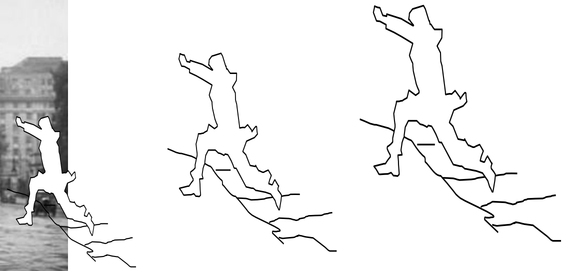
UrbanFlood – SSG4Env

Joint Workshop Detailed Programme
Monitoring and Flood Safety

11 & 12 November 2010

Amsterdam, the Netherlands

SEVENTH FRAMEWORK PROGRAMME



UrbanFlood – SSG4Env

Joint UrbanFlood & SSG4Env Workshop

Monitoring and Flood Safety

Dates

Workshop: Thursday 11th and Friday 12th November 2010
Field visit Dutch Flood Defences: Wednesday 10 November

Location

Grand Cafe Frankendael
Middenweg 116, 1097 BT Amsterdam, The Netherlands
www.frankendael.com

Goals of the workshop

Dissemination of UrbanFlood and SSG4Env results; learning from others in the field. Looking for possibilities to cooperate (Network of Excellence, Integrated Project, Joint Programming Initiative). During the breaks UrbanFlood and SSG4Env applications will be demonstrated, and there is an opportunity to visit the poster presentations and info market.

Useful information

For the most up to date information visit the UrbanFlood website at www.urbanflood.eu.

Information on public transport in the Netherlands: www.journeyplanner.9292.nl
Information on trains in the Netherlands: www.ns.nl

All rights reserved © URBANFLOOD CONSORTIUM

Workshop Programme

Wednesday 10 November: Field Visit Dutch Flood Defences

08:00 to 08:30	*Pre-registration / coffee*
08:30 to 17:00	Field visit: Dutch Flood Defences in the province of Noord-Holland
*** please note: departure place and time and detailed programme will follow*	

Thursday 11 November

09:30 to 10:00	*Registration / coffee*
10:00 to 10:45	introduction
10:45 to 12:30	**Theme 1 - Sensing**
12:30 to 13:30	*Lunch break + demo + poster presentations + info market*
13:30 to 15:15	**Theme 2 - ICT**
15:15 to 16:00	*Coffee break + demo + poster presentations + info market*
16:00 to 17:30	**Theme 3 – Modelling**
17:30 to 18:30	*Drinks*
18:30 onward	*Social Dinner*

Friday morning, 12 November

09:00 to 10:45	**Theme 4 – Application & Implementation**
10:45 to 11:30	*Coffee break + demo + poster presentations + info market*
11:30 to 12:30	Discussion: Towards European Cooperation on Flood Protection
12:30 to 13:00	Closing remarks – Rob Meijer
13:00 onwards	*Lunch + demo + poster presentations + info market, departure*

UrbanFlood *is a project funded under the EU Seventh Framework Programme, Theme ICT-2009.6.4a. ICT for Environmental Services and Climate Change Adaption. Grant agreement no. 248767. December 1, 2009 until November 30, 2012. Contact: Eemsgolaan 3 - PO Box 1416 - 9701 BK Groningen, The Netherlands – www.urbanflood.eu - info@urbanflood.eu*

SSG4Env *is a project funded under the EU Seventh Framework Programme, Theme ICT-2007.6.3 a ICT for environmental management and energy efficiency. ICT RTD in Collaborative Systems for Environmental Management. Grant agreement no. 223913. September 1, 2008 until August 31, 2011*

Asunción Gómez-Pérez. Ontology Engineering Group (OEG). Departamento de Inteligencia Artificial. Facultad de Informática. Campus de Montegancedo s/n. Boadilla del Monte-28660 Madrid, Spain – www.semsorgrid4env.eu - asun@fi.upm.es

Detailed Workshop Programme

Thursday morning, 11 November

09:30 to 10:00	*Registration / coffee*
10:00 to 10:15	Welcome / goals for the workshop – *Nico Pals*
10:15 to 10:45	About UrbanFlood / introduction to the themes – *Rob Meijer* The role of Users in the SG4E project - *Craig Hutton*
10:45 to 12:30	**Theme 1 - Sensing**
10:45-11:05	Development of a Multiscale Monitoring and Health Assessment Framework for Effective Management of Flood-Control Levee Infrastructure – *Mourad Zeghal and Tarek Abdoun, Rensselaer Polytechnic Institute, USA*
11:10-11:40	*Coffee break + demo + poster presentations + info market*
11:40-12:00	Early Detection of Dams and Dikes Anomalies with a Fibre-Optics Based Monitoring Solution (Artières, P. Pinettes, C. Guidoux, Y.-L. Beck, J.-R. Courivaud, J.-J. Fry, G. Dortland) – *Olivier Artières, TenCate Geosynthetics, and Patrick Pinettes, geophyConsult, France*
12:05-12:25	GeoBeads, multi-parameter sensor network for levee monitoring – *Erik Peters, Alert Solutions, NL*
12:30 to 13:30	*Lunch break + demo + poster presentations + info market*

