

A 3D-Imaging System for Phenotyping of Root Systems in Hydroponic Substrate

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ABSTRACT

Root growth and development are critical for plant survival and productivity. In order to increase the rate of genetic gain in breeding programs, novel tools are needed to provide accurate and reproducible phenotypic information from roots. Many systems have been developed to automate the process of extracting root traits using 2D and 3D imaging systems. While 2D systems are simpler and more widely used, most of the 2D features used today are affected by prospective distortions and occlusion. In order to overcome these limitations, 3D imaging systems have emerged as a more reliable alternative.

In this research, we propose a 3D imaging system based on structured-light scanning (SLS) for phenotyping of root system architectures (RSA). The SLS is used on plants growing in cylinders with hydroponic and translucent, gel-based substrates. This research also addresses the distortions caused by refraction of light by proposing a new distortion prune algorithm.

This work shows that the proposed method successfully creates undistorted 3D models from which newly proposed 3D features are further extracted. These 3D features are evaluated against traditional 2D features to demonstrate the potential advantages of the former over the latter in the autonomous classification of four families of soybean – growing under stress and/or normal conditions.