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| **Title:** | A Rapid, Low-Cost, and High-Precision Multifrequency Electrical Impedance Tomography Data Acquisition System for Plant Phenotyping | | | |
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| **Abstract:** |  |
| Plant phenotyping plays an important role for the thorough assessment of plant traits such as growth, development, and physiological processes with the target of achieving higher crop yields by the proper crop management. The assessment can be done by utilizing two- and three-dimensional image reconstructions of the inhomogeneities. The quality of the reconstructed image is required to maintain a high accuracy and a good resolution, and it is desirable to reconstruct the images with the lowest possible noise. In this work, an electrical impedance tomography (EIT) data acquisition system is developed for the reconstruction and evaluation of the inhomogeneities by utilizing a non-destructive method. A high-precision EIT system is developed by designing an electrode array sensor using a cylindrical domain for the measurements in different planes. Different edible plant slices along with multiple plant roots are taken in the EIT domain to assess and calibrate the system, and their reconstructed results are evaluated by utilizing an impedance imaging technique. A non-invasive imaging is carried out in multiple frequencies by utilizing a difference method of reconstruction. The performance and accuracy of the EIT system are evaluated by measuring impedances between 1 and 100 kHz using a low-cost and rapid electrical impedance spectroscopy (EIS) tool connected to the sensor. A finite element method (FEM) modeling is utilized for image reconstruction, which is carried out using electrical impedance and diffuse optical tomography reconstruction software (EIDORS). The reconstruction is made successfully with the optimized results obtained using Gauss–Newton (GN) algorithms. | |