**LA-2D**

A 2D lamina processing program that identifies and measures sediment laminae in sediment core images.

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**Summary**

The original intention of this version of LA-2D was to provide software facilitating lamina research of sediment core images from Lake Bosumtwi. It uses a multiple pass moving average and sectional contrast enhancement for initial image enhancement, a best fit algorithm to identify 1-D laminae, and connectivity analyses for 2-D lamina analyses. LA-2D can output various laminae attributes to data files (see output section). If there are depth and age model data, it can also calculate depth and age from the pixel number using depth and age models. However, LA-2D uses a format of depth model for Lake Bosumtwi project, and uses an age model for the core 5B from Lake Bosumtwi.

The following components are included in this repository

* README
* Sources codes;
* Makefile
* Binary made from GNU/C++ on Red Hat Enterprise Linux 5.8
* Example input files and images from Lake Hitchcock, MA
* Example input files and images from Lake Bosumtwi, Ghana

**Usage**

LA-2D requires an input parameter file name as an input parameter. It also requires a file named section\_depth\_info.txt for its depth conversion.

Usage information can be displayed by run the LA-2D without a parameter.

./LA-2D

as follows: usage: LA-2D input\_file [whether collate output] [whether output enhanced image files] [debug\_level]

The first program parameter is input file name that contains parameters for processing images. Each line is for one image: image file name, starting x, starting y, width (in x), height (in y), number passes of MPMV in x direction, kernel width of MPMV in x, number passes of MPMV in y direction, kernel width of MPMV in y, threshold of grayscale value for 1-D laminae, minimal length for sectional image enhancement. The image must be in bmp format, it must be rotated 90 degree counter clockwise from its physical position.

The second program parameter is a flag (0 or 1, 0 is “no”, 1 is “yes”, default is 0) to indicate whether produces one set of output data for all images in an input file. In the case of an input file contains multiple images, LA-2D can produce output data individually for each image, or it can produce output data with all images. This option is very useful when users like to get results for a sedimentary profile after tuned parameter for individual images.

The third parameter is a flag (0, 1) to indicate whether to output an enhanced image. This parameter was used to output images used in some figures in our presentation. The default value of this parameter is 0.

The last parameter is a debug level. It can be 0, 1, 8, 9. The default is 0.

To run examples from Lake Hitchcock in examples directory:

./LA-2D input-kfd\_01.txt

to process image KFD\_7-01.bmp.

./LA-2D input-kfd.txt

to process all images from Lake Hitchcock, MA.

To run examples from Lake Bosumtwi in examples directory:

./LA-2D input-bos-7h-1.txt

to process image 5B-7H-1.bmp.

./LA-2D input-bos-examples.txt 1

to process all Bosumtwi images in this direction and collate outputs to single files.

**Output**

By default, LA-2D will produce the following output files:

- IFNS\_all\_attributes.txt: IFNS is input *image file name stub* such as 5B-7H-1 for 5B-7H-1.bmp. Each line in this file is data for one lamina, its columns are attribute values. They are lamina sequence number, type (dark or light), begin pixel number, end pixel number, thickness, begin depth, end depth, thickness in mm, begin age, end age, age duration, average R, G, B and grayscale values of this lamina.

- IFNS\_2D\_laminae.bmp: this is an image overlaid with the final 2D-laminae in the processed area.

- IFNS\_laminae\_mean\_rgb.txt: columns for this file are lamina sequence number, begin pixel, end pixel, average R, G, B and grayscale values.

- IFNS\_laminae\_mean\_thickness.txt: it contains lamina sequence number, type of lamina, begin pixel, end pixel and lamina thickness.

- IFNS\_pixel\_mean\_rgb.txt: it contains average R, G, B and grayscale values of each pixel in the processed area.

- section\_summary.txt: if this file summarizes results for each line item in the input data. It includes name, begin x, end x, begin y, end y, width of image, height of image, begin depth, end depth, length in depth, begin age, end age, age duration, the number of pixel, the number of laminae, the number of laminae per mm, the number of pixel per mm, the number of laminae per year, the number of pixel per year in the vertical direction.

**Known bugs**

When I ran my test data, core dump errors occurred with some input data. I did not find any obvious defect in the source codes. LA-2D would run images successfully after changing beginning and ending coordinates of process area. With considerations that I will re-write the system very soon, I will leave this defect unfixed.

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