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Celebrating 25 Years

WinCELL™ 2016

WinCELL is an image analysis system specifically designed for wood cells analysis. It can quantify the changes in wood structure over annual rings.

Anatomical wood cell analysis is an alternative to wood density analysis with x-rays as done with WinDENDRO. Wood density, color, mechanical and chemical properties are related to wood structure which in turns is related to climate. By measuring the radial cells (tracheids) size, distribution and their proportion to walls, wood quality can be assessed.

WinCELL measures wood cell morphology on thin wood slices cut with a microtome or directly on wood surfaces (see below). Wood cells morphological data can be measured per annual ring in images that contains more than one ring or in a series of images each containing a fraction of a ring. In the latter case this is done with the aid of XLCell, a companion program for data post-processing and visualization.

Image analysers not made specifically for wood cells measurement are usually not able to produce data suited for dendrochronology studies. These systems lack some knowledge about annual tree rings formation and the structure of their cells to compute the ring width, for example. **WinCELL** has this kind of know-how built-in. It knows, for example, that a wall between two adjacent cells must be split in two to compute the cells length and earlywood or ring width. Its versatile settings allow to analyse different wood species: vessels of deciduous and radial row of conifer tracheids. It supports different automatic and interactive analysis modes among which there is one that allows you to select rows of cells to analyse them in a way that mimics traditional tracheidograms*. **WinCELL** handles incomplete cells, those truncated by image boundary, so that they have no effects on the average cell measurements.

Image Acquisition

Digital cameras and high-end scanners have made anatomical wood cell analysis more accessible than ever.

Wood cell analysis is traditionally done on thin wood slices cut with a microtome. To acquire images of such samples, a microscope with a receptacle tube for a camera attachment and a camera adapter are required. Staining is sometime used to enhance lumen-wall contrasts when acquiring images in translucent light. This is the ideal setup to acquire very high resolution and precise images but the field of view is usually limited so that it is difficult or impossible to view entire rings. Such images can be analysed and their data merged afterward in **WinCELL** to do cells analysis on a ring basis.

Alternative sample's preparation methods and imaging over larger areas also exists since some time but none is universally used. These are typically based on a scanner or a camera and macro lens and proper lighting. The difficulties with this approach are: to acquire images with good enough contrasts between lumen and walls, to do so without damaging them and to get enough resolution to accurately identify and analyse them. Their advantage is to allow to acquire images of a few annual rings per image, making their analyses easier.

WinCELL can analyse images acquired with scanners or digital cameras. The cameras we sell are of scientific quality grade and have a standard C-mount thread which allows them to be installed on a microscope using an adapter (C-Mount adapter, not included). These cameras can also be placed directly above the wood sample to acquire images with optional lenses. They are interfaced to computer via a fast USB connection. If you plan to use a scanner please inquire about the conditions before purchasing. **WinCELL** is TWAIN compatible, meaning it can acquire images from a few camera or scanner models.

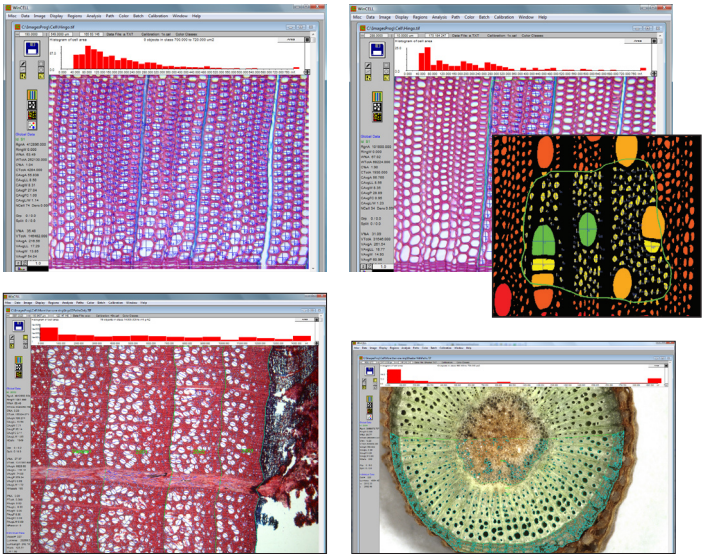
Image Acquisition from WinCELL

To acquire an image from **WinCELL**, simply click an icon in its main window. Upon doing so, it starts displaying images live (or semi-live depending on the camera model) on the computer screen while you adjust the microscope or the sample position. You can also set the image parameters (size, color, filtering) while the image is displayed. To digitize and analyze the image, simply click a button in the camera interface window.

