

52. IWK

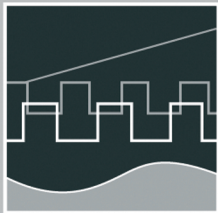
Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium



PROCEEDINGS

| 10 - 13 September 2007

FACULTY OF COMPUTER SCIENCE AND AUTOMATION



COMPUTER SCIENCE MEETS AUTOMATION

VOLUME II

Session 6 - Environmental Systems: Management and Optimisation

**Session 7 - New Methods and Technologies for Medicine and
Biology**

Session 8 - Embedded System Design and Application

Session 9 - Image Processing, Image Analysis and Computer Vision


Session 10 - Mobile Communications

Session 11 - Education in Computer Science and Automation

Bibliografische Information der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen
Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über
<http://dnb.ddb.de> abrufbar.

ISBN 978-3-939473-17-6

Impressum

- Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
- Redaktion: Referat Marketing und Studentische Angelegenheiten
Kongressorganisation
Andrea Schneider
Tel.: +49 3677 69-2520
Fax: +49 3677 69-1743
e-mail: kongressorganisation@tu-ilmenau.de
- Redaktionsschluss: Juli 2007
- Verlag: 
Technische Universität Ilmenau/Universitätsbibliothek
Universitätsverlag Ilmenau
Postfach 10 05 65
98684 Ilmenau
www.tu-ilmenau.de/universitaetsverlag
- Herstellung und
Auslieferung: Verlagshaus Monsenstein und Vannerdat OHG
Am Hawerkamp 31
48155 Münster
www.mv-verlag.de
- Layout Cover: www.cey-x.de
- Bezugsmöglichkeiten: Universitätsbibliothek der TU Ilmenau
Tel.: +49 3677 69-4615
Fax: +49 3677 69-4602

© Technische Universität Ilmenau (Thür.) 2007

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind
urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine
Verwertung ohne Einwilligung der Redaktion strafbar.

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

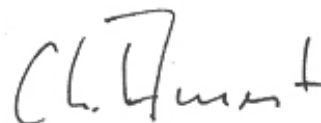
All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.

I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.



Professor Peter Scharff
Rector, TU Ilmenau



Professor Christoph Ament
Head of Organisation

Table of Contents

CONTENTS

	Page
6 Environmental Systems: Management and Optimisation	
T. Bernard, H. Linke, O. Krol A Concept for the long term Optimization of regional Water Supply Systems as a Module of a Decision Support System	3
S. Röhl, S. Hopfgarten, P. Li A groundwater model for the area Darkhan in Kharaa river Th. Bernard, H. Linke, O. Krol basin	11
A. Khatanbaatar Altantuul The need designing integrated urban water management in cities of Mongolia	17
T. Rauschenbach, T. Pfützenreuter, Z. Tong Model based water allocation decision support system for Beijing	23
T. Pfützenreuter, T. Rauschenbach Surface Water Modelling with the Simulation Library ILM-River	29
D. Karimanzira, M. Jacobi Modelling yearly residential water demand using neural networks	35
Th. Westerhoff, B. Scharaw Model based management of the drinking water supply system of city Darkhan in Mongolia	41
N. Buyankhishig, N. Batsukh Pumping well optimi ation in the Shivee-Ovoo coal mine Mongolia	47
S. Holzmüller-Laue, B. Göde, K. Rimane, N. Stoll Data Management for Automated Life Science Applications	51
N. B. Chang, A. Gonzalez A Decision Support System for Sensor Deployment in Water Distribution Systems for Improving the Infrastructure Safety	57
P. Hamolka, I. Vrublevsky, V. Parkoun, V. Sokol New Film Temperature And Moisture Microsensors for Environmental Control Systems	63
N. Buyankhishig, M. Masumoto, M. Aley Parameter estimation of an unconfined aquifer of the Tuul River basin Mongolia	67

