



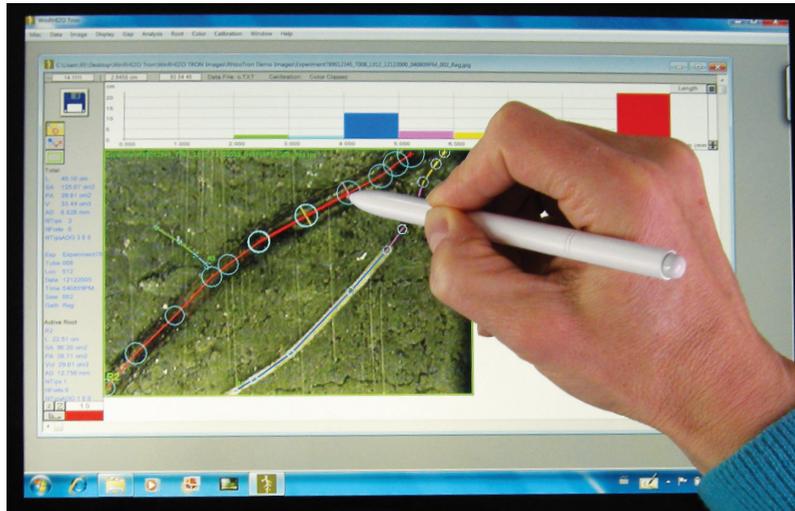
Image Analysis Tools for Plant Scientists since 1991



WinRHIZO Tron™ 2024

Interactive Image Analyser of Roots Growing in Soil and Rhizotron

WinRHIZO Tron is a manual root measurement program that allows you to analyse images produced by minirhizotron underground video camera systems or other sources that do not offer a good contrast between roots and their background. Root analysis is done by manually tracing over the roots in the image with a mouse or a pen. The latter requires a Windows Tablet or Hybrid laptop computer.



WinRHIZO Tron™ Software Program is Offered in 2 Versions:

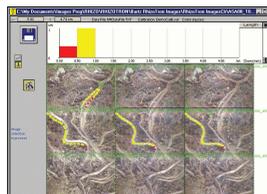
- **Tron**

can analyse one frame at a time



- **Tron MF**

can analyse multiple frames simultaneously



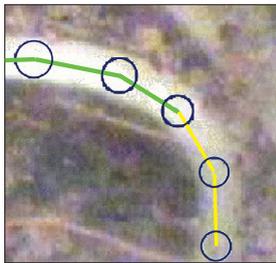
(MF=Multiple Frames)

* For automatic measurement of washed roots and Arabidopsis seedlings, please see our WinRHIZO™ product.

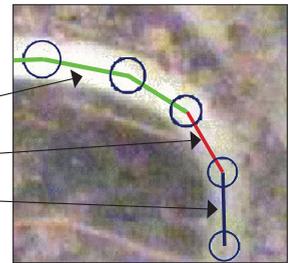
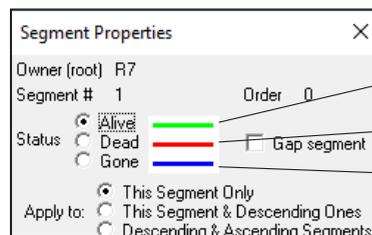
Easy Interactive Root Measurements with **WinRHIZO Tron™**

- As you trace the roots in the image by clicking on them, the morphological measurements are displayed in the command area of **WinRHIZO Tron** (see next page).
- You can scroll and zoom in some parts of the image or zoom out to view larger areas.
- Root segments and nodes can be modified, i.e. moved, re-sized, deleted or added, by clicking or pressing keyboard keys.
- When you create a root segment, you can either enter its properties manually or, with the press of a keyboard key, automatically assign it the same properties as the previous segment.
- An analysed root is made of segments delimited by nodes which correspond to the clicked positions. The color of the traced roots can be function of:

1- the segment diameter

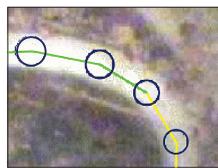


2- the living status (alive, dead, gone)

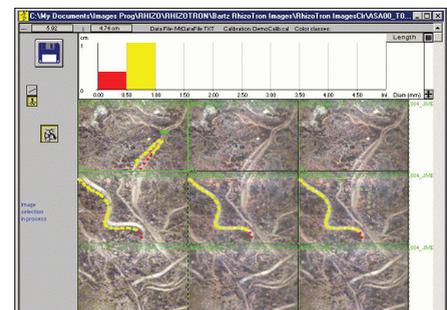


- Root diameter can be shown as following:

- > circles at nodes
- > lateral lines along the root edge
- > no display at all



- The distribution of root length, area, volume or number of tips is displayed as a function of the real root diameter in the graphic above the images. For example, if a root segment encompasses two diameter classes as in the image on the right, the root length is distributed among those two classes rather than in one average class. Colors used for the different classes are the same as those used to draw the roots in the image.