Cell Analysis can be Done in Different Ways

Region of Analysis

The first step for analysing a sample is to choose the region to analyse. **WinCELL** can analyse the whole image (left figure) or regions of any shape (right figure). There can be practically an unlimited number of such regions, which can overlap or not. These can include just a few cells, such as the vessels of a ring, a complete ring or any region you wish such as the entire image minus some defects or bark. Regions can be rectangular, circular or irregular shape. Their positions can be saved to a file to be recreated on different images at a later time. Regions can be resized or moved and the analysis is updated automatically.



Ring Analysis

A special type of analysis region is provided to analyse annual rings. **WinCELL** can analyse cells per annual ring for one or more rings per image and compute statistics on a yearly basis in WinDENDRO's data format compatible with stem analysis software programs such as WinSTEM and XLSTEM or in **WinCELL**'s own format.

The annual ring analysis process is semi-automatic. Ring boundaries are first identified (boundary traced and year entered) then **WinCELL** closes those regions to create one analysed region per ring. The latter has all the usual wood cell measurements of earlier versions, i.e. area, length, width, position, perimeter, form.... plus the ring data (area and width) and can be done interactively or in batch without operator supervision.

Data available per analysis region, image or annual ring are numerous and user selectable: Ring width, Ring area, Number of cells, Cell density, Total area occupied by cells and walls (in units or percentage of ring area), Average cells area, length, width, perimeter, form coefficient and more. These measurements are explained below.

Measurements

Lumen and Wall Area

Lumen and walls area are measured automatically and are a true measure of their area (based on the number of pixels contained within), not an estimation from the cell's diameter. Lumen can be separated into cells and vessels types based on their area and a third cell type, parenchyma, is available on a manual classification basis. Cells of different types are analysed separately: you get global and individual data for them. You can also change the classification of a cell interactively. Lumen and wall area are available as total values for the analysed region in measurement units and in percentage area. Lumen area is also available on a per cell basis.

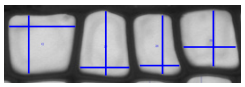
In addition to cell and wall areas, the Pro version can also measure the lumen and wall area in function of their color, globally for the analysed region or individually, i.e. per cell.

Tracheid Length and Width

Tracheids length and width are available as average values for the analysed region and individually per cell. The length and width, or radial and longitudinal diameters, can be computed by 4 different methods:

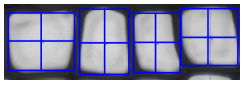
Maximum (Horizontal & Vertical)

Length is measured as the horizontal distance between the two farthest cell boundary points of same vertical position. Width is the vertical distance between points on the same horizontal position.



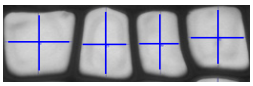
Bounding Box (Horizontal & Vertical)

Length and width are measured as the horizontal and vertical size of the bounding rectangle that encompasses a cell.



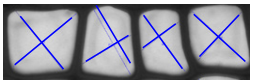
Center (Horizontal & Vertical)

Length and width are measured as the horizontal and vertical size of the cell in its centre of gravity position.



Any direction

Length is the distance between the two points on the cell boundary that are the farthest apart and width is measured perpendicular to this length at the position where the width measurement is the largest. Walls are not calculated with this method.



Cell Position

Cells centre position can be measured in the image and relative to the annual ring beginning. The latter allows to compute statistics about cell structural parameters distribution in function of position on annual rings.

Number of Tracheids (cells, vessels and parenchyma)

Cells and vessels in the analysed region or on traced paths, as explained below, are automatically counted.

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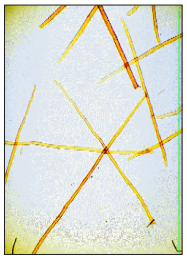
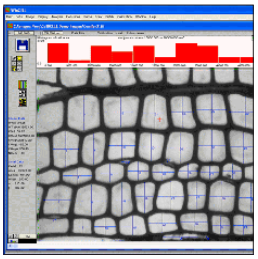
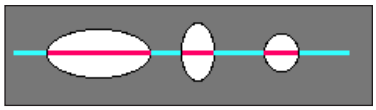
Interactive Measurements

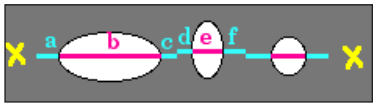




The previously mentioned morphological measurements can be computed automatically on all cells present in the analysed region or on selected cells via interactive measurements. In automatic mode, all you have to do is click the image or trace the outline of the region to analyse and cells included in that region will be analysed. In interactive mode, you simply draw a line across the cells to measure. The latter is typically used to analyse radial cell rows, i.e. rows of cells which position relative to a ring boundary are known.