M. Jacobi, D. Karimanzira 73
Demand Forecasting of Water Usage based on Kalman Filtering

7 New Methods and Technologies for Medicine and Biology

J. Meier, R. Bock, L. G. Nyúl, G. Michelson 81
Eye Fundus Image Processing System for Automated Glaucoma Classification

L. Hellrung, M. Trost 85
Automatic focus depending on an image processing algorithm for a non mydriatic fundus camera

M. Hamsch, C. H. Igney, M. Vauhkonen 91
A Magnetic Induction Tomography System for Stroke Classification and Diagnosis

T. Neumuth, A. Pretschner, O. Burgert 97
Surgical Workflow Monitoring with Generic Data Interfaces

M. Pfaff, D. Woetzel, D. Driesch, S. Toepfer, R. Huber, D. Pohlers, 103
D. Koczan, H.-J. Thiesen, R. Guthke, R. W. Kinne
Gene Expression Based Classification of Rheumatoid Arthritis and Osteoarthritis Patients using Fuzzy Cluster and Rule Based Method

S. Toepfer, S. Zellmer, D. Driesch, D. Woetzel, R. Guthke, R. Gebhardt, M. Pfaff 107
A 2-Compartment Model of Glutamine and Ammonia Metabolism in Liver Tissue

J. C. Ferreira, A. A. Fernandes, A. D. Santos 113
Modelling and Rapid Prototyping an Innovative Ankle-Foot Orthosis to Correct Children Gait Pathology

H. T. Shandiz, E. Zahedi 119
Noninvasive Method in Diabetic Detection by Analyzing PPG Signals

S. V. Drobot, I. S. Asayenok, E. N. Zacepin, T. F. Sergiyenko, A. I. Svirnovskiy 123
Effects of Mm-Wave Electromagnetic Radiation on Sensitivity of Human Lymphocytes to Ionizing Radiation and Chemical Agents in Vitro

8 Embedded System Design and Application

B. Däne 131
Modeling and Realization of DMA Based Serial Communication for a Multi Processor System

M. Müller, A. Pacholik, W. Fengler Tool Support for Formal System Verification	137
A. Pretschner, J. Alder, Ch. Meissner A Contribution to the Design of Embedded Control Systems	143
R. Ubar, G. Jervan, J. Raik, M. Jenihhin, P. Ellervee Dependability Evaluation in Fault Tolerant Systems with High-Level Decision Diagrams	147
A. Jutmann On LFSR Polynomial Calculation for Test Time Reduction	153
M. Rosenberger, M. J. Schaub, S. C. N. Töpfer, G. Linß Investigation of Efficient Strain Measurement at Smallest Areas Applying the Time to Digital (TDC) Principle	159
9 Image Processing, Image Analysis and Computer Vision	
J. Meyer, R. Espiritu, J. Earthman Virtual Bone Density Measurement for Dental Implants	167
F. Erfurth, W.-D. Schmidt, B. Nyuyki, A. Scheibe, P. Saluz, D. Faßler Spectral Imaging Technology for Microarray Scanners	173
T. Langner, D. Kollhoff Farbbasierte Druckbildinspektion an Rundkörpern	179
C. Lucht, F. Gaßmann, R. Jahn Inline-Fehlerdetektion auf freigeformten, texturierten Oberflächen im Produktionsprozess	185
H.-W. Lahmann, M. Stöckmann Optical Inspection of Cutting Tools by means of 2D- and 3D-Imaging Processing	191
A. Melitzki, G. Stanke, F. Weckend Bestimmung von Raumpositionen durch Kombination von 2D-Bildverarbeitung und Mehrfachlinienlasertriangulation - am Beispiel von PKW-Stabilisatoren	197
F. Boochs, Ch. Raab, R. Schütze, J. Traiser, H. Wirth 3D contour detection by means of a multi camera system	203

