please click the left button of a mouse in the starting point position in [after choosing this menu] a image, move a mouse to a terminal point as it is, and release a button at a terminal point. Distance in a straight line is calculated from the dpi value of the distance within a image, and a image.

[Length of polyline]

The distance between arbitrary many points is measured. Please click the left button of a mouse in the starting point position in [after choosing this menu] a image, click the left button of a mouse one by one on a line to measure further, and click the right button of a mouse at a terminal point. The sum total distance of a line is calculated from the dpi value of the sum total of the distance in a straight line within the image between each point, and a image.

[Angle]

The angle sandwiched by the two same line segments of the starting point is measured. Please push the left button of a mouse in a starting point position within a image, move a mouse to a terminal point as it is, and release a button at a terminal point.

[Azimth && Zenith Angle]

A zenith angle and a direction angle are measured. Since a starting point position is fixed to the center of a image, please click the left button of a mouse in a position to measure.

[Calc Scale]

[From Line]

The dpi value of a image is calculated from the relation between the distance between two in a image, and real distance. Real distance is inputted for the starting point and the terminal point of a scale after selection with a mouse like measurement of distance for two points.

[From Area]

The dpi value of a image is calculated from the relation between the area of the comparison target object in a image, and real area. The real area of the domain recognized to be a comparison target object is inputted after choosing the box domain containing a comparison target object.

[Classification]

Please read **VII. The example for image classification.**

5) [Analysis] menu

[Automatic Area Measurement]

The number of leaves, the circumference length, the degree of circular, and leaf area in the box area (it is in the state where the whole image was chosen at first) where the image active now is chosen are measured. Recognition of the portion of a leaf uses setting of the binarization conditions of a [option] menu. Moreover, it can set up whether calculation of the number of pixels of the maximum recognized [whether a label number is displayed on the leaf recognized as IV. analysis option and] to be a leaf and a minimum, and a circumference length and the degree of circular is carried out. . Please read an analysis option and V.< <area estimation >>.

[Color]

[Histogram]

The histogram of each digital value of R(red) -G(green) -B (blue) of the box area where the image active now is chosen is displayed.

[F/B Information]

About the portion recognized to be the leaf of the box area where the image active now is chosen, and other portions, an average and distribution of each digital value of R(red) -G(green) -B (blue) are calculated, respectively.

[Search by colors]

If a mouse is clicked within [after choosing this menu] a image, the number of pixels which the color and R-G-B each color of a pixel of the position have in tolerance level is countable.

[LAI estimation]

A canopy vegetation cover rate (Cover (%)), Sky Factor (bibliography 6), V/H (vertical/horizontal leaf angle), MLA (Mean Leaf Angle), and a Leaf Area Index(LAI) (LAI) are estimated from the hemispherical image by the fish-eye lens (bibliographies 1, 2, and 8). After choosing the circular portion in a image in the hemispherical range of a [range] menu, it performs (this menu cannot be used unless it has chosen). V. Please read < <LAI estimation >>.

[Apply LAI settings to Images]

LAI estimation is continuously performed by the same setting after performing LAI estimation from two or more images (the same image size and quality of image). As for all setting of a circular portion or a binarization etc., setting of LAI estimation is used. In a file selection dialog, a Shift key and a Control key are used together with a mouse, and two or more files can be chosen. Please use, when you analyze continuously the image photographed by the digital camera etc. In addition, as for the image chosen with this menu, only an analysis result (calculation value) is outputted, and no image is displayed.

[PAR Measurement]

The direct light and diffuse light in the measuring point (tree crown lower part) from the hemispherical image by the fish-eye lens, and the tree crown upper part (open environment) -- an another photosynthetically active radiation (PAR: mol/m^2) and another Direct Site Factor (DFS), Indirect Site Factor (ISF), and Total Site Factor (TSF) are estimated The circular portion in a image is chosen in the hemispherical range of a [range] menu, and after setting up north grade (angle 0) after that, it performs (this menu cannot be used unless it has chosen).

Please read V. < <PAR estimation >>.

[Gap Analysis]

Gap size is estimated from two images photographed towards the perpendicular upper part. Please look at reference 7 for details.

[Options]

Please read **IV. Options**.

6) [Region] menu

[Box area]

After choosing this menu, the arbitrary rectangle ranges in a image can be chosen with a mouse.

[Line Profile]

Change of each digital value of R(red) -G(green) -B on the line which connects two in the image chosen with the mouse (blue) is displayed.

[Hemispherical Image]

[Set Area]

[by Mouse]

Set the circular portion of a hemispherical image with a mouse on a screen.

[Input Diameter]

Input the number of pixels of circular portion for the diameter of a hemispherical image.

[Automatic]

The circular portion of a hemispherical image is estimated from a image. By the digital camera & fish eye converter of Nikon, a circular portion is correctly estimated from the information of a fish eye converter and image size.

[Move Center]

Moves at the center of the circular portion of a hemispherical image using mouse.

