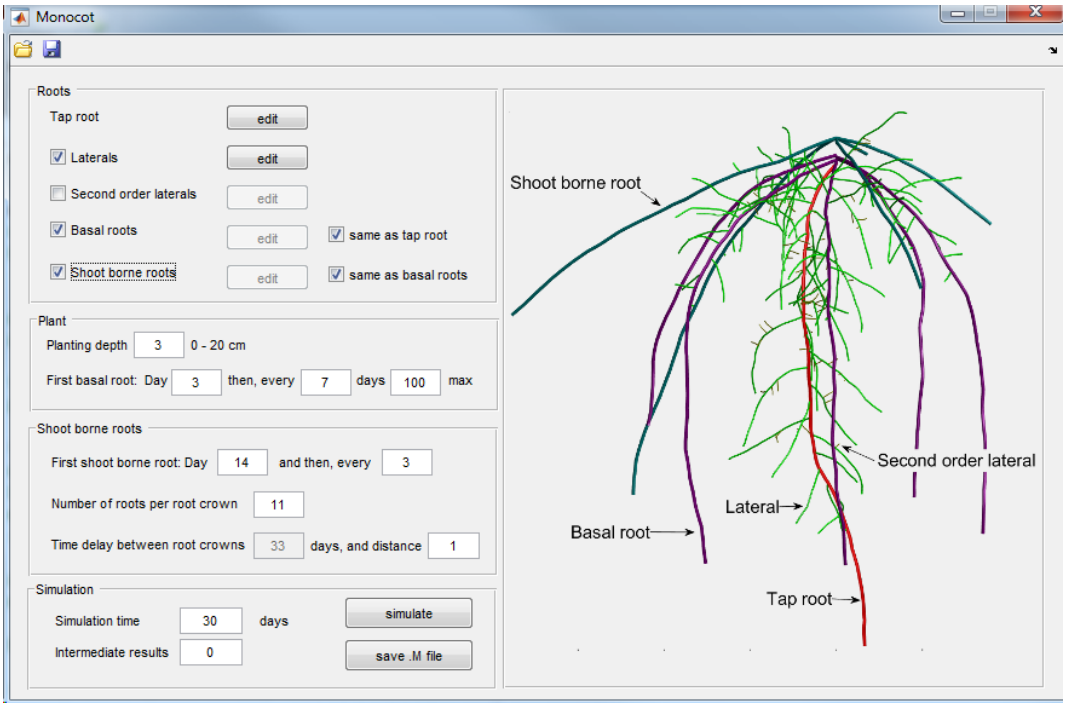
Quick guide - How to use the GUI

How to start the GUI from Matlab

1. Download the .zip file and extract in custom folder
2. Add all subdirectories to the Matlab path (by right clicking the 'version6' folder in the 'Current Folder' tap of Matlab, and then choose 'Add to Path -> Selected Folders and Subfolders')
3. Run Dicot.m or Monocot.m to open the main input form

Main input form

The script Monocot.m will display the following dialog, were root types can be selected, plant parameters can be specified, and simulations can be performed. The script Dicot.m is similar but with less functionality as it does not include any shoot borne roots. The nomenclature used to describe the root systems is according to the ISRR nomenclature (Gregory 2006; Zobel and Waisel 2010).

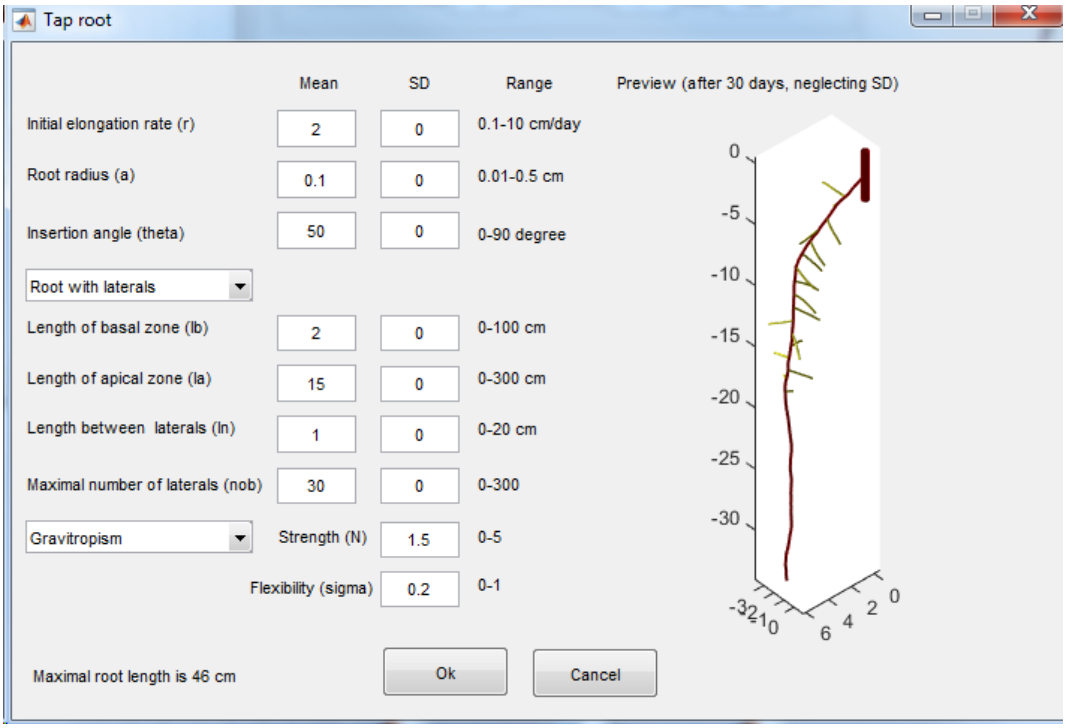


- In the 'Roots' panel, the root types that are selected will be used for the root system simulation. Depending on the availability of parameters you can use the same parameters for different root types (use 'same as tap root' checkbox and 'same as basal roots' checkboxes). Pressing 'edit' will open a dialog to input the root parameters of the corresponding root type.

