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Plant root tracking in 2-dimensional neutron radiographic images

Content :

Root system architecture is essential for plant nutrient and water uptake and is therefore crucial for plant development. Root system responses to heterogeneous soil conditions are of highest interest in plant nutrition, plant hydrology as well as plant breeding. Root architectural development includes architectural, morphological, anatomical as well as physiological traits. For the systematic investigation of such complex biological systems mathematical modelling is inevitable. An entire parametrisation of a root architectural model needs (a) elaborate experimental work (b) appropriate imaging techniques (c) advanced image analysis. In the last years there has been enormous progress in imaging techniques in terms of cost and image resolution, while there has been less progress in automated data evaluation.

We present a new approach for recovering root architectural parameters from 2-dimensional images of root systems. Its novelty is that the root tracking algorithm is based on a dynamic root architecture model. In this way it can be decided from a root system developmental point of view whether a specific path in the graph represents a root or not. This method helps in particular to distinguish root overlaps from branches and favours the analysis of root development over a sequence of images. We do not go into the details about the segmentation step, but we focus on the parametrisation of a root system model. The described algorithm starts with a sequence of segmented 2-dimensional images showing dynamic development of a root system. For each image morphological operators are used for skeletonisation. Based on this, a graph is created and analysed by graph theoretic methods. In this work, we exemplify the approach with 2-dimensional NR images of lupin-root systems grown in mesocosms filled with a sandy substrate.

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