



Image Analysis for dendrometrists and dendrochronologists



WinDENDRO™ 2021

Tree-Ring and Wood Density Analyser
Optimised for Optical Scanners

WinDENDRO has been designed for dendrometrists and dendrochronologists looking for a precise and efficient way to measure annual tree-ring widths and other related parameters such as minimum, maximum and average density, earlywood width and more.

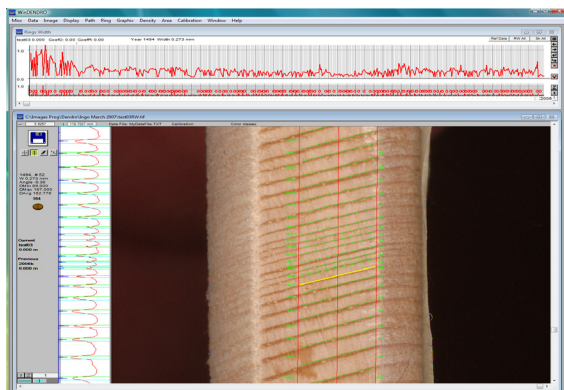


WinDENDRO analyses tree rings from wood disks, cores, X-Ray films and digital (filmless) X-Ray systems.

*Scanners shown on the left are for illustration purpose and do not correspond to models sold with **WinDENDRO**.

WinDENDRO is offered as a complete system or software alone. Its hardware components go from low cost, but precise, to faster and more precise high-end models. The software on its side is offered in three versions differing in functionality and costs. **WinDENDRO** runs on Windows operating systems.

WinDENDRO offers many advantages over manual measurement systems. Productivity gain, operator comfort, images archiving with or without their analysis, a working method that encourages and facilitates verifications such as comparison with master series during measurements and easy commands to move back and forth along an analysed sample without mechanical delays or backlash.



Since 1991, **WinDENDRO** has been updated frequently to make it on par with technological advances in image acquisition hardware (scanners and digital cameras), computers, operating systems and image analysis. It also has evolved based on suggestions from its large base of experienced users. It is a mature and robust system that has made its proofs in many laboratories worldwide as can be seen from hundreds of published scientific research works using **WinDENDRO**.

Analysis Process

The First Step- Image Acquisition

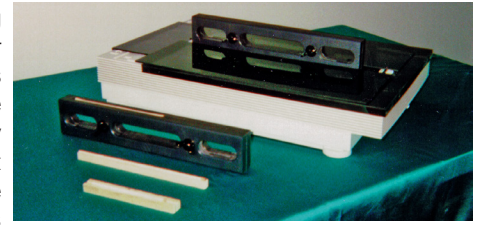
WinDENDRO is optimised for optical scanners but can also analyse images from cameras and digital filmless x-ray systems. It can open and save image files produced by these hardware manufacturers programs in a standard format such as jpeg or tiff. However, most of the time **WinDENDRO** acquires images directly from such devices when they are TWAIN compatible*. Optical scanners are particularly well adapted for tree-ring analysis. They produce high quality images over large areas.

WinDENDRO offers two methods to acquire images from scanners. The first one is optimised for ease of use and requires just a mouse click to get an image. Time is saved in bypassing the standard "Preview" step and by using positioning accessories which allows to repetitively place the samples at the right place on the scanner. The other scanning method is more complex and powerful. It uses the *Preview* step to optimise the scanning parameters.

Disks are placed face down on the scanner. You can scan the whole disk, although this takes huge amounts of memory, or you can scan narrow paths, a few millimeters or centimeters in width, from pith to bark. A scan typically takes between 10 and 60 seconds to complete depending on the image size, scan area and resolution. Note that scanning whole disks or using very high dpi such as 2400 or more needs more time and a fast computer with plenty of memory. Right after scanning, the image is displayed on screen.

**Although WinDENDRO can work with most TWAIN compatible scanners, we do not guarantee it will support all functionalities for all models. Our simple interface is guaranteed to work only with the models we sell. Our scanners also come with a calibration for higher precision. See the note regarding scanners on our web site.*

Optional positioning system with core holder eases and accelerates core scanning. The operator can rapidly position samples at the same place on the scanner glass, thus eliminating the need to preview before a scan, and allows manipulation of cores during their preparation. This system can be rapidly added or removed at any time.

