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Autonomous Irrigation Management by Fluent Soil Moisture Detection

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Abstract

Irrigation scheduling is essential to increase momentary soil-water availability to the plant. Guaranteeing a high level of water availability in the root zone plays a prerequisite role for productivity in terms of crop quantity and quality. Different substitute measurement methods have been used to manage irrigation. Soil water content, θ, is a central state variable that influences hydraulic properties of soil, which are to be found already when mathematical models are used to quantify water flow and nutrients transport in the soil. The direct acquisition of moisture content in soil has been a difficult task until the effect of the dielectric properties of soil constituents became ascertainable for the propagation speed of electromagnetic waves. Time Domain Reflectometry (TDR) enables to measure transient variation of moisture content. It enables to improve a determination of water dynamics in cropped soils during and between irrigation events (depletion rates at different depths, plant water uptake etc.). The number of potential simultaneous spots to be measured by TDR is limited. To cover broad areas stationary measurement setup is unaffordable and technically problematic. A dynamic sensor that is based on the TRIME technology (IMKO) has recently been developed. The sensor is designed to define the spatial distribution of water content in shallow top soil layers (h=3 cm). The system works with a high temporal resolution of 1 Hz. In order to acquire information about the moisture content of the relevant root zone, a current research approach intends to combine a second measurement system that is based on a modified active microwave sensor to provide the average water content for 30 cm penetration depth. The sensor fusion is promising, thus moisture content variation can be detected at high resolution and accuracy over large areas. Consequently the dynamics of moisture content in the root zone will become quotable over plot and field scale. Such information will be used for an interactive design of autonomous irrigation management in order to improve general and plant-related water use efficiency.

Keywords: Fluent, Irrigation, Site Specific, Soil Moisture, TDR, TRIME, Water Use

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