M. Brandner Vision-Based Surface Inspection of Aeronautic Parts using Active Stereo	209
H. Lettenbauer, D. Weiss X-ray image acquisition, processing and evaluation for CT-based dimensional metrology	215
K. Sickel, V. Daum, J. Hornegger Shortest Path Search with Constraints on Surface Models of In-the-ear Hearing Aids	221
S. Husung, G. Höhne, C. Weber Efficient Use of Stereoscopic Projection for the Interactive Visualisation of Technical Products and Processes	227
N. Schuster Measurement with subpixel-accuracy: Requirements and reality	233
P. Brückner, S. C. N. Töpfer, M. Correns, J. Schnee Position- and colour-accurate probing of edges in colour images with subpixel resolution	239
E. Sparrer, T. Machleidt, R. Nestler, K.-H. Franke, M. Niebelschütz Deconvolution of atomic force microscopy data in a special measurement mode – methods and practice	245
T. Machleidt, D. Kapusi, T. Langner, K.-H. Franke Application of nonlinear equalization for characterizing AFM tip shape	251
D. Kapusi, T. Machleidt, R. Jahn, K.-H. Franke Measuring large areas by white light interferometry at the nanopositioning and nanomeasuring machine (NPMM)	257
R. Burdick, T. Lorenz, K. Bobey Characteristics of High Power LEDs and one example application in with-light-interferometry	263
T. Koch, K.-H. Franke Aspekte der strukturbasierten Fusion multimodaler Satellitendaten und der Segmentierung fusionierter Bilder	269
T. Riedel, C. Thiel, C. Schmallius A reliable and transferable classification approach towards operational land cover mapping combining optical and SAR data	275
B. Waske, V. Heinzl, M. Braun, G. Menz Classification of SAR and Multispectral Imagery using Support Vector Machines	281

V. Heinzl, J. Franke, G. Menz Assessment of differences in multisensoral remote sensing imageries caused by discrepancies in the relative spectral response functions	287
I. Aksit, K. Bunger, A. Fassbender, D. Frekers, Chr. Gotze, J. Kemenas An ultra-fast on-line microscopic optical quality assurance concept for small structures in an environment of man production	293
D. Hofmann, G. Linss Application of Innovative Image Sensors for Quality Control	297
A. Jablonski, K. Kohrt, M. Bohm Automatic quality grading of raw leather hides	303
M. Rosenberger, M. Schellhorn, P. Bruckner, G. Lin Uncompressed digital image data transfer for measurement techniques using a two wire signal line	309
R. Blaschek, B. Meffert Feature point matching for stereo image processing using nonlinear filters	315
A. Mitsiukhin, V. Pachynin, E. Petrovskaya Hartley Discrete Transform Image Coding	321
S. Hellbach, B. Lau, J. P. Eggert, E. Korner, H.-M. Gro Multi-Cue Motion Segmentation	327
R. R. Alavi, K. Brie Image Processing Algorithms for Using a Moon Camera as Secondary Sensor for a Satellite Attitude Control System	333
S. Bauer, T. Doring, F. Meysel, R. Reulke Traffic Surveillance using Video Image Detection Systems	341
M. A-Megeed Salem, B. Meffert Wavelet-based Image Segmentation for Traffic Monitoring Systems	347
E. Einhorn, C. Schroter, H.-J. Bohme, H.-M. Gro A Hybrid Kalman Filter Based Algorithm for Real-time Visual Obstacle Detection	353
U. Knauer, R. Stein, B. Meffert Detection of opened honeybee brood cells at an early stage	359