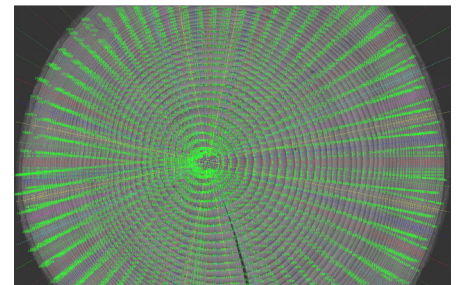
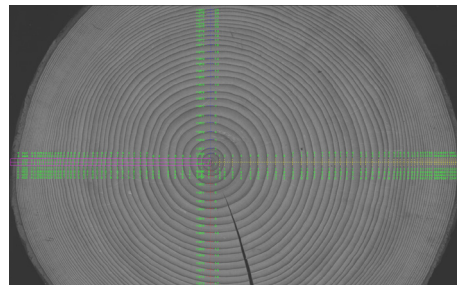
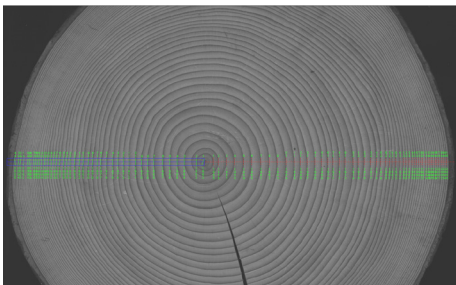


Some of our scanners are well adapted for disk or large samples scanning. Their edges are at the same level as the scan area glass which ensures that all the sample surface is in contact with the glass. This is important to have an image well focused.

Most scanners on the market have their scan area glass lower than the plastic surrounding it. Large samples are not in contact with the glass everywhere which produces unfocused images.

The Second Step- Rings Detection

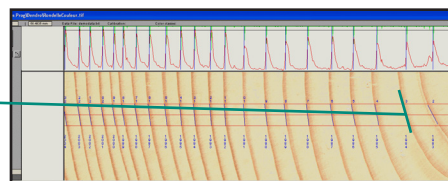
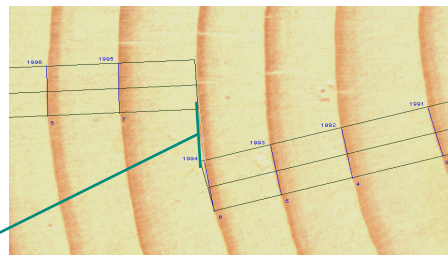
After image acquisition, you indicate **WinDENDRO** where to measure rings in the image by tracing paths interactively. Straight line paths such as those extending from a disk pith to bark can be created automatically with a single mouse click (up to a few hundreds in a single click). More complex shape paths (see below) are created manually by clicking at different places.



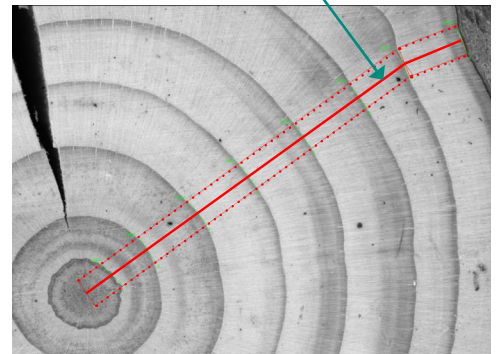
A path can run across a sample (core or disk radius) on a straight line. Hundreds of paths can be created with a single mouse click in predefined directions around the clicked position. Paths can also be created by clicking at their beginning and ending points.

Paths can contain discontinuities to skip crack or missing wood areas on damaged samples or to continue measurements in another direction e.g. to move perpendicular to ring boundaries or avoid damaged areas.

Ring-widths can be measured taking into account their boundary orientation relative to the path. This allows to increase the precision when using straight paths to achieve similar results as to path made perpendicular to ring widths.

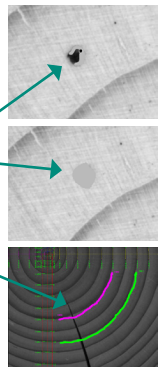
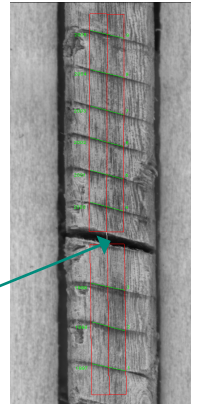


You can trace paths so that their trajectory is perpendicular to ring boundaries (as in manual dendrochronological measurement methods).



