Specialist Group on Instrumentation, Control and Automation

International Water Association

Newsletter April 2009

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CONTRIBUTIONS TO THE NEWSLETTER

Contributions should be submitted through e-mail in Microsoft Word (or WordPerfect if desired) to the Group Chairman or to the Group Secretary:

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CHAIRMAN’S NOTE

Dear ICA SG Members,

It’s getting really close! ICA2009, June 14-17, Cairns, Australia!

The preparation of the conference is progressing very well. A programme for both academics and practitioners has been set up, thanks to the strong support provided by all of you – authors, reviewers, program and organising committees, and of course the warmly welcomed delegates. The draft program is included in this newsletter for your information

The registration is open now. Be an early bird by registering online at http://www.iwa-ica2009.org/ before April 30th.

At ICA2009, an open Specialist Group meeting will be organised, where:

- The venue and organiser of ICA2013 will be selected. If you are interested in organising ICA2013, please send your proposal to me (zhiguo@awmc.uq.edu.au). You will be invited to give a short presentation at the open SG meeting. Decision will be made democratically through on-site voting.
- The Management Committee of the SG will be renewed, and this will be done through election. The membership is open to everyone who is an IWA member and is keen to serve the SG. Self-nomination is invited now. Details of the nomination and the election procedure can be found further on in this Newsletter. Please send your nomination to Henri Spanjers (Henri.Spanjers@wur.nl) by May 31.

Some people have inquired about the selection of conference papers for Water Science and Technology. An explanation of the procedure can be found at the conference website (http://www.iwa-ica2009.org/) under "paper submission".

I would also like to draw your attention to the three feature articles published in the newsletter and also the ICA article published in Water 21. These articles clearly show the benefits of and growing interests in ICA in water and water and wastewater systems.

I look forward to welcoming all of you in Cairns, Australia, very soon.

Best regards.

Zhiguo Yuan

Zhiguo Yuan
Chair of the IWA Specialist Group on Instrumentation, Control and Automation
Professor, Advanced Water Management Centre, The University of Queensland, Australia

CURRENT MANAGEMENT TEAM OF THE SPECIALIST GROUP

The Management Team of the Specialist Group consists of the following people. Biographies of the members can be found at:
http://www.iwahq.org/templates/ld_templates/layout_633184.aspx?objectid=633925&actionobjectid=277826&sgam=1

Formal members		
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HOW TO JOIN THE ICA SPECIALIST GROUP

Membership of the Specialist Group on Instrumentation, Control and Automation is open to all members of IWA. Specialist Groups represent the core vehicle for issue-based interaction on scientific, technical and management topics. The specialist groups facilitate collaboration and product generation, including conferences and publications. The specialist groups within IWA are self-managed and include groups covering all-important topics in the water management sector. Spread across IWA's membership in more than 130 countries, IWA's Specialist Groups are an exceptionally effective means of international networking, sharing information and skills and making good professional and business contacts.

Every IWA member can join an unlimited number of specialist groups and each group has its own program of conferences and other meetings and a regular newsletter or web-based discussion forum. To join the Specialist Group on Instrumentation Control, and Automation, please contact the Chairman or the Secretary. You may also directly contact Frances Lucraft (Frances.Lucraft@iwahq.org).

GROUP DESCRIPTION

This group seeks to provide a forum to exchange methodologies and experience internationally on all aspects of sensor technology, instrumentation, control and automation for water and wastewater systems. Practical experiences, case studies, management problems, operator aspects and integrated solutions of those systems will be important parts of the activities. Part of the specific topics may include: sensors and instrumentation; modelling and simulation for control and operation; control systems for water and wastewater treatment and transport; detection and early warning; diagnosis systems; plant wide control and integrated control; control as means of obtaining better sustainability; practical experience of instrumentation and control; information systems for operation; decision support; risk assessment; optimising operation.

MESSAGE FROM IWA

The IWA Board has met recently in Istanbul in connection with the World Water Forum. The Board noted the excellent audited turn-out for the year 2008 and the major contribution made by the Vienna Conference. IWA Publishing again made a major contribution to the IWA finances. The final accounts will be presented to the Governing Assembly at the Development Congress in Mexico in September 2009.

The Board noted the active role that IWA had played it the World Water Forum and the excellent response from participants in the topics it had organised. The Board recognised the important role that Paul Reiter and Darren Saywell had played in organising these sessions.

Development Congress Mexico 6 to 10 September 2009 – The Board noted the progress with implementing this Congress and the high level of interest in it. It re-emphasised the importance of this congress to the strategic directions of IWA.

Montreal – The Board noted the good progress that was being made with the 2010 biennial Congress.

FORTHCOMING IWA CONFERENCES

22-24 April 2009. London, UK
UK National YWP Conference 2009
Contact: Marianne Knight
Email: marianne.knight@ucl.ac.uk
Website: www.ucl.ac.uk/environment-institute/News/ywpc.htm

26-30 April 2009. Belo Horizonte
Ponds 2009
Contact: Secretariat
Email: ponds2009@acquacon.com.br
Web: www.acquacon.com.br/ponds2009

24 -27 May 2009. Aalbrog, Denmark
Microbial Population Dynamics in Biological Wastewater Treatment
Contact: Per Halkjær Nielsen
Email: phn@bio.aau.dk
Web: www.aspd5.com

31 May- 5 June 2009. Naxo, Greece
Health Related Microbiology
Contact: Alexandra Manou
Email: info@watermicro2009.gr
Web: http://www.watermicro2009.gr/

3-5 June 2009. Durhman, USA
Nanoparticle & Particle Separation
Website: www.ceint.duke.edu/nps09/

8-10 June 2009. San Francisco, USA
Micropol & Ecohazard
Contact: Mary Megarry
Email: mmegarry@nossaman.com
Website: www.grac.org/micropol.asp

10-12 June 2009. Kobe, Japan
Water Technology Supply
Contact: Secretariat
Email: sympo_8th@jwrc-net.or.jp
Web: www.intergroup.jp/water/en/index.html

26-29 April 2009. South Africa
Water Loss 2009
Contact: Secretariat
Email: waterloss2009@randwater.co.za
Web: www.waterloss2009.com

21 -22 May 2009. Minks, Belarus
Eastern Europe Regional YWP Conference
Contact: Maryna Tserashchuk
Email: siwawi@rub.de
Website: www.ywp-wik2009.org

28-29 May 2009. Bari, Italy
Ancient Civilisations
Contact: FederUtility
Email: acqua@federutility.it
Web: www.federutility.it

3-5 June 2009. Shanghai, China
Finding Solutions to the Challenges of the Chinese Water Sector
Contact: Adrian Puigarnau
Email: adrian.puigarnau@iwahq.org
Website: www.iwa-shanghai.org

5 June 2009. Shanghai, China
YWP Workshop at Aquatech China
Contact: Adrian Puigarnau
Email: adrian.puigarnau@iwahq.org
Web: www.ywp.iwahq.com

10 June 2009. Birmingham, UK
Water Loss UK Seminar
Contact: Malcolm Farley
Email: farley.malcolm@googlemail.com

14-17 June 2009. Cairns, Australia
Instrumentation, Control & Automation
Contact: Sandra Hall
Email: s.hall@awmc.uq.edu.au
Web : www.iwa-ica2009.org

15-17 June 2009 - Fredericton, Canada
Forest Industry Wastewater
Contact: Kelly Munkittrick
Email: krm@unbsj.ca
Web: www.unb.ca/cri/pulpmillconference

22-26 June 2009. Singapore
Singapore International Water Week
Contact: Secretariat
Web:
www.siww.com.sg/waterconvention/index.php

23-25 June 2009. Singapore
Leading-Edge Technologies
Contact: Adrian Puigarnau
Email: let2009@iwahq.org
Web: www.let2009.com.sg

