

## **DEVELOPMENT OF GROUND SURFACE DETECTION SYSTEM USING MICROWAVE RADAR TECHNOLOGY FOR USE WITH MECHANICAL WILD BLUEBERRY HARVESTING**

Muhammad Saad<sup>1\*</sup>, Travis J. Esau<sup>1</sup>, Qamar U. Zaman<sup>1</sup>, Aitazaz A. Farooque<sup>2</sup>, Arnold W. Schumann<sup>3</sup>

<sup>1</sup>Department of Engineering, Faculty of Agriculture, Dalhousie University, Truro, Nova Scotia, Canada

<sup>2</sup>Faculty of Sustainable Design Engineering, University of Prince Edward Island, Prince Edward Island, Canada

<sup>3</sup>Soil and Water Science Department, University of Florida, Gainesville, Florida, USA

\*muhammad.saad@dal.ca

### ABSTRACT

Mechanical harvesting of wild blueberries is highly dependent on operator skill to maintain optimum head height corresponding to the variable ground slope and fruit zone height to achieve optimum berry picking efficiency. Manual operation of the mechanical harvester including head height adjustment, ground speed control, and revolution control picking reel, not only affects the berry picking efficiency but also puts mental and physical stress on the operator. Microwave radar technology in radio frequency range has been used in agriculture for various tasks but its potential in detecting ground surface in wild blueberry fields has never been analyzed. In this research study, three systems having distinct operation frequency ranges were developed using radar sensors, namely: i) WALABOT Developer, 3.3-10 GHz, ii) ACCONEER A111, 60 GHz, iii) Terrahawk HT5230, 1.5-6.5 GHz. Developed systems were analyzed and compared initially in indoor lab conditions at Dalhousie University, Nova Scotia, Canada. Performance of the developed systems in detecting three selected surfaces (i.e., metal, wood, and soil) were compared at three distinct mounting heights (0.60, 0.80, and 1.00 m). Vegetation cover was simulated over the selected ground surfaces and performance of the developed systems were analyzed using three different media to simulate real field conditions: a) Control (air as medium), ii) Grass clippings, and iii) Hay. Precision, accuracy, and bias were calculated and compared using statistical parameters. Results indicated that Terrahawk radar sensor performed best as compared to the other selected radars with standard deviation ranging from  $\pm 0.21$  cm to  $\pm 1.1$  cm, RMSE ranging from 4.45 cm to 5.55 cm, and MBE ranging from 4.33 cm to 5.57 cm under all simulated conditions. Overall, Terrahawk radar sensor offered high precision and accuracy with slight underestimation in the height measurement of detected ground surfaces. Results of this study show the potential for automation of the harvester picking reel using the Terrahawk radar sensor for real time foliage penetration and ground surface detection in wild blueberry fields.

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