- Data saving is done automatically as roots are traced or modified. No command to activate.
- Root and segment naming can be done individually (enter the name you want) or it can be done automatically (enter the beginning of a fixed name and **WinRHIZO Tron** appends to it a number, which is increased for each subsequent root).

Interactive Root Measurements (continued)

- When you load an image that has the ICAP naming scheme, **WinRHIZO Tron** automatically extracts the parameters that will be used to identify the sample (tube and location numbers, date,...) from the file name.

Measurement data

Morphological measurements are calculated for each root and root segments. Total values for all roots are also available.

Choose which information is displayed and how it is presented (content, text size and color). Each analysed frame has its name written in its upper left corner, over the image. Select which morphological information will be displayed in the command area at the left of the image, as illustrated below.

```
T 204 L 0 S 1
Total
L 35.136 mm
SA 49.371 mm2
PA 15.715 mm2
V 5.5206 mm3
AD 4.473 mm/10
NTips 2
NForks 0
NTipsADG 2 0 0
RootDepth (Avg) 11.43
RootDepth (Min Max) 1.61 25.09
ImgDepth (Min Max) 0.00 73.28

Active Root
R2
L 19.058 mm
SA 28.779 mm2
PA 8.524 mm2
Vol 2.9944 mm3
AD 4.473 mm/10
NTips 1
NForks 0
NTipsADG 1 0 0
Order 0
ExtPL 5
Alt 5
NAxis 1
Depth (Avg) 19.84
Depth (Min Max) 11.29 25.09

Active Segment
# 4
Order 0
L 2.828 mm
SA 3.974 mm2
PA 1.265 mm2
Vol 0.444 mm3
AD 4.473 mm/10
Angle 13.32
Classif II
Magn 1
PathL 3
Depth (Avg) 21.39
Depth (Min Max) 20.75 22.04
```

- Total root measurements for the whole image: root length, surface area, projected area, volume, average diameter and number of tips.
- Image information extracted from file name using the ICAP naming scheme: experiment, tube, location, session, date, time and data gatherer.
- Active root name, e.g. R2, and its measurements data: length, surface, area,...
- Active segment number and its measurements data: length, surface, area,...

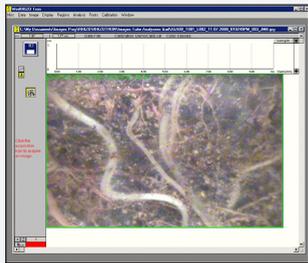
Detailed sample information, analysis settings and measurement data are saved in data files in ASCII text format which are well adapted for opening in spreadsheet-style programs such as Excel™.

Measurements and Features of Tron and Tron MF versions

| | Tron | Tron MF |
|--|------|---------|
| Morphological Measurements | | |
| Root length | √ | √ |
| Projected area | √ | √ |
| Surface area | √ | √ |
| Volume | √ | √ |
| Number of tips per root diameter class | √ | √ |
| Topology Analysis | | |
| • Available per link: | | |
| Branching angle | √ | √ |
| Connectivity - a link is classified into one of the following classes: | √ | √ |
| BL: Base Link | | |
| EE: External-External | | |
| EI: External-Internal | | |
| II: Internal-Internal | | |
| IL: Isolated Link | | |
| Magnitude - number of external links, with a tip, extending from a link | √ | √ |
| Path length - number of links between a link and the base link inclusively | √ | √ |
| • Available for a complete root system: | | |
| External path length - the sum of path lengths of all external links | √ | √ |
| Altitude - the largest path length | √ | √ |
| Developmental Analysis - Segment Order | | |
| Link order - primary, secondary, tertiary root, and so on | √ | √ |
| Root system highest order | √ | √ |
| Axis morphology - length, surface and projected area, volume, average diameter of connected links of the same order | √ | √ |
| Features | | |
| Exclude parts of image or root segments which appear in consecutive images. Image file name must be conformed to the ICAP naming scheme. | √ | √ |
| Load and display simultaneously multiple images acquired at different time and/or neighboring locations - see Regent's Space-Time Traveler | | √ |
| Copy and paste one, some or all measured roots of a neighboring image to another | | √ |
| Retrieve a previous analysis of an image and superimpose it on a current image to save time. Can also be done with a complete tube. | √ | √ |
| Shift the position of a single root or all of the roots in an analysed region. Useful to align a prior analysis over a new image. | √ | √ |
| Original images are never modified. The analysis is displayed over them. | √ | √ |
| Display root growth (highlight differences in function of time) | | √ |

In WinRHIZO Tron MF, with one click, you can load, view and analyse neighbouring images (frames), even whole tubes on your computer screen!