3-4 July 2009 - Alexandroupolis, Greece
Asset Management of Medium and Small Wastewater Utilities
Contact: Konstantinos P. Tsagarakis
Email: iwa@econ.soc.uoc.gr
Website: http://iwasam.env.duth.gr

1-3 September 2009 - Beijing, China
Membrane Technology for Water & Wastewater Treatment
Contact: Xia Huang
Email: xhuang@tsinghua.edu.cn
Website: www.iwa-mtc2009.org

6-9 September 2009 – Krakow, Poland
Nutrient Removal
Contact: Jan Oleszkiewicz
Email: oleszkie@cc.umanitoba.ca
Website: www.lemtech.pl/iwaang/

7-11 September 2009 – Tokyo, Japan
Urban Drainage Modelling
Contact: Hiroaki Furumai
Email: furumai@env.t.u-tokyo.ac.jp
Website: www.env.t.u-tokyo.ac.jp/8UDM

17-19 June 2009. Maastrich, The Netherlands
Techneau 2009: Safe Drinking Water from Source to Tap
Contact: Diana Marquardt
Email: diana.marquardt@avt.rwth-aachen.de
Website: www.techneau.eu

22 June 2009. Singapore
Young Water Talents Symposium
Contact: Ms Manesia Ahmad
Email: manesia@ntu.edu.sg

3-5 July 2009 - Alexandroupolis, Greece
Water Economics Statistics & Finance
Contact: Konstantinos P. Tsagarakis
Email: iwa@econ.soc.uoc.gr
Website: www.soc.uoc.gr/iwa

8-11 August 2009. Harbin, China
Sustainable Management of Sludge
Contact: Guoren Xu
Email: iwasludge2009@yahoo.cn
Web: www.iwasludge2009.org.cn

6-9 September 2009 –Mexico City, Mexico
IWA Development Congress
Contact: Darren Saywell
Email: 2009mexico@iwahq.org
Website: www.iwa2009mexico.org

7-11 September 2009 – Tokyo, Japan
Rainwater Harvesting
Contact: Mooyoung Han
Email: rwhm2009@gmail.com
Website: www.rhwm2009.org

10-11 September 2009 – Krakow, Poland
Modelling Activated Sludge Plants Course
Contact: Günter Langergraber
Email: guenter.langergraber@boku.ac.at
Website: www.bnr-iwa2009.pl

11-16 September 2009 – Davis, USA
Biofilms 2009
Contact: Stefan Wuertz
Email: swuertz@ucdavis.edu
Website: www.cevs.ucdavis.edu/Cofred/Public/Aca/ConfHome.cfm?confid=388

12-15 October 2009 – Seoul, Korea
Diffuse Pollution 2009
Contact: Lee-Hyung Kim
Email: leehyung@kongju.ac.kr
Website: www.dipcon2009.org

18-22 October 2009 - Taipei, Chinese Taiwan
ASPIRE 2009
Contact: Novia Perng
Web: www.aspire2009.org

25-28 October – Sydney, Australia
Efficiency 2009
Contact: Secretariat
Email: secretariat@efficient2009.com
Website: www.efficient2009.com

4-6 November 2009. Beijing, China
Asia Pacific Regional YWP Conference
Contact: Organisers
Email:
Web:

11-13 November 2009. Miami, USA
Leading-Edge Strategic Asset Management
Contact: Paul Olsson
Email: lesam@awwa.org
Web: www.lesam2009.org

21-25 September 2009 – Melbourne, Australia
Water Reclamation & Reuse
Contact: Secretariat
Website: www.reuse09.org

18 October 2009 -Taipei, Chinese Taiwan
YWP Workshop at ASPIRE 2009
Contact: Adrian Puigarnau
Email: adrian.puigarnau@iwahq.org
Web: www.ywp.iwahq.com

19-20 October 2009 - Taipei, Chinese Taiwan
Off-flavours at ASPIRE 2009
Contact: Novia Perng
Web: www.aspire2009.org

29-30 October – Copenhagen, Denmark
Water & Energy
Contact: Secretariat
Email: bs@danva.dk
Website: www.iwawaterandenergy2009.org/

11-13 November 2009. Katmandu, Nepal
Decentralized Water & Wastewater International Network
Contact: DEWSIN Conference Secretariat
Email: isanregmi@hotmail.com
Web: www.iwa.nepaliko.com

30 November- 2 December 2009. Palterston North, New Zealand
Water & Industry
Contact: Christine Bond
Email: water09@massey.ac.nz
Website: http://water09.massey.ac.nz/

All the forthcoming IWA conferences are listed on the IWA website:
http://www.iwahq.org/templates/ld_templates/layout_633184.aspx?ObjectId=634697

In the week following the ICA conference in Cairns the Singapore International Water Week will take place, and will include the *Leading Edge Technology* conference, 23 to 25 June.

A conference on *Water and Energy* will be organized in Copenhagen on October 29 to 30. See more details below.

NEWS FROM THE ICA SPECIALIST GROUP

ICA Management Committee Election

To the members of the ICA Specialist Group,

The ICA Specialist Group is in the process renewing the management committee, and five positions will become available, including the positions of Chair and Secretary. Anyone who is interested in serving on the Management committee is invited to apply for a position and to submit the following information:

- Up-to-date CV/resume
- Max 300 word description of how your skills and experiences could be applied to the role and any ideas of future activities for the group.
- The amount of time you are willing to dedicate to the SG activities, e.g. 1 - 2 hours a week

Please submit your self-nominations to the Specialist Group Secretary by return email by no later than May 31, 2009. All nominations will then be put to an open election at the forthcoming ICA conference in Cairns, Australia, June 14-17, where you will be offered an opportunity to present your candidature. We look forward to many enthusiastic self-nominations!

IWA Task Group on Benchmarking of control strategies for wastewater treatment plants

General

The goal of the task group is to develop and promote the use of a benchmark simulation protocol for objective evaluation of control strategies for WWTPs and produce a Scientific and Technical Report (part of IWA Publishing's series). The task group maintains a web site as a means to publicize on-going activities (http://www.benchmarkwwtp.org). Interest in the benchmark protocols has been extensive and the web site is regarded as the best platform for communication with interested parties including getting feedback and getting input from benchmark users whether they are experienced users or just getting started. Dissemination of results as well as inviting the research community to comment and influence the direction of the work is also done via suitable conferences and workshops. Information: Dr Ulf Jeppsson (chair), IEA, Faculty of Engineering, Lund University, PO Box 118, SE-221 00 Lund, Sweden. Phone: +46 46 2229287; fax: +46 46 142114; e-mail: ulf.jeppsson@iea.lth.se.

Short report from the IWA TG on Benchmarking on Control Strategies for WWTPs: – Dr Ulf Jeppsson

The *IWA task group on Benchmarking of Control Strategies for WWTPs* is now making a final effort to report, present and publish the research that has been ongoing for the last 12 years. Since the last task group (TG) update report in the ICA Newsletter (no 2, 2008), the BSM TG has focused on creating finalised software versions of the BSM1, BSM1_LT and BSM2. Moreover, about 15 detailed technical reports have been written, which will be published together with the future STR on an enclosed CD. The complete source code for the BSMs for several software platforms will also be included. As the BSM-STR editor-in-chief, Dr Krist V. Gernaey is coordinating the writing effort. A first draft of the STR will be delivered to IWA Publishing by the end of this summer and hopefully the entire work will be published towards the end of 2009.

The IWA Task Group on Good Modelling Practice

Task Group news

The IWA Task Group on Good Modelling Practice continues its work on a Scientific and Technical Report (STR) on the Use of Activated Sludge Models in Practice. A meeting in Bordeaux, France at the end of 2008 focussed on the development of procedures to analyse data quality and reconcile data for simulation studies. At the same meeting the structure of the report was refined. Another meeting took place in Nogi, Japan, in March 2009 to finalize a first draft of the STR. The goal is to send out the STR for external review in late summer and we hope to publish the report beginning of 2010.

