

Battle of the Water Sensor Networks (BWSN): A Design Challenge for Engineers and Algorithms



**Water Distribution Systems Analysis 2006
Cincinnati, Ohio U.S.A.
August 27-29, 2006
www.eng.uc.edu/wdsa2006/**

Initial Announcement

July 13, 2005

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1. Introduction

There has been increased interest in development of sensor networks to detect accidental and deliberate contamination events in water distribution systems and thereby facilitate corrective action or public notification. Optimization models and solution algorithms have been developed that locate a limited number of sensors to minimize the impact of such contamination events - by various metrics. These optimization models have made simplifying assumptions about design objectives, network contaminant transport, sensor response, event detection, emergency response, and installation and maintenance costs. Solutions can be difficult to obtain for large networks. Finally, little is known about how these design algorithms compare to the efforts of human designers, and thus what advantages they offer for practical design of sensor networks.

2. Outline of Approach and Schedule

The Battle of the Water Sensor Networks (BWSN) will objectively compare the performance of contributed sensor network designs, consisting of a set of sensor locations. Independent research teams and practicing engineers will contribute their designs for two different water distribution networks. Each team will be asked to develop designs according to a precise set of rules to facilitate design comparisons. These rules will specify the design performance metrics, the characteristics of contamination events, and the detection technology used to raise an alarm.

While teams will be encouraged to contribute designs for each network, partial contributions will be accepted. A comparison of the various solutions will be presented at a special session during the 8th Annual Water Distribution Systems Analysis Symposium, to be held in Cincinnati, Ohio, U.S.A., August 27-29, 2006 (www.eng.uc.edu/wdsa2006). Some contributors may be invited to

present a synopsis of their solution approach during this special session. If results warrant (as is expected), a jointly authored journal publication will be proposed to archive the design challenge and contributed solutions. The schedule of events for the Battle of the Water Sensor Networks is outlined in Table 1.

Table 1: Schedule of events

Date	Event
July 13, 2005	Initial announcement (this document)
October 1, 2005	Publication of test networks, problem details, and competition rules to conference web site (www.eng.uc.edu/wdsa2006)
April 1-7, 2006	Time interval for submission of sensor network designs by participants
April 7, 2006	Distribution of all contributed sensor designs to participants
June 1, 2006	Distribution of preliminary comparison to participants
August 27-29, 2006	Public presentation of results at WDSA06
October 1, 2006	Development of jointly authored journal manuscript (as warranted) to be submitted to <i>A.S.C.E. J. Water Res. Plan. Manag.</i>

3. General Competition Guidelines

Following is an outline of the competition guidelines. Designs conforming to these specifications will be requested for each of two test networks. Competition details, including the test networks, will be published according to the Schedule of events in Table 1.

1. On-line sensors and data processing algorithms are to be used to detect one or more categories of contaminants with particular fate and transport characteristics. The contaminant, sensor, and detection algorithm characteristics will be specified.
2. Epanet will be the standard model used to simulate transport, and network descriptions will be provided in Epanet input format.
3. Sensor network designs will be challenged by an ensemble of contamination scenarios sampled from a statistical distribution. This statistical distribution will specify the (joint) probability of contaminant volume (V), contaminant concentration (C), injection flow rate (Q), injection duration (D), injection location (X), and injection start time (T). Individual design teams will decide how to adapt or characterize this statistical distribution for design purposes.
4. Network operation (pump/valve control) and water demands will be assumed known - i.e., uncertainty or variability in these factors will not be introduced in this sensor network design evaluation.
5. A small number of quantitative design objectives will be described along with a scoring algorithm used to compare contributed designs. Design objectives may be related to, e.g., public health impacts, volume of contaminated water consumed prior to contamination, time of detection, number of failed detections, as well as other metrics. Individual groups are free to interpret these design requirements as needed for design purposes.

6. The number of sensors will be specified; teams may be asked to provide several different designs using different sensor budgets. Variations in cost among locations will not be considered in this sensor network design comparison.

4. Additional Information

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