SmartRoot : a novel image analysis toolbox enabling quantitative analysis of root system architecture

Guillaume Lobet and Xavier Draye

Université catholique de Louvain

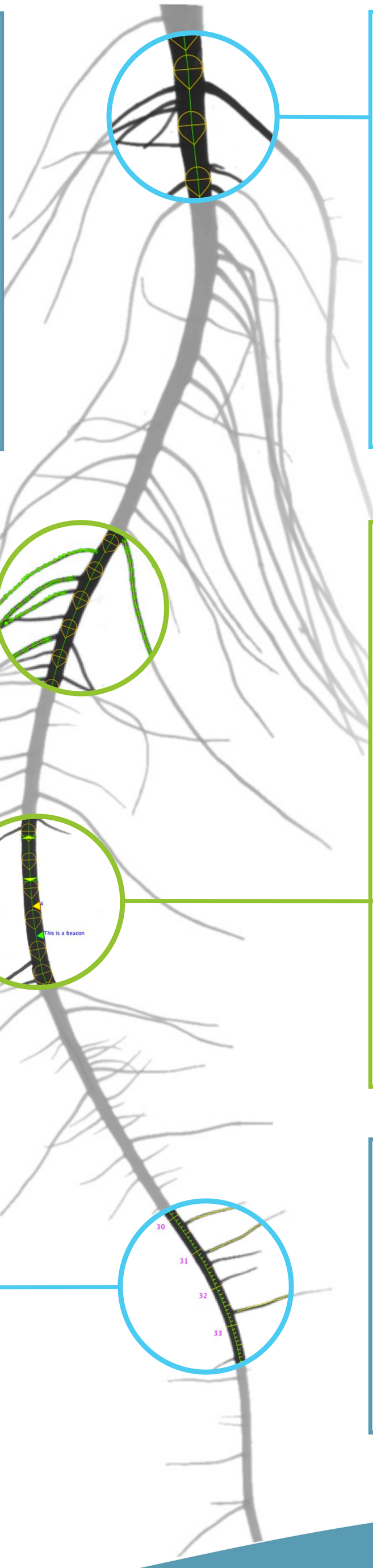
Earth & Life Institute

WHY USE SMARTROOT

SmartRoot is a semi-automated image analysis software which streamlines the quantification of root growth and architecture for complex root systems.

The software combines a vectorial representation of root objects with a powerful tracing algorithm which accommodates to a wide range of image source and quality.

The software supports a sampling-based analysis of root system images, in which detailed information is collected on a limited number of roots selected by the user according to specific research requirements.



HOW IT WORKS

SmartRoot features an automated individual root-tracing algorithm triggered by a mouse click anywhere along the root in the image source.

It determines the center (midline) of the root near the picked position and proceeds with the stepwise construction of a segmented line approximating the root midline, progressing forward and backward to the tip and base of the root.

The algorithm estimates the root diameter at each node of the segmented line.

USEFUL TOOLS

TOPOLOGY

Topological relationships can be set between roots (child-parent). Additionaly, an automated lateral tracing function was implemented in order to streamline topological analysis.

USER INTERFACE

SmartRoot user interface includes several tools to facilitate the root tracing process including a tree-like view of the traced root and bulk actions on several roots

Moreover, as the editing takes place on the traced nodes, it does not modify the source image and make this operation very intuitive

ANNOTATIONS

The vectorial structure of SmartRoot enables the referencing of virtually any type of information along the root axis. Annotations can be used to measure distances, pin-point regions of interest, etc.

TIME-SERIES

SmartRoot handles sequences of time-lapse images, hence enabling root growth and development analysis. Merging of information from different images is performed based on the root vectorial representation and is therefore not dependent on the cartesian coordinates. A direct and pratical implication is that an exact superposition of time-lapse images is not required.

TECHNICAL

- Coded in Java
- ImageJ plugin
- Vectorial root representation
- Storage in XML files
- Export to CSV and SQL
- Plateform independent
- Freeware

www.uclouvain.be/en-smartroot

CONCLUSION

SmartRoot is a novel software supporting in-depth characterization of root morphology, geometry, and topology from images or time-lapse image sequences.

The software uses several algorithms designed for root tracing and has been validated on a wide range of image spatial resolution, noise, and contrast.

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More info

A Novel Image Analysis Toolbox Enabling Quantitative Analysis of Root System Architecture.
Guillaume Lobet, Loïc Pagès and Xavier Draye
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