Work with one image at a time, three consecutive locations of the same tube, or three consecutive images in time of the same location.



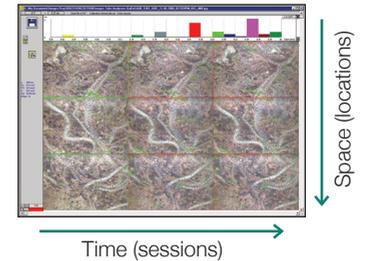
First (top) image of the tube
Second image of the tube
Third image of the tube

Traced roots can overlap frames or can be constrained to their boundaries (see right).



Image a first session
Same location a session after
Same location at a later session

Combine the left Space and Time series to get a **Space-Time** Tile of neighbouring images.



Load one or more sessions of a complete tube simultaneously!

Just click any image belonging to a tube and **WinRHIZO Tron** will load all images in order of deepness. With simple clicks, you can move up and down the tube just as you would do with the camera inside the tube.

Load not only the images but their analyses too!

Without any additional intervention, a previous analysis can be loaded and displayed over the image.

Make many analyses at a time (MF version only)

When multiple images are loaded, they can be analysed individually (each image has distinct measurement data) or globally as a session unit (roots can overlap frames and a single measurement data set is saved for the group of images). Individual or tiled images which have been analysed, can be saved to a file or printed with or without their analyses superimposed over them.

You can copy the analysis from an image or a series of images to another. For example, to save time you can copy the analysis of an image from a previous session onto an image that has not yet been analysed and modify the analysis rather than starting from scratch. You can even copy the analysis of a complete tube to another with a few clicks.

As you make or modify existing analyses, measurement data are automatically saved to data files and summary information is displayed on the screen. There is no need to activate specific commands.

WinRHIZO Tron can highlight root growth or mortality over time.

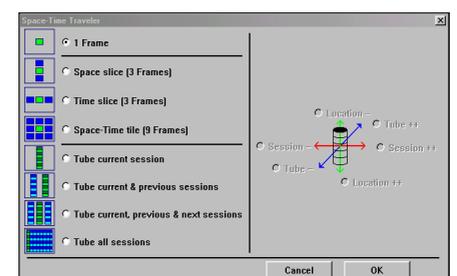


For a given location, roots that were not present in the previous session or have since disappeared are drawn with bold lines.

Regent's Space-Time Traveler

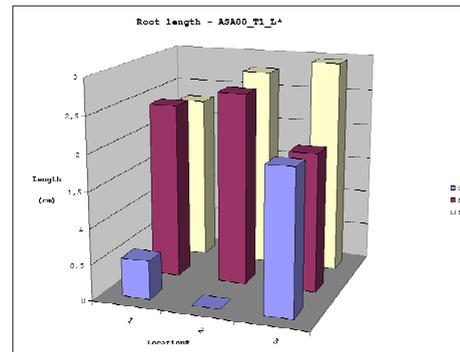
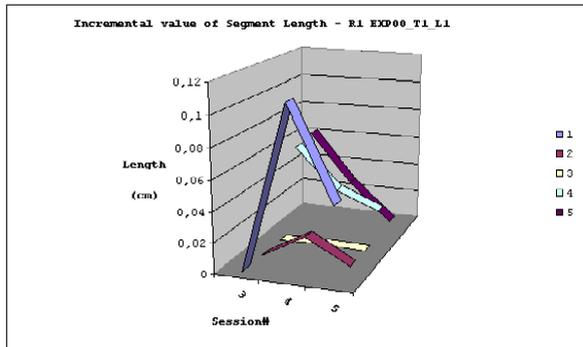
Thanks to **WinRHIZO Tron's** Space-Time Traveler, with a single click you can load, relative to the image(s) displayed on the screen, the next or previous:

- Tube,
- Location in the tube: move up and down in depth one frame at a time,
- Session in time: same tube, same location(s), but at a different sampling time.



XLRhizo Tron companion program for data visualization

XLRhizo Tron is greatly appreciated to visualize and analyse data produced by WinRHIZO Tron & Tron MF. This utility program runs in Microsoft Excel and allows to manipulate, reorganize and display measurements data graphically. It can, for example, plot root growth as a function of time for images acquired at different moments. XLRhizo Tron companion program is included with WinRHIZO Tron.



At Least 5 Good Reasons for Choosing our Products

1

Perpetual Software Licences

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2

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3

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- Provided by our competent software engineers

4

High Quality Hardware

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- Special lighting system for thick samples, e.g. roots, seeds, needles
- Positioning systems with trays and wood core holders for easy and rapid scanning of samples
- Blue reflectance target for wood density analysis
- Several software can share the same scanner
- Self-leveling mount with compact DSLR camera and calibrated fisheye lens for canopy analysis

5

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