Title
CON2: Management of Soil Moisture and Nitrate Transport Using Sensor Networks and Feedback Control

Permalink
https://escholarship.org/uc/item/7285862h

Authors
Yeonjeong Park
Juyoul Kim
Jose Saez
et al.

Publication Date
2005
Management of Soil Moisture and Nitrate Transport Using Sensor Networks and Feedback Control

Yeonjeong Park¹, Juyoul Kim¹, Jose Saez², and Thomas C. Harmon³
¹UCLA Civil & Environmental Engineering, ²Loyola Marymount University Civil & Environmental Engineering, ³UC Merced School of Engineering

Introduction: Sensor Networks to Nitrate Monitoring for Protecting Groundwater Quality

Reclaimed Water for Irrigation in Palmdale, CA

Nitrate Pollution in Groundwater

• Reclaimed water is recycled for agricultural irrigation
• Nitrate in the reclaimed water serves as a fertilizer, but has potential compromise underlying groundwater quality
• The objective of this project is to systematically develop sensor networks and design a control system to monitor and respond to nitrate propagation in soils

Problem Description: Determine the Best Management Strategy for Pollution Prevention

Irrigation Control and Management in Support of Wireless Sensor Networks

• A control algorithm is required to maximize the reclaimed water input subject to groundwater protection.
• Real-time parameter estimation of the simulation models is needed using on-line data from sensors
• Due to the spatial variability of soil properties, parameter estimation for the simulation models requires geostatistical treatment (e.g., semivariogram and kriging)
• Novel multi-level sensing stations (pylons) are deployed at varying spatial densities over a portion of a 30 acre test plot.
• Each pylon monitors conditions (temperature, moisture and nitrate distributions) in its own 1-D setting
• Pylons communicate with other nearby pylons to delineate dissolved nitrate distribution in time and space

Proposed Solution: Near Real-Time Parameter Estimation and System Control

Feedback Control for Optimal Irrigation

• The objective of irrigation control is to determine the application rate such that wastewater usage is maximized and the nitrate regulatory level is not violated.
• The control scheme is executed by using the on-line data feedback from the pylons and providing control to the watering pivot.

Geostatistical Parameter Estimation

• Spatial distribution of hydraulic conductivity is visualized in contour maps created by kriging methods.
• We can then estimate soil properties at unsampled locations with geostatistical realizations.

Control Scheme Combined with Parameter Estimation