Docket #: S16-251

Optimized Algorithm for Managed Aquifer Recharge and Recovery Systems

Stanford researchers have developed SCOA-DUPI (Simulation-based Control Optimization Algorithm with Dynamic Uncertain Parameter Inversion), which relies on real-time data collected though embedded sensors that can be used to ease the operational challenges of Managed Aquifer Recharge and Recovery (MAR) facilities. Superior to traditional field sampling techniques, SCOA-DUPI uses embedded sensor networks to provide data at much finer spatial and temporal resolutions, helping MAR operators effectively and efficiently make better operational decisions. SCOA-DUPI will help determine efficient recharge and recovery rates and consistent water quality and quantity output, enabling smaller, more cost efficient, and reliable MAR system. In addition, SCOA-DUPI is not tied to any specific numerical model that simulates the physical system so it can easily adapt to any of the various existing simulation packages that use ASCII input/output file formats.

Figure

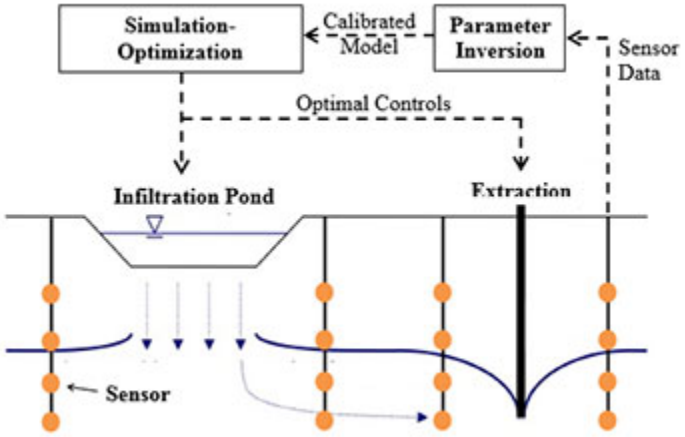

Figure description - Conceptual MAR control schematic. Adapted from (Regnery et al., 2013)

Stage of Research:

- Prototype tested on laboratory scale in a two-dimensional synthetic aquifer under both homogeneous and heterogeneous packing configurations
- Experimental results verified the feasibility of the approach and suggested that the system can improve the operation of MAR facilities
- The dynamic parameter inversion reduced the average error between the simulated and observed pressures between 12.5 and 71.4%. The control optimization algorithm ran smoothly and generated optimal control decisions

Applications

- Control algorithm for MAR systems to improve operations
- For example, analyzing surface water, stormwater, and treated wastewater for recharge by use of infiltration basins or infiltration galleries

Advantages

- Uses **embedded sensor networks,** to provide data at much finer spatial and temporal resolutions
- **Data driven, real-time control algorithm to improve MAR systems:**
  - Efficient recharge and recovery rates
  - Consistent water quality and quantity output
  - Smaller, more cost efficient, and reliable systems
- **Easily adaptable** - SCOA-DUPI can adapt to any of the various existing simulation packages that use ASCII input/output file formats

Publications

- Drumheller, Z.W., K.M. Smits, T.H. Illangasekare, J. Regnery, J. Lee, and P. Kitanidis. "Optimal decision making algorithm for managed aquifer recharge and recovery operation using near real-time data: Benchtop scale laboratory demonstration." Ground Water Monitoring Remed., February 2017.
- Smits, K. M., Z. W. Drumheller, J. H. Lee, T. H. Illangasekare, J. Regnery, and P. K. Kitanidis. "Development of a Control Optimization System for Real Time Monitoring of Managed Aquifer Recharge and Recovery Systems Using

Intelligent Sensors." In AGU Fall Meeting Abstracts. December 2015.

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