10 Mobile Communications

K. Ghanem, N. Zamin-Khan, M. A. A. Kalil, A. Mitschele-Thiel Dynamic Reconfiguration for Distributing the Traffic Load in the Mobile Networks	367
N. Z.-Khan, M. A. A. Kalil, K. Ghanem, A. Mitschele-Thiel Generic Autonomic Architecture for Self-Management in Future Heterogeneous Networks	373
N. Z.-Khan, K. Ghanem, St. Leistritz, F. Liers, M. A. A. Kalil, H. Kärst, R. Böringer Network Management of Future Access Networks	379
St. Schmidt, H. Kärst, A. Mitschele-Thiel Towards cost-effective Area-wide Wi-Fi Provisioning	385
A. Yousef, M. A. A. Kalil A New Algorithm for an Efficient Stateful Address Autoconfiguration Protocol in Ad hoc Networks	391
M. A. A. Kalil, N. Zamin-Khan, H. Al-Mahdi, A. Mitschele-Thiel Evaluation and Improvement of Queueing Management Schemes in Multihop Ad hoc Networks	397
M. Ritzmann Scientific visualisation on mobile devices with limited resources	403
R. Brecht, A. Kraus, H. Krömker Entwicklung von Produktionsrichtlinien von Sport-Live-Berichterstattung für Mobile TV Übertragungen	409
N. A. Tam RCS-M: A Rate Control Scheme to Transport Multimedia Traffic over Satellite Links	421
Ch. Kellner, A. Mitschele-Thiel, A. Diab Performance Evaluation of MIFA, HMIP and HAWAII	427
A. Diab, A. Mitschele-Thiel MIFAv6: A Fast and Smooth Mobility Protocol for IPv6	433
A. Diab, A. Mitschele-Thiel CAMP: A New Tool to Analyse Mobility Management Protocols	439

11 Education in Computer Science and Automation

S. Bräunig, H.-U. Seidel Learning Signal and Pattern Recognition with Virtual Instruments	447
St. Lambeck Use of Rapid-Control-Prototyping Methods for the control of a nonlinear MIMO-System	453
R. Pittschellis Automatisierungstechnische Ausbildung an Gymnasien	459
A. Diab, H.-D. Wuttke, K. Henke, A. Mitschele-Thiel, M. Ruhwedel MAeLE: A Metadata-Driven Adaptive e-Learning Environment	465
V. Zöppig, O. Radler, M. Beier, T. Ströhla Modular smart systems for motion control teaching	471
N. Pranke, K. Froitzheim The Media Internet Streaming Toolbox	477
A. Fleischer, R. Andreev, Y. Pavlov, V. Terzieva An Approach to Personalized Learning: A Technique of Estimation of Learners Preferences	485
N. Tsyrelchuk, E. Ruchaevskaia Innovational pedagogical technologies and the Information educational medium in the training of the specialists	491
Ch. Noack, S. Schwintek, Ch. Ament Design of a modular mechanical demonstration system for control engineering lectures	497

N. B. Chang/ A. Gonzalez

A Decision Support System for Sensor Deployment in Water Distribution Systems for Improving the Infrastructure Safety

ABSTRACT

Meeting security objectives for a water utility is a challenging task. The need for thoughtful and comprehensive planning for prevention, mitigation, response and recovery from an event became even clearer after the attacks of 9/11. In response, an Emergency Response Plan (ERP) for water supply systems is now required under the Bioterrorism Act of 2002 in the US. As part of this process, each US utility will incorporate the results of their Vulnerability Assessment into an existing or new ERP. The goal of this paper is to introduce the architecture of an intelligent decision support system in this emerging area for decision support in emergency preparedness and response for water utilities. It presents the integration of knowledge acquisition, ontology modeling, expert system evaluation, and environmental assessment for structuring an environmental decision support system.

INTRODUCTION

There are nearly 60,000 community water supplies in the United States serving over 226 million people [1]. In an uncertain world, the prepared water utilities must provide safe and reliable water supplies in spite of natural and man-made disasters. In general, the framework for water utility protection comes in six parts, from environment to convey, to treatment, to storage, to distribution, and to point of use [2]. Natural disasters of concern may include earthquakes, floods, wind, public health, drought, hurricane, fire, and volcanoes. Human-caused disasters of concern may include electric power failures, communication and information failures, accidents and fire, hazardous material releases and contamination, security threats, equipment failure or line breaks. They are circumscribed by dotted lines alongside the service system to help identify the boundaries of the impacts that could be either conventional or non-conventional.