The results of our first questionnaire will be published in one of the next issues of Water Science & Technology (see Hauduc *et al*. 2009, see article below). For the second questionnaire we received several answers so far but are looking for more input and are looking forward for YOUR contribution (see below)! Work is also ongoing to investigate implementation errors for published ASM models.

Training Course

A 2-day introductory modelling course will be organized following the IWA 2nd Specialized Conference on Nutrient Management in Wastewater Treatment in Krakow, Poland on September 10 and 11, 2009. See the conference website for more details:
(http://www.bnr-iwa2009.pl/index.php?d=4/modelling) or contact Günter Langergraber:
(guenter.langergraber@boku.ac.at) for further information.

Activated Sludge Modelling in Practice - International Surveys – H. Hauduc, S. Gillot, L. Rieger, T. Ohtsuki, A. Shaw, I. Takács and S. Winkler

The Good Modelling Practice Task Group (GMP-TG) of the International Water Association (IWA) is developing guidelines for the use of Activated Sludge Models (ASM). As part of this work the group created and sent out a questionnaire to current and potential activated sludge model users in 2007. The objectives of the questionnaire were (i) to better define the profile of ASM users, (ii) to identify the tools and procedures that are actually used and (iii) to highlight the main limitations while building and using ASM-type models.

Ninety-six answers were received from all over the world from several types of organisation. The results were analysed to identify the modellers' perceptions of models depending on their profile. This survey provided useful insights into the use of activated sludge models. It also pointed out the main limitations of modelling and the expectations of users for improvements. The full results of this survey are described in Hauduc *et al*. (In press).

Generally speaking, the majority of North-American and European modellers are using models in different ways. In Europe, models are most often used by researchers for optimisation purposes, while in North America most modellers are employed by private companies and carry out design studies. Modelling is an engineering tool, but a lack of relevant training has been highlighted. This study also reveals that models are sometimes not properly applied, probably due to a lack of knowledge and standardised procedures.

The development of standardised modelling procedures and better knowledge transfer by making some practical case studies available should address such obstacles as:

- the complexity (apparent or actual) of the model theories and modelling procedures,
- the time consuming steps and therefore the cost of modelling and
- the modellers' appreciation of the reliability of the models.

A second questionnaire was developed in 2008 to:

- clarify some results of the first questionnaire
- provide inputs for the GMP task group report such as typical values and case studies from several countries and different wastewater treatment conditions

Probably due to the higher complexity of the second questionnaire only twenty-eight answers were received. Nevertheless, these answers will enable the task group to build a database of modelling projects that will be complemented by published modelling studies. This database will also provide typical values and parameters depending on the environmental and wastewater treatment conditions.

We would still appreciate your contribution. Please download the questionnaire and send it to helene.hauduc@cemagref.fr. Questionnaire Number 2 Download: http://www.iwahq.org/templates/ld_templates/layout_633184.aspx?ObjectId=676413

Reference: H. Hauduc, S. Gillot, L. Rieger, T. Ohtsuki, A. Shaw, I. Takács, S. Winkler (In press). Activated Sludge Modelling in Practice - An International Survey. *Water Science and Technology*.

More information

For more information see our website: www.modeleau.org/GMP_TG or contact the Task Group Chair, Leiv Rieger, leiv.rieger@gci.ulaval.ca.

Work Group on Real-time Control of Urban Drainage Systems (RTCUDS)

General

The work group is part of the International Joint Committee on Urban Drainage of IWA and IAHR (International Association on Hydraulic Research) and resides under the IWA Specialist Group on Urban Storm Drainage. The objectives are to promote the appropriate and beneficial use of Real Time Control in Urban Drainage Systems, disseminating information about procedures, coordinating research and developing activities related to system design, operation, rehabilitation, maintenance and control. The intention of the group is to bridge the gap between the actual available technology and its use in urban drainage systems. More information on the Work Groups' activities is available at the group's website http://www.dica.unict.it/users/acampisa/rtcwg/. Information: Dr. Alberto Campisano (chairman), University of Catania, Italy, Phone: +39 (0)95 7382730, Fax: +39 (0)95 7382748, e-mail: acampisa@dica.unict.it, and Dr. M. Pleau (secretary), BPR-CSO, Quebec, Canada; Phone: 001-514-257-2439, Fax: 001-514-257-2414, E-mail: Martin.Pleau@bpr-cso.com. Work Group Web site: http://www.dica.unict.it/users/acampisa/rtcwg/

PAST AND FORTHCOMING ICA-RELATED CONFERENCES

10th IWA Conference on Instrumentation Control and Automation, Cairns, Australia, 14-17 June 2009.
Draft Programme can be found on the following website: http://www.iwa-ica2009.org

TECHNEAU Conference, Safe Drinking Water from Source to Tap, Maastricht, The Netherlands, 17-19 June 2009
The conference will provide a leading podium for those professionals concerned with drinking water challenges and adaptive strategies. TECHNEAU, in cooperation with other research programmes in Europe and beyond, will present state-of-the art and breakthroughs on water treatment technologies, sensors and monitoring and water systems simulation and operations. The conference will also address small scale systems, risk assessment and risk management and consumer issues. Special attention is given to the implementation of research outcomes in practice. Workshops and field trips will allow participants to contribute actively. One of the workshops serves to shape the WSSTP research agenda on water treatment technologies. The topics that will be discussed include Sensors and monitoring and further: Treatment, Small scale systems, Risk assessment and risk management, Distribution, Alternative water supply & sources, Consumer involvement, Future drinking water, Strategies to address challenges of the water sector, Highlights of ongoing EU water research projects. You can find more information on:
www.iwahq.org/templates/ld_templates/layout_633184.aspx?ObjectId=679562 or on the organiser's website: www.techneau.org/index.php?id=45

Conference on Water and Energy, Copenhagen, October 29-30, 2009
Water & Energy 2009 – *mitigation in the water sector & potential synergies with the energy sector*. The conference website www.iwawaterandenergy2009.org provides updated details.

Water and energy are two critical resources for which there are already competitions in some societies. Climate changes will also affect both sectors, and consequently protective countermeasures (adaptation) as well as preventive measures against further climate changes (mitigation) will be required.

Water resources needed for power production (cooling water, …) in competition with other uses (agriculture, urban water abstraction, ...) and environmental impacts (hydropower dams, ..) are examples. Power consumption for water management conducted by utilities may rise drastically in case of overexploitation or drought induced reductions of natural water resources in megacities with fast growing populations (desalination, ...). Similarly, higher water quality demands to ensure biodiversity according to environmental regulations may require extended wastewater treatment normally leading to higher power consumptions and carbon footprints. All this requires effective innovation and changes in behaviour.

The IWA Water and Energy 2009 Conference puts focus on measures for mitigation in the water sector and potential synergies with the energy sector. The conference will be a forum for knowledge sharing among a multitude of stakeholders. Keynotes, platform and poster presentations on state-of-the art and ongoing pioneering efforts will set the scene for intense and constructive discussions. Messages from the conference will be condensed and refined into statements forwarded to the UN Climate Change conference (COP15) December 2009.

For more details, please contact any of the Program Committee co-chairmen, Gustaf Olsson (Gustaf.olsson@iea.lth.se) or Bo N. Jacobsen (Bo.Jacobsen@eea.europa.eu).

2nd IWA/WEF Wastewater Treatment Modelling Seminar, March, 2010

Following on from the success of WWTmod2008, we are pleased to announce that the 2nd IWA/WEF Wastewater Treatment Modelling Seminar (WWTmod2010) is scheduled for March 28-30, 2010.