[Set Direction]

Set the direction of the circular portion of a hemispherical image. Click the portion which the direction understood within the image and input the direction (angle from north) of the position.

[Draw sum trajectory]

Draw a solar orbit in the image using the informations of the latitude, the longitude, and the altitude (altitude) set up at [Options] menu.

[Draw Scale]

Draw the scale of a azimuth and a zenith angle at intervals of 10 degrees.

IV. Options

[Analysis] -> [Options], the following setting is possible. File preservation (Save) and reading (Load) of option setting are possible. A file is recorded in INI format. However, the file saved automatically after that is not necessarily read.

[Image]

<Resolution>

When the reading accuracy (dpi) of a image is known beforehand, a value is set up here. Leaf area is calculated from the number of pixels of the portion recognized to be the leaf of the analyzed image, and the value of this reading accuracy. The default value of reading accuracy is 100 (dpi).

<Distortion Correct >

A check of an Auto correction check box rectifies a distortion aberration using the value of the parameter of the next door of a check box automatically before analysis execution (full image). Moreover, [processing]-> [distortion-aberration correction] uses this parameter.

<Color search >

The permissible error (0-255) of each color of color search is set up. The pixel within a permissible error is recognized for the difference of the luminosity value of RGB each color of the pixel chosen with the mouse, and the luminosity value of RGB each color of arbitrary pixels as a search result. When all permissible errors are 0, the pixel of the completely same color as the selected pixel is recognized.

<Binarization>

To binarize an image, a threshold value should be decided. The pixels having the lower value and having the higher value than this value are respectively considered background and foreground. Although this procedure is usually applied to graysclae image that each pixel have the value ranging from 0 to 255, the LIA32 automatically convert any type of the image to full color image after reading from the file. A color perceived by the human eye can be defined by a linear combination of the three primary colors (red, green and blue) which each primary color have the level ranging from 0 to 255. These three color levels form the basis for the RGB-colorspace.

In the [Source] of this panel, the source used for the binarization can be selected (default: blue level). In LIA32, the source other than the primary color level, i.e., [Class], [Search], and [RGB(&&)] can be used for this purpose. The [Class] and [search] respectively use the setting obtained from the image classification and that of color search. The [RGB(&&)] means the combination of the results from the three primary colors.

In addition, LIA32 have same functionalities (see reference 3) to estimate the threshold value statistically based on the histogram of source only in case that primary color or [RGB(&&)] is selected for the [Source] . LIA32 can also set the threshold value manually by selecting the [Fixed] for the [Thresholding].

[Leaf area]

<Buffer size for area measurement>

The buffer size used for leaf area estimation is set up. Although the default of buffer size is 2000, please increase this value at the time of capacity over.

<Setting for area measurement>

Although there is a function (labeling) to recognize two or more leaves automatically, in estimation

of recognition pixel size leaf area, the range of the number of pixels of a leaf recognized not to recognize to not much small things (garbage etc.) or a too large thing here is set up. If -1 is set as the maximum of size, it will become having no maximum.

<Show label number>

A check of this check box displays a label number on the image after leaf area estimation.

<Calc shape stat>

If this check box is checked, the circumference length and the degree of circular of a leaf which have been recognized are computable.

<Reflexive labeling>

When the target object is carrying out the complicated form, a target object may be unable to be recognized in the usual labeling. In such a case, please check this check box.

<Save perimeter >

The pixel coordinates around a target object are saved by the Comma Separated Value at a file.

[Fish-eye lens]

<Lens type>

The type (the projecting method) of a fish-eye lens is chosen. This option is an effective option only when treating a hemispherical image. In addition, although rectified based on the data of both companies about 8mm Fisheye lens of Nikon and Sigma, and the fish eye converter for Nikon CoolPix, since there are no data about other lenses, correction has not been carried out. The default is changed into the fish eye converter for Nikon CoolPix from this version.

<Radi of Circle area>

Here, the slide of a hemispherical image or the radius on a photograph is inputted.

<Azimth(Az) mask>

The method of estimating LAI corresponds to the same method (reference 1) as LAI-2000, and the method (reference 2) by Norman&Campbell. Here, the angle (zenith angle) used by the method by Norman&Campbell (reference 2) can be restricted. By the default, it has calculated per 1 time to 0 degree (0-1) - 89 degrees (89-90).

Here, when calculating LAI, the range of a direction excepted from calculation can be set up. A unit is a degree.

[PAR]

<Constant>

<t>

The value of 0.1 to 1 is taken with the transmissivity of the amount of optical air. A standard value is 0.6 (1 is inputted if you want to know the light intensity of the atmosphere upper part (reference 8).).

<Altitude>

Altitude of a photography point (m)

<% PAR>

The rate of PAR occupied to the amount of insolation. In the Torrid Zone, it is about 51% (reference 8).

<%Dif>

Percentage of the diffuse light relative to direct light. In fine weather, 15% is suitable (reference 8).