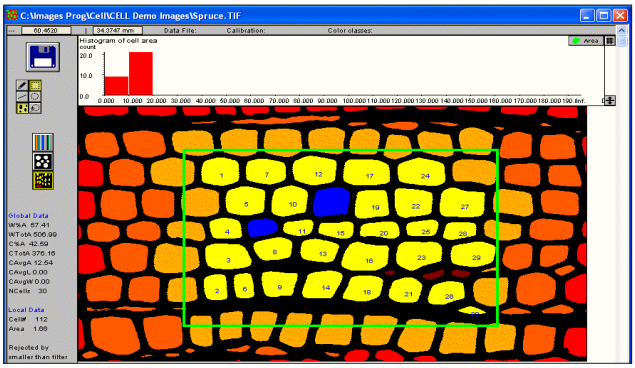
There are four types of interactive measurements. In manual mode, no image analysis is done. It is provided to measure any object's length simply by clicking at its ends. It can be used to measure a cell length or as illustrated to the right, fibres length. Straight objects can be measured with two mouse clicks at their ends while curved objects can be measured with additional mouse clicks at inflection points along their curvature. Another manual mode is provided to measure an object length and width in pair which can later be used to estimate its area. The latter can be used to measure cells which don't have enough contrast for the automatic analysis.





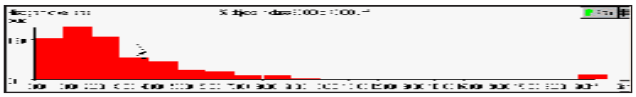
Two semi-automatic measurement modes allow to measure cells length and their two adjacent walls thickness on opposite sides of the lumen. With one method, this is done in the traced direction while with the other, this is done in the radial direction. These two semi-automatic measurement modes also produce the length of radial cell rows between annual ring boundaries to get ring width.

Features

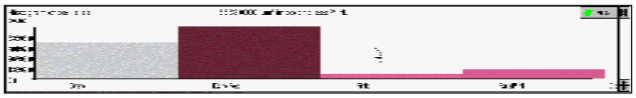


WinCELL uses the concept of analyzed region in order to reject incomplete cells. Cells touching the image boundary or located outside the analyzed region are not considered when computing average cell area, length and width measurements.

The color used to draw a cell indicates its classification: partially or completely outside or inside the analysed region, rejected by operator, debris, cell type (cell, vessel or parenchyma).



The cells distribution histogram displays the number of cells in function of area, length or width and for the Pro version the area in function of color.



Measurements data are available interactively during the analysis and in text files that can be read by many software programs. These files are easily opened and visualized in spreadsheet style programs like Microsoft Excel. You can also click a cell to display its morphological measurement data. The cells distribution histogram, visible during the analysis or after in XLCell, also presents a global view of the cell structure parameters.

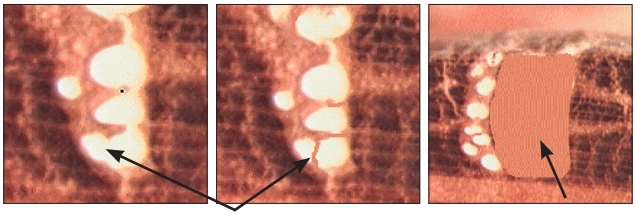
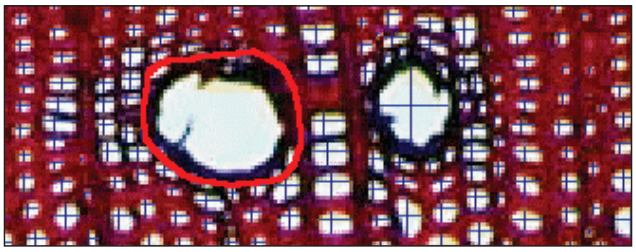


Image edition allows to compensate for defects or poor contrast. Images can be edited with any color. It is easy to select a color present in the image and edit with it. A pen, to draw lines, and a lasso tool, to fill outlined regions, are provided for edition.



Defects or regions you do not wish to be analysed can be excluded by outlining them with Exclusion Regions or by editing the image. Exclusion Regions can have any shape. They can be used in Ring Analysis to skip gaps or cracked areas on dried wood or broken cores.

Cells can be grouped, like the four parts of this vessel, to be analysed as a single one.

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Miscellaneous Features

WinCELL can analyse grey levels or color images. Our cameras produce both kinds. The Pro version can do more analyses on color images. It can display and analyse one of its three color channels, use the color content to better classify the pixels into lumen and wall or quantify area in function of color.

Calibrations are easy to perform on targets sold by microscope manufacturers. Different target models are supported.

