H13N-1188 High Precision Zero-friction Magnetic Dendrometer

Monday, 9 December 2024

13:40 - 17:30

Hall B-C (Poster Hall) (Convention Center)

Abstract

As agricultural demand for freshwater escalates amid climate change, optimizing irrigation management is paramount for resource efficiency and sustainability. Soil water deficits adversely affect crop yield and quality by impeding plant growth and development. Dendrometers, which measure stem diameter fluctuations, offer potential improvements in irrigation management for high-value woody perennial crops by correlating these fluctuations with traditional water stress metrics. However, traditional methods face precision challenges due to mechanical hysteresis and thermal expansion. The OPEnS Lab addresses these issues with a high-precision dendrometer utilizing zero-thermal expansion carbon fiber, a frictionless spring tensioning approach, and a linear magnetic encoder, achieving up to 0.5-micron resolution. Thermal fluctuations are minimized to less than 1 micron over diurnal swings of 25°C. Depending on the build quantity, the device costs between $225 and $450 per unit, with assembly taking 4 to 6 hours. The dendrometers, equipped with LoRa and WiFi telemetry under evaluation, can operate for over two years on battery power without solar charging. Mass deployment promises a continuous record of water stress-induced stem dimension changes, enhancing decision support for irrigation management. In the 2024 growing season, these dendrometers are being tested on various crops, including blueberries at Lewis-Brown Farm, hazelnut trees at the North Willamette Research and Extension Center, and cacao trees at Biosphere 2. New designs used in 2024 informed by ongoing research accommodate larger plant stem sizes with larger wishbones and stability by using 3 springs between the wishbone and frame. This innovative approach integrates advanced field sensing, data management, and decision-support systems, contributing to the sustainability transitions of the agricultural sector.

Authors

L
Nicholas Le
Oregon State University

R
Lars Rasmussen
Oregon State University

E
M Elwood-Dieu
Oregon State University

Z
Maria Zamora Re
Oregon State University

Z
Dragomira Zheleva
Oregon State University

N
Lloyd Nackley
Oregon State University

S
John Steven Selker
Oregon State University

Presenting Author

U
Chet Udell
Oregon State University

View Related