The seminar organizers are working on the call for contributions which will be distributed in the next few weeks. There is also still a chance to become a sponsor for this unique event on wastewater treatment modelling. For more information please contact Peter Vanrolleghem: (peter.vanrolleghem@gci.ulaval.ca).

PhD THESES DEALING WITH ICA

All PhD students and their supervisors around the world are invited to contribute to this section of our next Newsletter by sending an abstract of maximum one page and, if possible, details on how to get hold of a copy of the thesis.

Multivariate and qualitative data analysis for monitoring, diagnosis and control of sequencing batch reactors for wastewater treatment

Kris Villez, BIOMATH, Ghent University, Belgium
Supervisor: Prof. Peter A. Vanrolleghem
Download: http://biomath.ugent.be/biomath2/publications/download/villezkris_phd.pd

This thesis deals with the development, application and validation of techniques for data analysis in view of supervisory control of cyclic systems, including and integrating aspects of monitoring, diagnosis and control. Two so far largely separated tools for data mining of process data are used as a basis for the presented developments. These are Principal Component Analysis (PCA) and Qualitative Representation of Trends (QRT). A pilot-scale sequencing batch reactor (SBR) for wastewater treatment is used as a case study for the major parts of the work presented. Another application is pursued regarding the analysis of flow measurement time series derived from an urban drinking water network.

The pilot-scale SBR setup studied throughout the work has served as a valid source of data-rich information-poor data sets, which are consequently used for evaluation of several data analysis tools for process supervision and control. It is observed that the design of the given experimental unit is suboptimal in view of the desire to discriminate between physical and biological failures of the system. In fact, an impending need exists to detect and diagnose biological faults, and the intent was to develop and evaluate techniques for this purpose. Several remarks and suggestions for improved design of experimental setups are given.

The first of the evaluated approaches for data analysis, Principal Component Analysis, is popularly reported as a straightforward method to deal with correlated measurements in the context of process monitoring and diagnosis. In view of fundamental limitations of the original (linear) PCA technique, a myriad of extensions and adjustments that deal with non-linearity, dynamics, natural changes of processes and the typical three-dimensional nature of batch process data (i.e. batch index, time-in-batch and measured variable), are already presented in literature. However, a lack of proper evaluation, validation and comparative studies is observed. In addition, the concepts of Maximum Likelihood and bias-variance trade-off, already theoretically presented for PCA modelling excercises, have so far been left unattended at large by the process monitoring research community.

A conventional extension for batch process data, Multi-way PCA (MPCA), is evaluated for process monitoring of both the hydraulic parts of the system only as well as for the multivariate data of the complete SBR system. For many types of faults, good performance rates are obtained by means of the MPCA models. In this, the performance proves to be rather insensitive to choices in the modelling stage such as the chosen approach for scaling of the data. Peculiar types of faults, which are of a time-local or frequency-local nature, are not likely detected by the presented approach. It is therefore concluded that process monitoring should integrate techniques that allow the detection of such events, e.g. by making use of the wavelet framework already presented and applied for process monitoring. Also, suggestions for improvement of PCA modelling practice, not limited to the case study, are added.

Modelling by means of MPCA is also used as a basis for process diagnosis. Explorative treatment of the diagnosis problem showed that MPCA is a straightforward tool to visualize and recognize faults. Despite this result, automatisation of this recognition process by means of combination of MPCA and fuzzy clustering is found to be applicable to a limited extent and therefore remains suitable for further research. Suggested modifications may lead to increased interpretability of the models, more generalized and appropriate representation of reality and, overall, improvement of diagnosis performance.

SBR systems are characterized by their cyclic operation and the recognition of several phases that constitute the cycles. The time length of cycles and phases is not necessarily the same for each cycle which allows large flexibility in design and operation. Generally speaking, the determination of the optimal lengths is not an easy task. Therefore, a new control scheme for phase length optimization is proposed, applied in real-time and evaluated as successful. In the proposed scheme, the Hotelling's T2 statistic, which is also defined in the context of PCA, is used to define a region in the data space, corresponding to the targeted completion of biochemical reactions. If sufficient consecutive multivariate data samples are found within this region, the necessary reactions are judged to be complete signifying that the running phase can be shut down safely. The control scheme proved technically successful and is shown to lead to significant improvements in effluent quality of the studied SBR system, hereby representing a clear proof of concept.

The second approach used for automated data analysis is taken from the field of qualitative analysis. Qualitative analysis aims at the qualitative description of data and has so far largely been concentrated on the qualitative representation of time series. Following a review and evaluation of available techniques, it is concluded that proper identification of inflection points is not possible on the basis of the most generic techniques available in literature. One technique, based on the cubic spline wavelet decomposition, is selected and improved in such a way that inflection point detection is possible in a more reliable and consistent way. Suggestions for other observed problems, such as the inability to appropriately detect jump changes by means of the cubic spline wavelet method and the lack of robustness associated with the interval-halving approach found in literature, are proposed.

The qualitative analysis framework is successfully evaluated for data mining of time series typical for urban drinking water networks. Qualitative analysis proved to reveal details of the studied time series that are not obvious from the more classic wavelet spectrum analysis technique. In an application to the studied SBR system, the qualitative analysis technique is integrated into a preliminary design for closed loop supervisory control on the basis of qualitative analysis. To this end, two simple tables, one connecting the qualitative analysis results with corresponding diagnostics and another connecting the diagnostics with proposed control actions, are devised.

In the closing chapter, Conclusions and perspectives, the decision to develop monitoring schemes in the absence of knowledge, which was fundamental to the earlier choice for data-driven approaches, is evaluated critically. It is indicated that the presumed absence of knowledge proves not to correspond to the now historical reality. Based on the latter observation, mixed approaches, taking the best of knowledge-driven and data-driven approaches, are motivated for future practice in process analysis and supervision. In addition, several suggestions are given with respect to multivariate and qualitative analysis, including improvements and extensions of currently available techniques as well as new applications and opportunities for data analysis.

PUBLICATIONS

Titles already described in previous editions of this Newsletter

- Biological Wastewater Treatment – Principles, Modelling and Design. M. Henze, M. C. M. van Loosdrecht, G.A. Ekama and D. Brdjanovic (Editors). Publication Date: 02 Sep 2008 • ISBN: 9781843391883, Pages: 528 • Hardback
- Advanced Environmental Monitoring. Kim, Young J.; Platt, Ulrich (Eds.) 2007, XXII, 422 p. ISBN: 978-1-4020-6363-3.
- Automation and Control Solutions in the European Water and Waste Water Sector. Frost & Sullivan, January 2007, Pages: 117
- European Pumps in the Water and Waste Water Markets. Frost & Sullivan, September 2006
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- Instrumentation, Control and Automation in Wastewater Systems. IWA Scientific & Technical Report No. 15. G. Olsson, M. Nielsen, Z. Yuan, A. Lynggaard Jensen and Jean-Philippe Steyer (2005). IWA Publishing. ISBN: 1 900222 833. Pages: 246. Paperback. Publication Type: Books.
- Role of ICT in future operation of wastewater treatment plants Foundation for Applied Water Research (Stowa), Report 2003-03. ISBN: 90.5773.206.8. (In Dutch.)
- Dynamical Modelling & Estimation in Wastewater Treatment Processes. ISBN: 1 900222 507. D. Dochain and P. Vanrolleghem (2001) Publication Date: December 2001. Pages: 360. Hardback. Publication Type: Books.