Meeting the security objectives for water utilities is an obviously challenging task. The need for thoughtful and comprehensive security planning for preventing an event, mitigating the impact of an unavoidable event, responding to an event, and recovering from an event became even clearer after the terrorist attacks of September 11, 2001 [3]. In response, an Emergency Response Plan (ERP) for water supply systems is now required under the Bioterrorism Act of 2002 in the United States. Each U.S. utility will need to incorporate the results of their Vulnerability Assessment into an existing or new ERP. The US Environmental protection Agency identifies three major steps in developing procedures - response, recovery, and remediation, with a list of initial and recovery notification required [4]. It should be consistent with the crisis management structure set out under the National Incident Management System enacted by the US Department of Homeland Security on March 1, 2004, which provides standardized protocols and procedures to coordinate the efforts of water systems and first responders during emergencies. Having a well-thought-out intelligent decision support system (DSS) in place before an extraordinary event strikes allows public officials to quickly respond to and stabilize chaotic situations.

The goal of this paper is to introduce the architecture of an intelligent DSS in this emerging area and delineate how to develop integrated ontological engineering analyses, expert systems' evaluation, and environmental modeling platforms for decision support in emergency preparedness and response for water utilities. It particularly presents the process of knowledge acquisition, ontology modeling, expert system evaluation, and environmental assessment for structuring the environmental decision support system (EDSS). This EDSS will help the users learn from experts with practical experience in developing the sensor network plans for Vulnerability Assessment (VA) and putting them into effect in all aspects. Based on the elements that go into this EDSS, it may help to determine a sound monitoring process to effectively implement ERP in a water utility.

METHODOLOGY

A key concept when determining or evaluating a potential threat to a water utility is the "design-basis threat," which is the credible threat that a utility's security systems are designed to protect against [5]. Identifying the design-basis threat should be based on knowledge of the threat profile in a specific area, as well as past events

from which a good source of information on the region's threat profile. Prior to the 9/11 terrorist attacks, most water utilities would have identified an operational accident, such as chlorine gas leak, or natural disaster, such as storm events resulting in high turbidity source water, as the primary threat to their utility. Nowadays, the possibility of deliberate disruptive terrorist attacks must also be considered. Achieving this goal could call for an advanced planning, design, and operation of sensors and sensor network in response to the acute needs for building an EDSS.

In the past, advanced early warning systems around the world can be found in Ohio River (USA), Paris (France), St. Clair River (Canada), River Trent (United Kingdom), River Dee (United Kingdom), Yodo River (Japan), Rhine River (multiple countries), Edmonton (Canada), etc [6]. There are also numerous traditional exterior and interior detection sensor technologies available for various type of VA in these early warning systems. For example, monitoring stations installed in River Trent, United Kingdom, generate alarms based on water quality, and telemeters this data to treatment facilities for emergency response. In this case, the following are considered to be the most significant pollutant risks, including pesticides, ammonia, dissolved oxygen, chlorate, bromide, nitrate, boron, nickel, antimony, Giardia, Cryptosporidium, total phenols, polycyclic aromatic hydrocarbons, and hydrocarbons. In addition to traditional instruments, emerging monitoring techniques have been developing with unprecedented speed. Most notable in this development is the biosensors for testing the bacteria/viruses/protozoa, given that waterborne pathogens had been a long standing threat to human societies. A critical issue in water utility is how to utilize the knowledge about those newly-developed sensors to aid in the design of emergency preparedness and response systems in the near future, including the early warning systems. This paper aims to present a unique viewpoint from an Artificial intelligence (AI) perspective for promoting risk-based DSS in emergency events.

Monitoring Technologies

The accidental discharge of contaminants from various industrial sources and natural floods might occur at unpredictable times. In the past, online physical and chemical sensors were installed to detect physical and chemical parameters, such as temperature ammonia, turbidity, color, conductivity, pH, dissolved oxygen, conductivity, oxidation reduction potential (ORP), chloride, hardness, alkalinity, particle numbers, volatile organic compound (VOC) (e.g., such as Methyl, Tertiary