<Diffuse model>

When calculating Indirect (diffuse) Site Factor (ISF), Direct Site Factor (DSF), and Total Site Factor (TSF) (reference 8), select the assumption of diffuse light [Uniform Overcast Sky (UOC) or Standard Overcast Sky (SOC)] .

<Time Zone>

The belt between the standard time of a photography point. In the western hemisphere, it becomes the value of plus in minus and the Eastern Hemisphere.

<Target>

The date for estimating PAR.

<Latitude>

Latitude of a photography point.

<Longitude>

Longitude of a photography point.

V. The example for the analysis of none hemispherical image

<<Leaf area measurement >>

(1) Select the menu as [File]-> [Open], an then read a image first.
(2) Select the menu as [Analysis] ->[Options], and then set up each options (Resolution, Binarization, and Object settings) . When resolution is unknown, please compute resolution from the target object in a image using [Processing] -> [Calc Scale].
(3) Although it does not matter when targeting whole image, please set the target area by [Region] -> [Box Area].
(4) Select the menu as [Analysis] ->[Automatic Area Measurement], and then the results were output into the information window.

VI. The example for the analysis of hemispherical image

The hemispherical photography has been widely used to estimate the canopy characteristics such as leaf area index as well as the potential direct and diffuse light through discrete canopy openings. The hemispherical photography has the advantage of providing a permanent record of the canopy openings, light environment and stand condition. As a permanent record, the photographs can be studied using existing analytical methodology and would serve for future studies as method are further developed and refined. An inexpensive high-resolution digital camera that can equip with an exclusive fish-eye lens has recently become available, and it will save us the cost, time and labor for film processing and image scanning . The digital technique also has the advantage that the images can be viewed immediately in the field, and retaken if necessary .

<<LAI estimation >>

(1) Same as (1) of <<Leaf area measurement>>.
(2) Select the menu as [Analysis] ->[Options], and then set up each options (Binarization and fish-eye lens type settings). In LAI estimation, the Case of Binarization setting is usually selected as ">=" (since it is usually brighter than other portions in the leaf gap and the luminosity value is large).
(3) Select the menu as [Region] ->[hemispherical image] -> [Set Area] -> [Automatic], and then automatically selected circle area id drawn on the image. If the selected circle area does not fit to the circle area within the image, select the menu as [Region] ->[Hemispherical Image] -> [Set Area] -> [from 3 points] and then click at three points on the edge of circle are of the image.
(4) Select the menu as [Analysis] -> [LAI measurement].], and then the results were output into the information window.

The transmissivity used for estimation of a canopy vegetation cover rate and LAI is carrying out the same calculation by the same procedures as HEMIPHOT software. Please read the manual of HEMIPHOT for details. Please look at reference 6 about Sky Factor. In addition, the Sky Factor calculation function of LIA32 is verified by Dr. Inoue (present : Tottori University) who is the author of reference 6.

* In these processings, recognition of the portion of a leaf and a leaf gap is judged by the digital value or distinction function of RGB of a image according to the set-up binarization conditions. Please look at the item of (4) binarization conditions of IV for details.

< <PAR estimation >>

(1) Same as (1) of <<LAI estimation>>.
(2) Same as (2) of <<LAI estimation>>. Additionally, set up constants and position (latitude, longitude, and altitude) for the photography point in the [PAR] page of [Options] dialog box.
(3) Same as (3) of <<LAI estimation>>.
(4) Select the menu as [Region] ->[Hemispherical Image] ->[Set Direction]. Then click at the position where the angle from north is well-known in advance and input the angle.
(5) Select the menu from the list of [Analysis] -> [PAR Measurement] belonging to the period required.

VII. The example for image classification

< <image classification >>

LIA32 can perform the supervised classification of image using the discriminant analysis technique (reference 4) by the digital values of RGB colors as follows:

(1) Select the menu as [processing] -> [supervised classification] -> [start sampling], and then select the color of first group in the color dialog box. The selected color is only used for painting the classified

pixels of this group and is not the source of the discriminant analysis.

(2) [Sample points] dialog box is coming on the screen.

(3) Click at the pixel of the present group on the image. The position of selected pixels are output to the [Sample points] dialog box.

(4) If finished specifying the pixel of the present group, click the [New Group] button on the [Sample points] dialog box.

(5) Repeat the procedures (3)-(4) for all groups.

(6) Click the [Analyse] button on the [Sample points] dialog box. Then the parameters for the classification is estimated. These parameters can be used for the binarization by selecting the [Source] of [Options] dialog box as "class".

(7) Select the menu as [processing] -> [supervised classification] -> [View Classified Image], and then the classification image is displayed and the number of pixels of each group is displayed on an information window. Moreover, please perform [processing] -> [supervised classification] -> [Save Parameters] to save the parameters of linear discriminant function estimated in the procedure (6).

*The sampling data for discriminant analysis is a maximum of 20 groups and 300 pixels in total. The number of sample pixels of each group does not need to be the same.

VIII. Acknowledgement

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IX. Bibliography list

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