MULTI-NATIONAL PROJECTS

NEPTUNE – New Sustainable Concepts and Processes for Optimization and Upgrading Municipal Wastewater and Sludge Treatment: Fault-tolerant Control

As part of the NEPTUNE project (www.eu-neptune.org) innovative fault-tolerant and efficient control systems for wastewater treatment are being developed. The focus is on finding an efficient and trustworthy combination of monitoring, diagnosis and control concepts. The first result of the work is an evaluation tool to compare monitoring and diagnosis algorithms, that allows selecting the most appropriate algorithms for each situation (this work will be presented at the ICA2009 conference). Current research aims at defining different levels of control for nitrogen and phosphorus removal and at developing fall-back strategies in case of failing equipment. In order to compare the performance of the strategies different evaluation criteria are being developed. In this sense, Life Cycle Analysis (LCA) criteria are included for evaluating the process performance under different control strategies. Cooperation is going on with the IWA Task Group on Benchmarking control strategies to develop the sensor, fault and inhibition models, and monitoring performance evaluation criteria that will be shared between both projects.

Contact for "Fault-tolerant Control" within the NEPTUNE project: Dr. Lluís Corominas: Lluis.corominas@gci.ulaval.ca

Running projects already described in previous editions of this Newsletter

- ADD-CONTROL project. More information: Eduardo Ayesa Iturrate, Director of Environmental Engineering Department, CEIT - IK4 Research Alliance, Paseo de Manuel Lardizabal, 15, 20018 San Sebastián, SPAIN, Tel: +34 943 212800 (Ext. 2215), Fax: +34 943 213076, http://www.ceit.es.
- AquaFit4use (7th Framework programme). Coordinator of the Project: Willy van Tongeren (willy.vantongeren@tno.nl), TNO, The Netherlands. Coordinator of the Working Package 2 "Modeling, monitoring and automation in industrial water systems": Dr. Paloma Grau (pgrau@ceit.es), CEIT, Spain
- NOVEDAR_Consolider. Coordinator of the Project: Prof Juan Lema (jmlema@usc.es), University of Santiago de Compostela, Spain. Webpage: http://www.novedar.com/en/default.asp. Coordinator of the Working Package 6 "Integrated Modelling and Control": Dr. Eduardo Ayesa (eayesa@ceit.es), CEIT, Spain.
- EU-NEPTUNE project (6th Framework Program). Contact: Prof. Hansruedi Siegrist (hansruedi.siegrist@eawag.ch). "Fault-tolerant Control" within NEPTUNE, Contact: Dr. Leiv Rieger (leiv.rieger@gci.ulaval.ca)
- Recommendations for the calibration and evaluation of pH on site measuring instruments. Project coordinator: Cedric Rivier, cedric.rivier@lne.fr
- Water Supply and Sanitation Technology Platform: Technical Working Group 'Urban and Peri-Urban Water Systems'. EU platform. More information : www.wsstp.org
- Sustainable Management of Water Resources by Automated Real-Time Monitoring (ALERT). Project co-ordinator: Dr R.D. Ogilvy, rdo@bgs.ac.uk, http://coastal-alert.bgs.ac.uk

Readers are invited to contribute to this section of our next Newsletter by sending an article of one-two pages.

Cost/Benefit of Process Optimization on Wastewater Treatment Plants

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Process optimization on a wastewater treatment plant should start with a thorough "walk through" of the plant together with the plant manager in order to understand the process lay-out and the possible "bottlenecks" of the daily operation. Next step should be to make a list of different initiatives which will solve/mitigate the "bottlenecks" without bigger construction works, and discuss the list with the plant management before making a detailed description of selected initiatives. Detailed descriptions of each initiative should include:

- Possible changes in plant configuration incl. minor construction work
- Needed sensors and actuators (like frequency controllers)
- Description of the planned process control
- An estimate of the results of the initiative divided into yearly values of:
    - Reduction of use of resources – energy and chemicals
    - Reduced effluent values – lower effluent tax*
    - Increased capacity - depreciation period 25 years
- Initiative costs and an estimate of the period for the return of the investment (ROI) in order to be able to select the most profitable initiatives – if initiatives are not driven by legislation

*In Denmark there is an effluent tax of €1.48/kgBOD, €2.68/kgTN and €14.77/kgTP, which gives an easy way of putting costs to reduced effluent values – obviously effluent values also have to comply with effluent standards.

The above procedure has been used in four projects on wastewater treatment plants operated by the utility Aarhus Water and Wastewater for the Municipality of Aarhus, Denmark. The estimates of the ROI of the initiatives selected were ranging from 1.5 to 3 years, and the most profitable initiatives with an estimated ROI of less than 2 years were implemented. After implementation the value and the ROI of the initiatives were calculated again based on actual measurements.

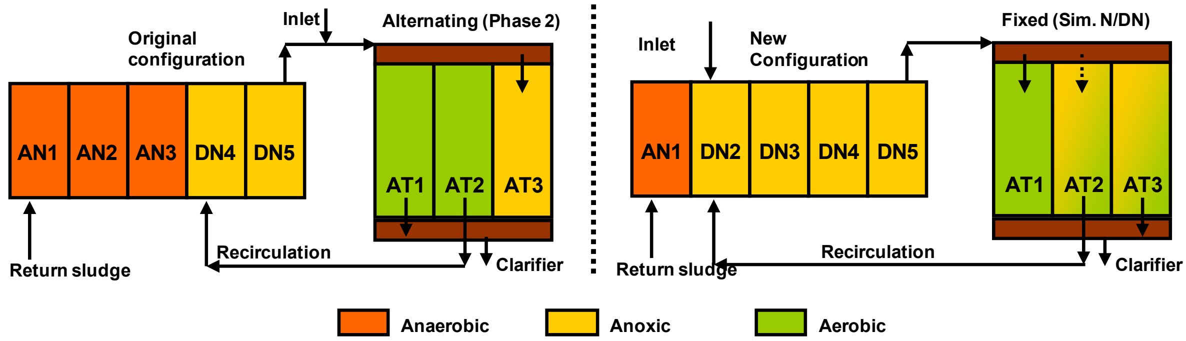
Economic results: Process Optimization - Municipality of Aarhus	Unit	Wastewater Treatment Plant				Total
		Marselis	Egaa	Viby	Aaby	
WWTP size	PE	200,000	120,000	83,000	84,000	487,000
Reduction of use of resources	EUR/year	73,000	31,000	40,000	132,000	276,000
Reduced effluent values	EUR/year	114,000	19,000	27,000	2,000	162,000
Increased capacity	EUR/year	54,000	50,000	132,000	27,000	263,000
Total	EUR/year	241,000	100,000	199,000	161,000	701,000

The above table reports the actual achieved results, and it clearly demonstrates that there is a potential in using ICA based process optimization – not only related to economy but also towards environmental impact (reduction of effluent values and CO_2-footprint at the same time). Further, the estimated values of the ROI proved to be relatively conservative. However, due to changing loads on the wastewater treatment plant it can be difficult to measure the value of the implemented initiatives in absolute figures, and it is suggested to use key performance indicators as described below.

Process optimization is a true multi disciplinary task and in order to describe the above procedure in more detail, the work done at wastewater treatment plant Viby is used as an example. The "bottlenecks" could be described as:

- The plant has to be operated with a high suspended sludge content (> 7 kg SS/m^3) in order to reach the necessary aerobic sludge age to secure nitrification
- Effective secondary clarifier area too small during rain – not only due to the high suspended sludge content, but also due to a skew distribution of the load between clarifiers.
- COD/N ratio is not favourable for denitrification

Changes in plant configuration: Process tanks re-configured as shown below – going from a combination of a recirculation and alternating system to a "clean" recirculation lay-out - knowing the risk of losing the Bio-P process by reducing the anaerobic volume in order to have anoxic volume moved from the alternating aeration tanks (AT1-3).



Re-configuration allow the plant to be operated with a suspended sludge content around 4 kg SS/m^3 still giving the necessary aerobic sludge age to secure nitrification. Further, an old sludge concentration tank which were not in use anymore, were set up to internally produce a carbon source using hydrolysis of primary sludge. The supernatant is pumped to a buffer tank and can be dosed to AT3, the resulting sludge is pumped to the inlet of the process tanks.