Butyl Ether, MTBE), toxicity (Microtox monitor), total organic carbon (TOC), some inorganic matter (UV Kontron), water quality (e.g., Hydrolab depth sampling), and flavor profile (e.g. methylisoborneol (MIB) and geosmin). Plant operators normally count on color and turbidity measurements for chemical dosing and control. For example, both powdered activated carbon (PAC) and alum are added in response to high levels of color and turbidity. Yet, detection and identification of microorganisms on a real-time basis would significantly further reduce the risk of contaminated water reaching the end-users. In recent years, there are some bio-monitoring stations that had been deployed in river systems, such as the cases of river Rhine, Japan and South Korea, to supplement their extensive system of online gas chromatographs in source water. Several types of fish tests, daphnia tests, mussel tests, bacteria tests, and algae tests were applied in parallel with any online physical and chemical sensors. On a routine basis, analyses are performed for samples taken at different depths in the reservoirs, lakes, and rivers to detect Chlorophyll-a, plankton, zooplankton, etc. in response to public health concerns.

In response to special needs, there are many emerging monitoring techniques that are on the horizon. Some of them have started becoming commercially available while the others are still in an exploratory phase. The new technologies, such as an electronic nose using acoustic wave sensor, quartz micro balance (QMB), metal oxide (MOX), and polymer composite sensor (PCS), are emerging. The last, has been used in California to detect algae blooms and odor problems. In addition, methods for real-time measurement of trihalomethanes (THMs) and haloacetic acids (HAAs) in water distribution networks are highly desirable because of the promulgation of Maximum Contaminant Levels (MCLs). Some emerging methods are becoming gradually available [7]. Yet, there is a growing concern of bioterrorism in water supply, such as the introduction of *Cryptosporidium* [8]. Some rapid bacteriological methods, such as DNA-gene chip technology, flow cytometry, immunoassays, polymerase chain reaction (PCR), electrochemiluminescence, ribotyping, bioluminescence, and immunomagnetic separation (IMS) have been devised to meet the real-time needs for online measurement [6]. The Oak Ridge National Lab has devised a new tool, AquaSentinel, to detect a broad spectrum of poisons. AquaSentinel will be commercialized soon [9]. These new and emerging monitoring techniques may aid in vulnerability assessment by providing an additional dimension of crucial information for decision making.

Environmental Decision Support System

The proposed rule-based expert system for the customized sensor network in a GIS platform will be derived from extensive experience in modeling water transmission and distribution networks. The primary concern is the disruption of supply to a large number of customers in rural communities with all the consequences for disrupting fire fighting capabilities and public health risks. The optimal locations for sensor deployment may then be drawn from multi-dimensional simulation outputs with respect to associated statistical indices. Contaminated water can have potentially catastrophic impacts on the health of end users, such as happened in Milwaukee, Wis., in April 1993 where a cryptosporidiosis outbreak infected more than 400,000 water consumers. In Gideon, Mo., in Nov., 1993, a Salmonella outbreak resulted in the death of seven individuals [12]. Integrating modeling and mapping systems to realize the contaminant kinetics and modeling strategies becomes the recent focus, promoting system reliability and the ability to present the risks to customers in a more amiable way [10, 11]. Specific uses generally require particular model synthesis and integration. For example, the assessment of THMs and HAAs in water distribution networks must rely on the combination of water quality models and hydraulics models (e.g., such as Hardy-Cross method). Vulnerability assessment can be further made possible by combining sensors with models to determine what would be the optimal locations in the water supply systems to deploy and which type of sensor is required for corresponding location. Models required in this area include hydraulic models, steady state water quality models, dynamic water quality models, optimization models, and display/visualization models. The models encompass a wide range of methods that can be used to predict the water quality in source water, treatment trains, and water distribution networks under a set of conditions. Ontology modeling can be integrated with environmental models for decision making. Some ontologies issues have been investigated for groundwater contamination and remediation in which dynamic semantics and task-oriented knowledge are often represented by rules or problem-solving methods [13, 14, 15]. The appropriate use of sensors/sensor networks in an EDSS would be able to combine all early warning information from source water monitoring systems to process monitoring of water treatment plants, and to the monitoring of water quality in distribution systems. On a design-basis, striving to link all critical components together, the advances of ontological engineering may further promote the functionality of the EDSS by providing a friendly

design tool for the collection and selection of sensors and predictive models. Seamless integration of the EDSS into current SCADA systems can be anticipated by appropriate applications of water quality and demand forecasting, process modeling and assessment, inferential sensing, and process control [16].