Debris, i.e defects or non cells objects, can be automatically filtered out by morphological features (area, length, width, form, length to width ratio), color (Pro version) or by editing the images.

Original images acquired from **WinCELL**, analysed or not can be saved in standard tiff or bmp files for opening in other application programs. Images saved with their analysis in the same file are automatically reanalysed when reopened in **WinCELL** (useful to validate or modify a previously done analysis).

Batch processing is provided to analyse a series of images without operator supervision. This analysis mode works only for analyses that can be done automatically (non-interactively).

It is possible to store the analysis settings in configuration files for retrieving and reutilizing at a later time.

You can choose which data are saved.

WinCELL can also be used as a general area meter to measure leaf area, for example, or a morphology analyser for other objects by modifying its default settings.

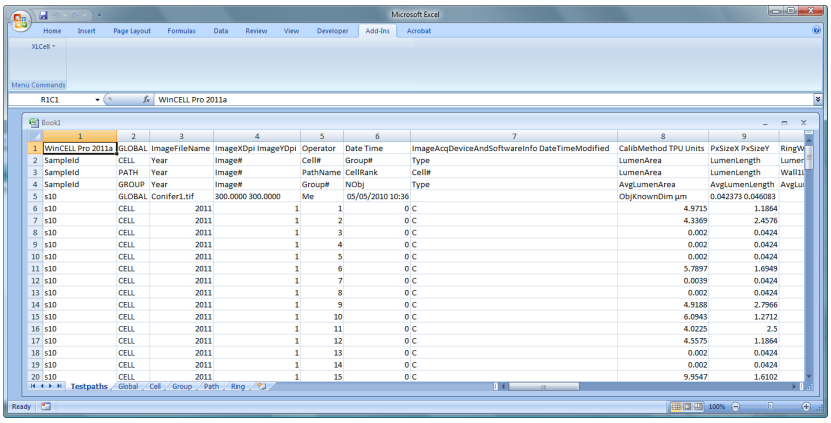
Like all Regent's products, **WinCELL** is a stand-alone program with all the built-in necessary functionality. It does not require an additional complex image analysis program or user programming skills as in some other cell analysis programs. **WinCELL** Regular software comes for FREE when you buy WinDENDRO (Reg or Density).

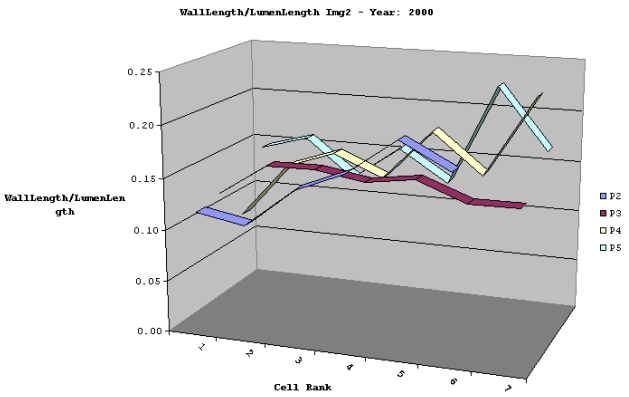
WinCell's morphological measurements can be visualized graphically using XLCell.

XLCell is a utility program that runs in Microsoft Excel which purposes is to reclassify and visualize data produced by **WinCELL**. It can separate measurements data into different sheets as a function of their type (global, individual cells, interactive paths, annual ring) for one or many images.

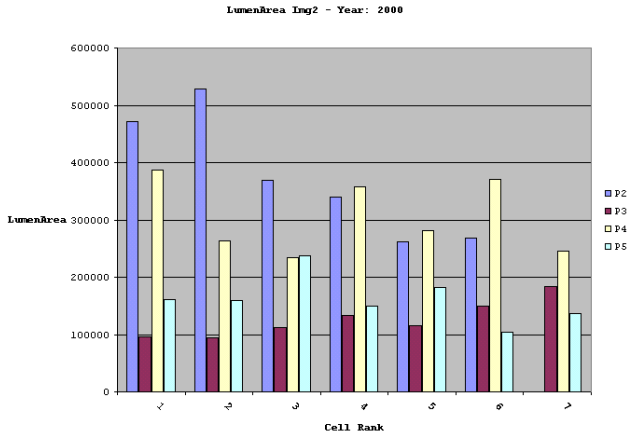
XLCell can merge sample data that has been analyzed in more than one image such as when a ring is too large or the camera resolution too low to be digitized in a single image. A command is provided to merge the measurement data of an annual ring split into two or more images as if it was acquired as one.

XLCell can display graphically different measurements for visualization or validation.





Wall Length to Lumen Length ratio for cells of four paths



Lumen area for cells of four paths

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