WinCELL is a software program designed to analyze and quantify wood cell morphology. It is intended for use with thin wood slices cut with a microtome or directly on wood surfaces. WinCELL can perform a variety of tasks, including:

- **Lumen area analysis** for cells of five paths.
- **Debris removal** through morphological features like area, length, width, form, and length to width ratio.
- **Calibrations** for targets sold by microscope manufacturers.
- **Batch processing** for analyzing multiple images without operator supervision.
- **Configuration files** for storing analysis settings.
- **Interactive and automatic analysis modes** for different wood species.
- **Wood cell morphological features** can be measured per annual ring in images that contain more than one ring or in a series of images each containing a fraction of a ring.

### Technical and Ordering Information

- Website: [www.regentinstruments.com](http://www.regentinstruments.com)
- Email: sales@regentinstruments.com
- Phone: 418-653-1357

### Miscellaneous Features

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

- **XLCell** is a utility program that runs in Microsoft Excel and is designed 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).
- XLCell can perform operations like merging sample data that has been analyzed in more than one image and separating measurements data into different sheets as a function of their type (global, individual cells, interactive paths, annual ring).
- XLCell can display graphically different measurements for visualization or validation.

### Image Acquisition

- **WinCell** can analyze grey levels or color images (our cameras produce both kinds). The Pro version can do more analyses on color images.
- It can display and analyze 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 (defects or non cells objects) can be automatically filtered out by morphological features (area, length, form, length to width ratio), color (Pro version) or by editing the images.
- Original images acquired from WinCELL, analyzed or not can be saved in standard tiff or bmp files for opening in other applications programs.
- Images saved with their analysis (in the same file) are automatically reanalyzed when reopened in WinCELL (useful to validate or modify a previously done analysis).
- Batch processing is provided to analyze 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.

### Image Analysers

- 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.
- 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 all at once.
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### Anatomical Wood Cell Analysis

- **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 in effect 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 contain 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 that separates 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 to select rows of cells to analyze them in a way that mimics traditional trachidograms*.
- WinCELL handles incomplete cells, those truncated by image boundary, so that they have no effects on the average cell measurements.

### Image Acquisition

Recent developments in 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 (New in version 2011)
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 original 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 (area, length, width, position, perimeter, form, ...) plus the ring data (area, 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 next.

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 vessel types based on their area and a third cell type, parenchyma, is available only on annual 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 per cell. The length and width (or radial and tangential 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 on the same horizontal position. Width is the horizontal distance between points on the same horizontal position.
- **Bounding Box (Horizontal & Vertical)**: Length and width are measured as the horizontal and vertical diameter of the cell. They are computed from the position where the width measurement is the largest. Walls are not calculated with this method.
- **Center (Horizontal & Vertical)**: Length and width are measured as the horizontal and vertical diameter of the cell in its center of gravity position.
- **Any direction**: Length is the distance between the two points on the same horizontal line that encompass the cell. 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 (explained next) are automatically counted.