RF-Based Non-Invasive Cauliflower Size Measurement through Foliage

Tech ID: 34551 / UC Case 2025-544-0

ABSTRACT

Researchers at the University of California, Davis have developed a non-invasive RF millimeter-wave system that measures crop size and maturity through foliage to enable precise and automated harvesting.

FULL DESCRIPTION

This technology utilizes millimeter-wave radio frequency (RF) signals to non-invasively assess the size, density, and maturity of crops such as cauliflower, lettuce, and kale without damaging foliage. By transmitting RF signals through the crop and analyzing signal attenuation related to water content and density, the system generates detailed measurements and heat maps of the crop structure. The system includes configurable transmitter and receiver antennas, lenses, and actuators controlled by an integrated computer controller to scan and assess crops remotely. Arrays of antennas can be mounted on agricultural vehicles for scanning multiple rows simultaneously, facilitating targeted harvesting decisions and integration with robotic harvesters.

APPLICATIONS

- Precision agriculture for monitoring and harvesting crops like cauliflower, lettuce, and kale.
- Robotic harvesting systems requiring accurate maturity and size data.
- Agricultural equipment manufacturers integrating crop sensing modules.
- Farm management systems optimizing harvest timing and labor allocation.
- Agritech startups developing smart farming solutions and crop analytics.

FEATURES/BENEFITS

- Non-destructive and non-invasive measurement of crop size and maturity.
- Enables selective robotic harvesting by providing accurate internal crop data.
- Millimeter-wave RF signals penetrate foliage, eliminating the need to remove leaves.
- Scalable design from single sensor setups to arrays for rapid multi-row scanning.
- Integration with actuators and controllers for automated positioning and data processing.
- Produces heat maps and actionable outputs to inform harvesting decisions.
- Reduces labor costs and crop damage associated with manual inspection.
- Eliminates the need for manual crop inspection that damages plants.
- Overcomes difficulty in remotely assessing crop size through foliage.
- Addresses farm labor shortages and high costs by enabling robotic harvesting.
- Reduces inconsistencies and inaccuracies in crop maturity evaluation.

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OTHER INFORMATION

KEYWORDS

actuators, antennas, controllers, crop measurement, millimeter wave, non-invasive sensing, precision agriculture, robotic harvesting, RF signals, spectrum analysis

CATEGORIZED AS

- **Agriculture & Animal Science**
  - Devices
  - Plant Traits
- **Communications**
  - Other

- Allows rapid scanning of multiple crop rows without physical contact.

PATENT STATUS

Patent Pending

- Wireless
- **Sensors & Instrumentation**
  - Physical Measurement
- **Engineering**
  - Robotics and Automation

RELATED CASES

2025-544-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Reversed Feedback Amplifier Architecture
- Ultra-High Range Resolution Doppler Radar Front End With Quadrature-Less Coherent Demodulation
- Field Effect Bipolar Transistor
- Low Energy and Noise Sub-Sampling Phase-Locked Loop
- Crop Transportation Robot
- Programmable System that Mixes Large Numbers of Small Volume, High-Viscosity, Fluid Samples Simultaneously
- High-Frequency Imaging and Data Transmission Using a Re-configurable Array Source with Directive Beam Steering
- Hybrid Electromechanical Metamaterials for Optical and Electrical Devices
- Phased-Locked Loop Coupled Array for Phased Array Applications
- Scalable Phased Array Standing Wave Architecture
- Embedded Power Amplifier
- Reducing Electrical Current Variations in Phase-Locked Loop Systems
- Software Of Predictive Scheduling For Crop-Transport Robots Acting As Harvest-Aids During Manual Harvesting

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