WinDENDRO Features Per Software Model

Feature	WinDENDRO Software Model			Description
	Basic	Reg	Density	
Analysis (Paths)				
Number of automatic ring detection methods	1	2	2	All versions have the intensity differences method. The Reg and Density versions have an alternative method called Teach&Show method which is sometimes better for deciduous (but can also work with conifers). Two methods give more options for low contrasted rings.
Paths per image (max)	4	256	256	The Basic version can work only with 1 to 4 paths at a time.
Vertical or horizontal paths	Y	Y	Y	Paths in the same direction as the image edges.
Paths in any direction	N	Y	Y	Paths in directions other than horizontal and vertical
Multi-segments paths	N	Y	Y	Paths that have more than one segment and can change direction between segments
Brother paths	N	Y	Y	Possibility to add paths to existing ones sharing the same origin (such as a disk pith).
Tangent to ring boundary	Y	Y	Y	Ring widths are more precise when they are oriented to follow the ring boundary direction.
Skip gaps (cracks, void)	Y	Y	Y	To exclude areas such as cracks due to wood drying from the ring widths measurements.
Batch Reanalysis	N	Y	Y	Possibility to reanalyse images previously analysed under different analysis parameters.
Measurements				
Earlywood, latewood width measurement	N	Y*	Y*	* The density version produces more precise earlywood width measurement when density analysis is turned on (even if no light calibration is done). This version is strongly recommended for this measurement.
Sapwood width	Y	Y	Y	Must be indicated manually by the operator.
Ring features	N	Y	Y	For each ring, you can set up to five features or observations that you define (frost ring, wide, missing...) plus add textual comments. Features are displayed in the image, the ring-widths graphic and are saved with the analysis data.
Log/Area module	N	N	Y	This module includes the following features: <ul style="list-style-type: none"> • Compression (reaction) wood and voids (cracks) areas measurement. This is done manually by tracing them in the image. • Disk area, shape (form coefficient), perimeter, average radius, ring density per inch or cm in function of distance to pith. This is done semi-automatically.
Light reflection analysis	N	Y*	Y*	Export the path intensity profile to text files (on a pixel basis). *The density version will produce more precise measurements when density analysis is turned on (even if no light calibration is done). This version is strongly recommended for this measurement.
Density analysis	N	N	Y	You can use x-ray films, images from digital filmless x-ray systems or the Blue Intensity method. Measurements per ring include; minimum density, maximum density, average ring density, average earlywood density, average latewood density and ring orientation.
Image Sources				
Analyse tiff, jpeg or bmp files	Y	Y	Y	Tiff uncompressed is recommended for precision. Tiff compressed and jpeg 2000 can be opened.
Acquire images from TWAIN compatible scanners and cameras	Y	Y	Y	All the scanners we sell are TWAIN compatible.
Calibration for images which come from a camera	Y	Y	Y	Calibration of images from a camera can be done with a single mouse click when Regent's new calibration targets are included in the image.
Image Processing And Analysis				
9 to 16 bits per pixel grey levels	N	N	Y	Grey levels images with more than 8 bits per pixels of information (typically 10, 12 or 16 bits/pixel) produce greater precision density analyses.
Color channel selection	N	N	Y	Color images can be visualized and analysed on one of its three color channels (Red, Green, or Blue) or using the three of them (a regular color image). If the color channel is changed while an analysis is displayed, the paths intensity profile and density values for each ring (min, max, average) are recalculated automatically.
Image edition	N	Y	Y	You can edit the image (modify its content) with any color present in it (by picking it up interactively) or by defining your own colors. This allows to remove defects that prevent ring analysis from being done accurately. It can also be used to remove artefacts for density analysis (on x-ray films or wood). Any modifications done to the image are permanent if you save the image after edition.
Image Temporary Markers	N	Y	Y	You can draw temporary markers over the image (to help you keep track of rings along a disk to find missing ones for example). Markers appearance (thickness, color) can be changed after they have been created and can have an identification name.
Background light variations removal	N	N	Y	Mostly used with camera images.
Multiple analysis windows	Y	~Y	~Y	Each window contains its own image, ring paths and data file. *The Ring Width Graphic can display the ring width series of the active window or all windows (not available with the Basic version).
Graphic				
Ring-width graphic, cross-dating, skeleton plots, detrending	N	Y	Y	Refer to the Graphic section of this brochure.
Misc.				
Save data in ascending/descending order	Y/N	Y/Y	Y/Y	From pith to bark or bark to pith.
Save Ring Width data in Decadal	Y	Y	Y	Ring Width data can be saved directly in Decadal (Tuscson) format instead of WinDENDRO format.
Save only the last few rings of a path	N	Y	Y	For stem analysis mostly. To study growth of only some years of interests.
Customisable sample identification	N	Y	Y	Choose the meaning and type of some variables that identify a sample before its analysis. This information is saved with the data.