- In the ‘Plant’ panel, planting depth and the first occurrence and frequency of basal roots are specified.
- In the ‘Shoot borne roots’ panel, first occurrence and frequency of shoot borne roots are specified. Furthermore, shoot borne roots can emerge from root crowns that will develop upwards the shoot.
- In the ‘Simulation’ panel the simulation time and number of intermediate results are specified. Pressing ‘simulate’ will start the simulation, and results will be shown in a new window. The use of intermediate results will enable the visualisation of the temporal development of the root system. The button ‘save .M file’ exports the model as Matlab script using Rootbox commands. This helps to analyse results and add functionality to the model (e.g. root-soil interaction).

Root parameter input form

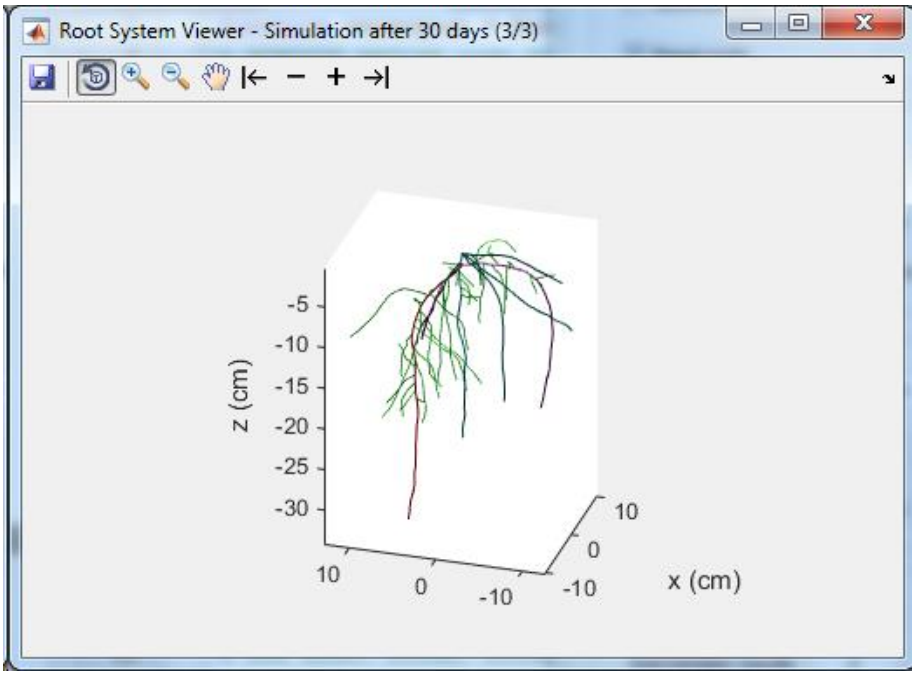
Pressing the ‘edit’ button in the ‘Roots’ panel will open the following dialog where root parameters for a specific root type are defined.



- The first column contains the parameter names, the second column consists of the mean values of the parameters, the third column contains the standard deviation of the parameter. In the fourth column a rough parameter range is provided, including the units.
- The figure on the right hand side offers a preview to quickly visualize the effect of the parameter values on the growth of the individual root.

Visualisation of simulation results

Pressing the ‘simulate’ button in the ‘Simulation’ panel of the main input form will open the following viewer of simulation results.



- The geometry can be saved using the RSML format by pressing the ‘save’ symbol.
- The root system can be explored by rotating, zooming and panning.
- If intermediate results were created, it is possible to navigate through these results with the <-, -, +, -> symbols.

Workflow creating a root architecture model

Start with modelling the tap root, basal roots, and shoot borne roots (disable ‘Laterals’ and ‘Second order laterals’ checkboxes). For testing, it is often useful to set all standard deviations to zero.

After entering the simulation time in the main input form press ‘simulate’. The resulting root system will be shown in a new window.

After the main root layout is correct, add laterals and second order laterals as well as realistic standard deviations to the parameters.

Save the model by pressing the ‘save’ symbol in the upper right corner of the main input form.

How to add functionality to the model

Press ‘save .M file’ to save your model as a Matlab script that uses Rootbox functions.

Choose an appropriate time step *dt* (in the Simulation part of the script)

Modify the simulation loop (under the comment ‘run simulation’) to implement sensitivity or uncertainty analysis, and root soil interaction. A simple example of root-soil interaction is presented in the file Example_MaizeCoupling.m.

References

Gregory PJ (2006) Plant Roots: Growth, Activity and Interactions with the Soil. Wiley

Zobel RW, Waisel Y (2010) A plant root system architectural taxonomy: A framework for root nomenclature. Plant Biosyst 144:507–512.