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Abstract

System Identification of Linearized Rice Growth Dynamic for Precision Irrigation †

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Abstract: Modeling crop growth dynamics has been used to predict and analyze the effects of water stress on crop yields for different irrigation managements. In particular, rice, a water intensive crop, has been extensively modeled using simulation software such as ORYZA3, Aquacrop, and WARM. Despite these established simulation models, only soil water balance models are utilized for real time irrigation control. The reasons are twofold: the complexity in incorporating non-linear and highly interactive nature of crop physiological mechanisms in a control framework; and the difficulty in estimating these physiological mechanisms compared to using soil water sensors for soil water balance models. This work developed a system identification technique that improves accuracy in irrigation timing, amount and efficiency by integrating crop growth dynamics to estimate evapotranspiration as feedback in the soil water balance model. Sample simulation runs from ORYZA3 were used to build and validate a water limited growth dynamics. A two level regression technique was used resulting in reduced expressions for leaf area index, biomass, and soil water depletion. With advancements in wireless sensor technologies, the modeling framework maximizes use of field sensor information to adequately estimate the crop state. Thus, it can be adopted in advance control techniques for irrigation.

Keywords: Crop modeling; precision irrigation; control

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