CONCLUSION

Current regulatory pressures are driving the drinking water industry to more sophisticated levels due to the recent homeland security and public health concerns. An EDSS integrating AI and traditional DSS techniques can be developed for most drinking water treatment process, covering from source water, transmission system, treatment facilities, finished water storage, distribution system, and supporting infrastructure. It is also essential that the importance of online analyzers in the advanced real-time monitoring system be reflected in the development of an EDSS as well as the implementation of effective analyzer quality assurance and error detection programs.

References:

- [1] U.S. EPA (1999). 25 year of the Safe Drinking Water Act: History and Trends, EPA 816-R-99-007, Office of Water, Dec. 3, 1999.
- [2] Grigg, N. S. (2002). Surviving Disasters in Water Utilities: Learning from Experience. AWWA Report, ISBN 1-58321-204-3.
- [3] Hogan, A. Jr. and DeBoer, J. (2005). Security Planning in an Unstable World: A Public Official Guide. AWWA Report, ISBN 1-58321-252-3.
- [4] U.S. EPA (2002). The Guidance for Water Utility Response, Recovery & Remediation Actions for Man-Made and/or Technological Emergencies, Office of Water (4610M) EPA 810-R-02-001, April 2002.
- [5] American Water Works Association (AWWA) (2002). Water System Security: A field Guide. ISBN 1-58321-193-4.
- [6] Grayman, W. M., Deininger, R. A., Males, R. M. (2001). Design of Early Warning and Predictive Source-Water Monitoring Systems. AWWA Report, ISBN 1-53821-172-1.
- [7] Emmert, G. L., Cao, G., Geme, G., Joshi, N., and Rahman, M. (2003). Methods for Real-time Measurement of THMs and HAAs in Distribution Systems. AWWA and EPA Report, ISBN 1 84339 8982.
- [8] Foran, J. A. and Brosnan, T. M. (2000). "Early warning systems for hazardous biological agents in potable water." Environmental Health Perspectives, 108(10), pp. 993-996.
- [9] Krause, C. (2005). "Bioterrorism Early Warning System-Algae?" Journal of Environmental Health, p43.
- [10] Mays, L. W. (editor) (1989). Reliability Analysis of Water Distribution Systems. ASCE, New York, ISBN 0-87262-712-8.
- [11] Mays, L. W. (editor) (2000). Water Distribution Systems Handbook. McGraw-Hill, New York, ISBN 0-07-134213-3.
- [12] Clark, R. M. and Grayman, W. M. (1998). Modeling Water Quality in Drinking Water Distributing Systems. American Water Works Association, Denver, CO, ISBN0-89867-972-9.
- [13] Chan, C.W., Peng, Y., and Chen, L. L. (2002). "Knowledge acquisition and ontology modeling for construction of a control and monitoring expert system." International Journal of Systems Science, 33(6), 485-503.
- [14] Antoniou, G. and van Harmelen, F. (2004). A Semantic Web Primer, Cambridge, MIT Press.
- [15] Omelayenko, B., Crubezy, M., Fensel, D., Benjamins, R., Wielinga, B., Motta, E., Musen, M., and Ding, Y. (2005). UPML: The language and tool support for making the semantic web alive, in Fensel et al., (eds.), MIT Press, 140-170.
- [16] American Water Works Association (AWWA) (2002). Online Monitoring for Drinking Water Utilities. Edited by Erika Hargesheimer, Osvaldo Conio, and Jarka Popovicova, ISBN 1-58321-183-7.

Authors:

Prof. Ni-Bin Chang and Prof. Avelino J. Gonzalez
University of Central Florida
Orlando, FL, 32816 USA
Phone: (407) 823-1375 and (407) 823-5027
E-mail: nchang@mail.ucf.edu and gonzalez@ucf.edu