Needed sensors and actuators: Beside existing flow meters it is necessary to have ammonium and nitrate sensors after DN5 and in AT1-3. Suspended solids and sludge volume meters are placed in the outlet channel from AT1-3. Sludge blanket meters are mounted in the clarifiers. Frequency controllers exist on recirculation and return sludge but not on dosing pump to AT3.

Planned Process control: For the process tanks below controls were planned/implemented:

- Weir opening to AT2 relative to load estimate calculated from NH_4 sensor after DN5
- Surface aerators (each aerator: high/low/off) in AT1-3 after NH_4-setpoints for each tank
- Carbon source dosing in AT3 after NO_3 sensor in AT3
- Recirculation according to NO_3 sensor after DN5

For the two sets of clarifiers (4 clarifiers/set) below controls were planned/implemented:

- Balanced (flux-based) overall return sludge pumping from each set of clarifiers according to suspended solids and settling velocity estimated from the sludge volume meter
- Balanced load between clarifiers in the same set by distributed return sludge pumping according to sludge blanket meters
- Balancing load between sets of clarifiers using rate of change of average sludge blankets in each set of clarifiers to distribute the flow to each set

After re-configuration, installation of sensors/actuators and implementation of the real time control, the performance of the initiatives were calculated – for reduction of resources using performance indicators. The calculation of used energy per kg of removed Total Nitrogen (kWh/kgN-removed) is given as an example. A one year period P1 (July 2005-June 2006) representing plant operation before the process optimization is compared to a one year period P2 (July 2007-June 2008) representing plant operation after process optimization.

The main energy consumption to operate the process tanks is lying with the surface aerators, and is therefore used as the variable part of the energy used for Nitrogen removal, whereas the more fixed part is lying with mixers, etc. A change of the performance indicator "Specific energy use" measured as kWh/kgN-removed will therefore reflect the re-configuration of the process tanks and the direct control of aerators from ammonium measurements.

The use of energy to operate the process tanks in the two periods is shown below, and as can be seen less energy has been used in P2 (after process optimization) – the direct measured reduction being 153,728 kWh/year or 11.5 % less energy used in P2 than in P1.

		Process tanks		
		Energy	N removed	Spec. Energy
Period	Description	kWh/d	kg/d	kWh/kgN
1	No. of data	365	136	136
	Average	3668	419	9.6
	Period total	1342508	153353	-
2	No. of data	366	133	133
	Average	3248	490	7.2
	Period total	1188780	179259	-
Difference (2-1)	Average	-420	71	-2.4
	Period total	-153728	25906	-
	Difference in %	-11.5	16.9	-25.0

However, in P2 approximately 26 tonnes more TN have been removed, and the performance indicator shows a reduction from 9.6 to 7.2 kWh/kgN-removed, which is a saving on energy of 2.4 kWh/kgN-removed or 25 %. This is the real observed effect of reducing the suspended solids content in the process tanks (reduced endogenous respiration) and implementation of direct control of aerators after the ammonium concentration (only necessary aeration giving a lower DO and also simultaneous nitrification/denitrification).

Similar performance indicators have been used for the other initiatives, some of these also leading to increased capacities – in the Viby case it is obvious that a reduction of the suspended solids content in the plant together with the control of the return sludge and the distribution of the load to the clarifiers will increase the hydraulic capacity of the plant – the value of the increased capacity being calculated as the needed investment in clarifier area using the original configuration of the process tanks.

Finally, the wastewater treatment plants are now showing a much higher degree of stability, because controllability is increased. Ammonium setpoints for the aeration tanks at wastewater treatment plant Viby are now directly reflected in the effluent values, which means that effluent values can be selected to be a compromise between saving on the energy (reduced CO_2 footprint) or further minimize effluent values (increased CO_2 footprint).

Testing flow-meters using a field-laboratory

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The existing control system for the pumping stations is at the end of its life span in the municipality of Breda (the Netherlands). For this reason in 2003 a decision was made to replace the system by a new control system, which is equipped with the most modern information and communication technologies. This new system will collect a large quantity of data from several sources of information.

A field laboratory has been built for training purposes of the new system as well as to allow research in overflow measurements and flow-measurements in (partly-filled) sewers. There are many ways to regulate the flow. Experiments can be conducted with groundwater and real wastewater.

Using this field laboratory four different types of flow-meters are tested in the range 150-450 m^3/h and compared with a fully calibrated flow-meter in the pressure pipe line connected to the pump. Three types of tests have been carried out: determining stabilization time, testing flow-meters for 100% filled sewers and testing flow-meters for partly-filled sewers. In this newsletter some results of tests conducted with different types of flow measurement devices are described. For more details we refer to the literature. To get insight in the best accuracy to obtain under field conditions the possibility was created to install the measurement devices at different locations. There was also direct access to the data of the calibrated flow-meter.

Field laboratory

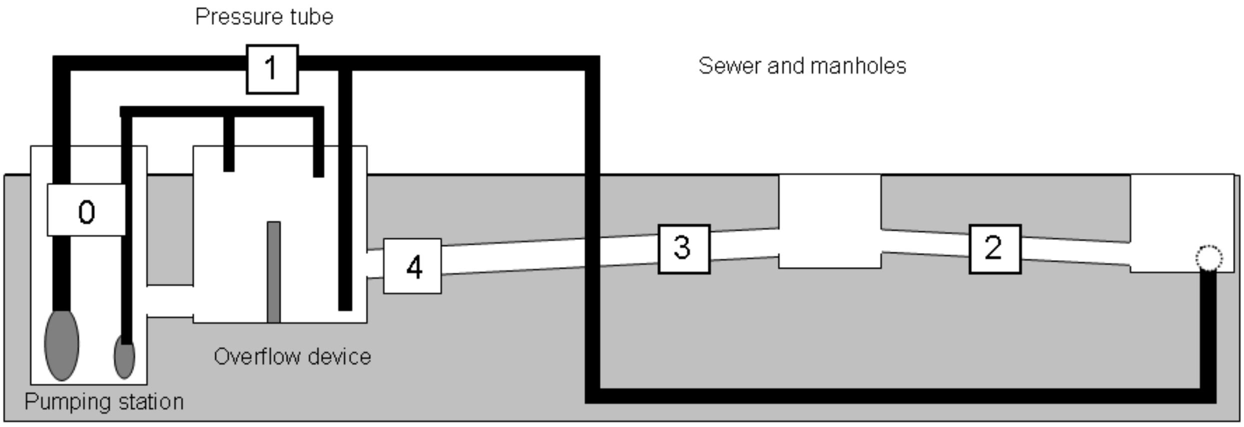
Sewer pipe line (50m)

Pumping station

Spill in overflow-manhole

Overflow structure

Diffusion wall



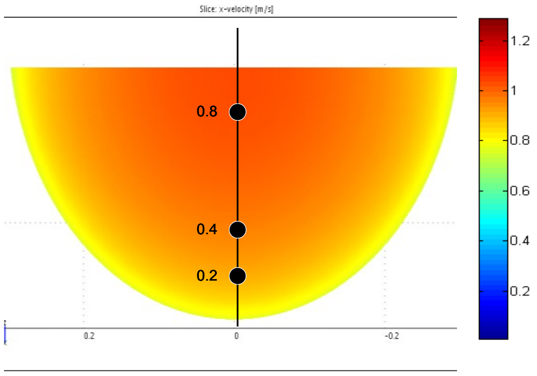
Schematics of the field laboratory. Different flow-meters are installed for testing. 0: electromagnetic flow-meter (factory-calibrated); 1: ultrasonic flow-meter (clamp-on); 2: electromagnetic flow-meter (mouse); 3: Doppler/ultrasonic flow-meter; 4. radar flow-meter (contactless).