Data

When an analysed image is saved to a file, the analysis is automatically saved with it. This analysis can later be retrieved, validated or modified simply by loading the image in **WinDENDRO**. The analysis data such as ring width, minimum density etc, are also saved to standard text files that can be read by many programs including spreadsheet style software like Microsoft's Excel. **WinDENDRO** has its own format, documented in its user guide, to store these data. They can also be saved directly in decadal (Tucson) format used by dendrochronologists at 1/100 or 1/1000 of a mm precision. Unlike the decadal format, the **WinDENDRO** format allows to store the analysis settings, date and time, image information along with the ring measurements.

Stem Analysis

XLSTEM is an optional stem analysis program that runs within Microsoft Excel. It allows to visualize data produced by **WinDENDRO** and to do standard stem analysis such as reconstituting tree growth as function of age, measuring tree volume... Calculations can be done interactively on selected trees or in batch.

XLSTEM calculates the following information from ring width data produced by **WinDENDRO**:

- Mean radius (quadratic method), diameter and area per disk (cumulative or incremental)
- Tree height and volume as a function of age or year (cumulative or incremental)
- Basal and summary information about the tree

It has three height interpolation methods: Linear, Carmean and Newberry.

Misc.

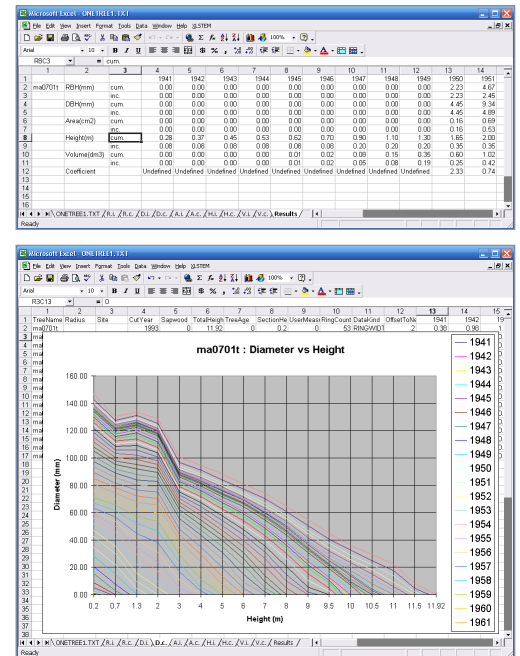
WinDENDRO comes with a printed color illustrated manual, and prompt and competent technical support via e-mail. Our technical support team is close to and can rely on **WinDENDRO** programmers for technical advices.

WinDENDRO is a member of eight product families for plant science research and production. One of these families includes **WinCELL** software for wood anatomical cell analysis. Visit our web site for more details!

What's New About WinDENDRO™ 2021?

- Multiple analysis windows are now supported. Each window contains its own image, ring paths and data file. The Ring Width Graphic can display the ring width series of the active window or all windows.
- The 64-bit software version can load, save and analyse uncompressed tiff images larger than 4GBytes (Big TIFF).
- Ring Width data can be saved in Decadal (Tucson) format directly.
- Images analysed with version 2021 can be saved in older formats 2009 to 2019 providing features specific to 2021 are not used. This allows exchange of analysed files with these previous versions.
- All "Itrax" features are now included in the Density version. The Itrax version no longer exists.

WinDENDRO™ has been designed in collaboration with Dr. Rejean Gagnon and Dr. Hubert Morin at the Dendroecology Laboratory at Université du Québec à Chicoutimi (Canada).



Tree height as a function of diameter

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For details or to place an order, please contact us.



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