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# 3D Root: A root phenotyping toolkit for 3D scans by X-Ray Computed Tomography

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Breakthrough imaging technologies may challenge the plant phenotyping bottleneck regarding marker-assisted breeding and genetic mapping. In this context, X-Ray CT (computed tomography) technology can accurately obtain the digital twin of root system architecture (RSA) but computational methods to quantify RSA traits and analyze their changes over time are limited. RSA traits extremely affect agricultural productivity. We develop a spatial–temporal root architectural modeling toolkit called 3D Root based on 4D data from X-ray CT by cylindrical fitting. This novel approach is optimized for high- throughput phenotyping considering the cost-effective time to process the data and the accuracy and robustness of the results. As a consequence, significant root architectural traits and its distribution, including number, length, growth angle, height, diameter, branching map, and volume of axial and lateral roots, are fully automatically extracted. As 3D scans from X-ray CT become a standard data to non-invasively digitize RSA in lab conditions, we envision 3D Root will contribute moving the next generation of root phenotyping forward.

## Speaker Biography

Monica Herrero-Huerta did her civil engineering with a PhD entitled 'Close-range photogrammetry applied to agroforestry engineering' from the department of cartographic and land engineering, University of Salamanca (SP, 2016). She completed her postdoctoral studies from Delft University of Technology (The Netherlands) in the department of geosciences and remote sensing (2015-2018). She is a research staff member at Purdue University for the Institute for plant science, College of agriculture (IN, USA). Currently, she is a distinguished researcher at the University of Salamanca (SP) and active member from TIDOP research group (Geomatic technologies for the 3D digitization and modeling of complex objects) (SP). Her research interests to date have been focused primarily on close-range hyper spectral photogrammetry and LiDAR by alternative platforms and specifically in computer vision and deep learning analysis by multi-sensor data fusion applied to plant science.

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