Field Laboratory

The field laboratory consists of three main parts: the pumping station, the overflow device and the sewer pipeline with two manholes, see pictures. The manhole at the end, the inflow manhole, receives the pumped water and the one in the middle of the sewer is to install monitoring devices like flow-meters. Water can be pumped from the pumping station through the pressure tubes to the overflow device or to inflow-manhole. By gravity, water will flow through the sewer to the overflow device and eventually to the pumping station.

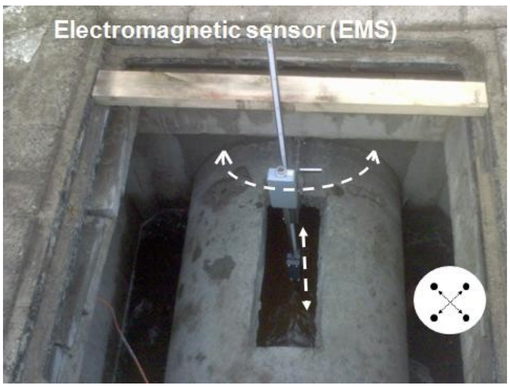
For the tests described in this paper, the electromagnetic flow-meter, which is located above the large pump, is used for reference. The flow-meter was calibrated in the manufacturers factory. The accuracy of the meter is 0.5-2% for flow rates smaller than 100 m^3/h and 0.5% for flow rates larger than 100 m^3/h.

Correction for disturbance
Normally flow is calculated out of the mean velocity and the wet surface. But in comparison with for instance overflow-structures the flow needs to be calibrated for disturbances, the local situation and flow-conditions. This correction factor needs to be determined in situ. Companies often use factory-calibrated parameters or use the 3-points method to measure the mean velocity. With the common used three point method the manufacturers assume a normally distributed velocity-profile (see figure).



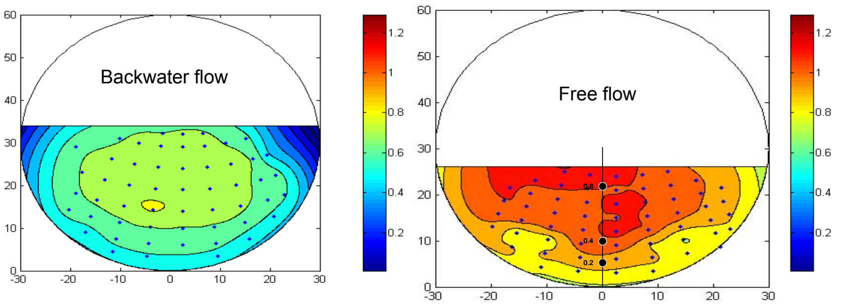
$Q = \alpha \cdot u \cdot A(h)$
where: u = measured velocity, A(h) = wet section, α = correction factor.

To verify if this type of velocity profiles occur in sewer systems the velocity was measured in a partially filled sewer using an electromagnetic sensor. The EMF has 4 cross-linked sensors to measure the velocity. It was installed in the sewer and stepwise moved in other directions (x,z).



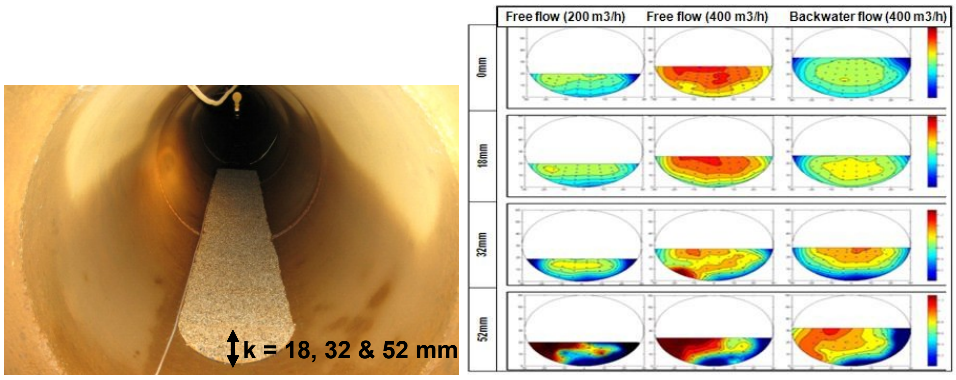
The measured points are marked as spots in the figures below. One for free flow conditions and one for backwater conditions.

We found out that the measured velocity profiles were quite different from the theoretical velocity distribution profile. For free flow conditions the bias was higher than for backwater flow conditions (skewness). Under backwater flow conditions it is also visible that the surface velocity is not representative to obtain the mean velocity. However, to calibrate non-contact flow-instruments, manufacturers often use the surface velocity as representative for the mean velocity. By using the 3-points method the bias-error can reach to about 30%. The velocity profile disturbance is caused by small disruptions like stones, concrete, profile disruptions, skew inflow, resistance of air etc.



Influence of profile disruptions

To determine the influence of sludge in sewers on the accuracy of flow-meters three layers of artificial sludge were installed. Layers of 18, 32 and 52 mm were used. The bias error increased from 5 to 40%. The next figure shows the different measured velocity profiles for different flow conditions and different thickness of layers. Hardly any profile looks like the theoretical velocity profile distribution.



Comparison of two instruments

We also have compared two flow-meters with the factory calibrated flow-meter. The in-line Flo-Tote and the contactless Flo-Dar. The precision of the Flo-Tote (which is installed in the waste water flow) is about 20%. The precision of the Flo-Dar (which is a non-contact instrument) is about 50%. The main reasons for this inaccuracy are the fact that the surface velocity is not representative for the velocity and also reserve flow conditions are not detected. To determine the reflection of the beam the Flo-Dar-system uses an FFT-algorithm. This algorithm has to detect the peak over threshold values. But it appeared that not always the right peaks were detected, so the algorithm is not yet secure enough.

Conclusions

The main conclusion of our research is that we must not have too high expectations of the accuracy of flow-meters in partially-filled sewers. Even with an in-situ calibration and sensors free of material, bias-errors of max. 50% are to be expected! For this reason flow-meters better be installed in 100% filled conduits (if possible) and if installed in partially filled conduits no obstacles/sludge may influence the flow-meter. A break-through in measuring techniques or in situ calibration methods is necessary to reach higher accuracies.

Literature
Testing flow-meters using a field laboratory. *International Congress on Urban Drainage (ICUD11)*, Edinburgh Scotland, September 2008.
Heleen de Man (2008) On the applicability of discharge measuring techniques in partially filled conduits. TU-Delft, August 2008.
H. de Man, M. Moens and M. Klootwijk (2008) Onderzoek naar de nauwkeurigheid van debietmetingen in deels gevulde leidingen. *Rioleringswetenschap* No 31, September 2008.

Improving design of measuring and control systems by introducing sensor models into dynamic WWTP simulation

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Nowadays, there is an increasing interest and demand for using sensors/analyzers to monitor and control wastewater treatment plants (WWTP). A variety of sensors is available on the market with different characteristics. To test and compare control strategies model-based approaches are widely used. However, normally sensor and actuator models are not included or the models assume the sensors to be ideal (i.e. no response time and no noise). A proper use of sensor models describing their actual behavior would make the results of the simulations more realistic. The objective of the presented study was to analyze the influence of different kinds of sensors on controller and WWTP performance and energy consumption. The focus is on the implementation of sensor behavior into sensor models and their inclusion in WWTP models.

The BSM1 simulation platform developed by the IWA Task Group on Benchmarking Control Strategies was used. The benchmark system provides a standardized environment to run simulations in order to objectively compare control strategies by having a standardized influent, plant configuration, size and dynamics. In this case, a cascade control strategy was used to manipulate the aeration, using on-line DO and NH_4 measurements (a NH_4 On-Off controller defined the DO setpoint). A NO_3 controller manipulating the internal recycle flow rate guaranteed optimal denitrification. Different combinations of sensor models were tested, which were set up based on experimental data (according to ISO 15839, 2003), and on a set of predefined sensor classes (Rieger *et al*., 2003).

The comparison of the simulation results showed that process and control performance change with different sensor characteristics (see Figure 1). It was found that the use of slow sensors (higher response time or sampling interval) increases energy costs (aeration supply and pumping energy) and effluent concentrations. For the specific control strategies tested it was observed that an increase in response time of the DO sensor had more effect on the cost than an increase in the NH_4 sensor response time. The results also showed that the use of slow sensors may decrease nitrogen removal efficiency. It is therefore concluded that proper selection and use of sensors is necessary to ensure good performance of the controller and of the overall system. Using sensor models in model-based comparisons of control strategies can help making the proper selection.

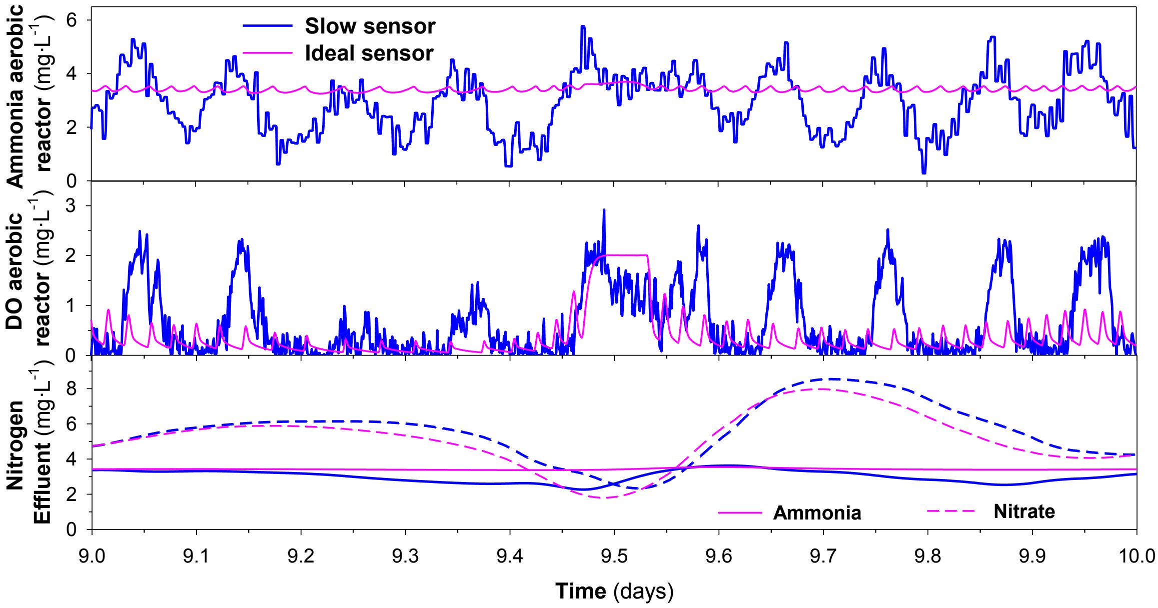

Figure 1. WWTP performance when using ideal and slow sensors (response time of 30 min for NH_4^+ and 5 min for DO; measuring interval of 5 min for NH_4^+) in the closed loop operation (up and middle: output values of the sensor models; down: true values in the effluent).

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ISO (2003) *Water quality -- Online sensors/analyzing equipment for water -- Specifications and performance tests.* ISO 15839.

Rieger L., Alex J., Winkler S., Boehler M., Thomann M. and Siegrist H. (2003). Progress in sensor technology - progress in process control? Part I: Sensor property investigation and classification. *Water Sci. Technol*. **47**(2), 103–112.

ICA-RELATED URLs

Associations
http://web.tiscali.it/RTCUSD
http://www.atv-dvwk.de
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http://www.iea.lth.se

Newsletters:
http://www.omeda.com/wwr

NEWS FROM IWA PUBLISHING

Water Science and Technology

During the past few months the editorial team has been significantly upgraded. We have now implemented a list of 20 categories, "large" and familiar topics that comprehensively cover the whole scope of the journal. The author submitting a paper now has to indicate one broad category that should characterize the paper. Then the paper can be sent ***automatically*** to the editor responsible for this topic area.

We use the well known Editorial Manager online submission and peer review system (as used for Water Research and the Elsevier Science journals, amongst many others) and, after some problems in the implementation phase last year, we now have a robust system that works well.

We now have an editorial team with an impressive competence. Each one of the 20 categories has a responsible editor. This editor can further rely on associate editors from each one of the Specialist groups. The senior editors are now used both as backups for the "category" editors and as advisors for the improvement of the journal. This means that we now have an editorial team of more than 65 people. You will find the complete list on the website http://www.iwaponline.com/wst/default.htm Considering the increasing flow of submitted papers we are now in a better position than ever to meet this demand. Also the publishing office has hired a new journal administrator, *Michelle Herbert*, to assist in the process.

For the publication of the ICA papers there are instructions on the conference website. Similar procedures will take place in most of the IWA conferences, one every ten days!

NEW from IWA Publishing

Benchmarking of Control Strategies for Wastewater Treatment Plants

Editors: Krist V Gernaey, Ulf Jeppsson, Peter A Vanrolleghem, John B Copp and Jean-Philippe Steyer

Wastewater treatment plants are large non-linear systems subject to large perturbations in wastewater flow rate, load and composition. Nevertheless these plants have to be operated continuously, meeting stricter and stricter regulations.

Many control strategies have been proposed in the literature for improved and more efficient operation of wastewater treatment plants. Unfortunately, their evaluation and comparison – either practical or based on simulation – is difficult. This is partly due to the variability of the influent, to the complexity of the biological and biochemical phenomena and to the large range of time constants (from a few minutes to several days). The lack of standard evaluation criteria is also a tremendous disadvantage. To really enhance the acceptance of innovative control strategies, such an evaluation needs to be based on a rigorous methodology including a simulation model, plant layout, controllers, sensors, performance criteria and test procedures, i.e. a complete benchmarking protocol.

This book is a **Scientific and Technical Report** produced by the IWA Task Group on Benchmarking of Control Strategies for Wastewater Treatment Plants. The goal of the Task Group includes developing models and simulation tools that encompass the most typical unit processes within a wastewater treatment system (primary treatment, activated sludge, sludge treatment, etc.), as well as tools that will enable the evaluation of long-term control strategies and monitoring tasks (i.e. automatic detection of sensor and process faults).

Work on these extensions has been carried out by the Task Group during the past five years, and the main results are summarized in **Benchmarking of Control Strategies for Wastewater Treatment Plants**. Besides a description of the final version of the already well-known Benchmark Simulation Model no. 1 (BSM1), the book includes the Benchmark Simulation Model no. 1 Long-Term (BSM1_LT) – with focus on benchmarking of process monitoring tasks – and the plant-wide Benchmark Simulation Model no. 2 (BSM2). A CD-ROM Appendix containing benchmarking software developed by the Task Group, simulation results and detailed technical reports describing all aspects of the benchmark systems is also included.

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Editors: Theo van den Hoven and Christian Kazner

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Editors: M. Henze, M. C. M. van Loosdrecht, G.A. Ekama and D. Brdjanovic

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This book addresses this deficiency:

- It assembles and integrates the postgraduate course material of a dozen or so professors from research groups around the world that have made significant contributions to the advances in wastewater treatment.
- The book forms part of an internet-based curriculum in wastewater treatment which also includes:
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Upon completion of this curriculum the modern approach of modelling and simulation to wastewater treatment plant design and operation, be it activated sludge, biological nitrogen and phosphorus removal, secondary settling tanks or biofilm systems, can be embraced with deeper insight, advanced knowledge and greater confidence.

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Authors: Cao Ye Shi, Wah Yuen Long, Ang Chee Meng, Kandiah S. Raajeevan

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