Thursday afternoon, 11 November

13:30 to 15:15	**Theme 2 - ICT**
13:30-13:50	Sensor networks and the semantic web - *Kirk Martinez, University of Southampton's Electronics and computer sciences department, UK*
13:55-14:20	Common Information Space, a framework for creating and hosting Early Warning System – *Bartosz Balis, PhD, Cyfronet AGH, Poland*
14:25-14:45	Machine Learning Methods for Environmental Monitoring and Flood Protection (Alexander Pyayt, Bernhard Lang, Ilya Mokhov, Artem Ozhigin) – *Alexander Pyayt and Artem Ozhigin, OOO Siemens, Russia*
14:50-15:10	The Strength of Solid Data..... – *ir. M.T. van der Meer, Fugro Water Services, NL*
15:15 to 16:00	*Coffee break + demo + poster presentations + info market*
16:00 to 17:30	**Theme 3 - Modelling**
16:00-16:20	Coastal Flood Modelling – *Robin Newman Emu Ltd, UK*
16:30-16:50	The UrbanFlood multiscale modelling cascade and Virtual Dike for simulation of dike stability under dynamic hydraulic loading – *Valeria Krzhizhanovskaya and Natalia Melnikova, University of Amsterdam/StPSPU , NL/Russia*
17:00-17:20	Use of artificial intelligence methods in complex flood defence reliability analysis – *Ben Gouldby, HR Wallingford, UK*

17:30 to 18:30	*demo + poster presentations + info market* *Drinks (offered you by STOWA)*
18:30 onward	*Social Dinner*

Friday morning, 12 November

08:30 to 09:00	*Starting up slowly – coffee + demo + poster presentations + info market*
09:00 to 10:45	**Theme 4 – Application & Implementation**
09:00-09:20	Empowering Stakeholders in Flood Management and Response (M.Clark; C.Hutton) – *Professor Mike Clark, director of the GeoData Institute, University of Southampton, UK*
09:30-09:50	Improvement of the inspection of dikes by GMS in the Czech republic (V. Beneš , G IMPULS Praha spol. s r.o.; Z. Boukalová, VODNÍ ZDROJE, a.s.) – *Vojtech Benes, Czech Republic*
10:00-10:15	LiveDijk Eemshaven: the first sensor network in a sea dike – *Sander Bakkenist , BZ Innovation Management BV and Christiaan Jacobs, Water Board Noorderzijlvest, NL*
10:20-10:35	Monitoring of embankments in the UK – *Jonathan Simm, HR Wallingford, UK*
10:45 to 11:30	*Coffee break + demo + poster presentations + info market*
11:30 to 12:30	Discussion: Towards European Cooperation on Flood Protection
12:30 to 13:00	Closing remarks – *Rob Meijer*
13:00 onwards	*Lunch + demo + poster presentations + info market, departure*

Demonstrations:

Interactive simulation and visualisation for early warning systems: live demo on a multitouch table. *Rob Belleman, Fajran Iman Rusadi , Gleb Shirshov and Valeria Krzhizhanovskaya , University of Amsterdam, and Jeroen Broekhuijzen, TNO*

Generating Early Warning Systems: Live examples of three different Early Warning Systems. *Jeroen Broekhuijsen (TNO), Bartosz Balis (Cyfronet), Artem Ozhigin (Siemens), Alexander Payayt (Siemens), Tomasz Bartynski (Cyfronet), Marek Kaztelnik (Cyfronet)*

SemsorGrid4Env Flood Demonstrator
Jason Sadler, Craig Hutton, Oles Kit (GeoData)

Please do not forget to complete the questionnaire and hand it in at the reception desk, or email it to info@urbanflood.eu.

Version: 6 November 2010

OVERVIEW OF THE PRESENTATIONS

Thursday morning, 11 November

Theme 1 - Sensing

Development of a Multiscale Monitoring and Health Assessment Framework for Effective Management of Flood-Control Levee Infrastructure

M. Zeghal[1], T. Abdoun[1], B. Yazici[1], A. Marr[2]

[1]Rensselaer Polytechnic Institute, Troy, NY, USA
[2]Geocomp, Boston, MA, USA

The integrity and reliability of levees, earthen dams and flood-control infrastructure are essential components of homeland safety. The failure of such systems due to a natural or man-made hazard such as a (hurricane) storm surge, flood, earthquake, deterioration, or terrorist attack can have monumental repercussions, sometimes with dramatic and unanticipated consequences on human life, property and the country's economy. This presentation will reports on an ongoing research program to develop a new health assessment framework with the potential to streamline our ability to monitor, manage and ensure the safety of levees and other earthen systems of a flood-control infrastructure. The proposed framework involves a comprehensive multi scale monitoring and analysis for real time health assessment of this infrastructure. This framework relies on long term continuous monitoring techniques that are minimally-intrusive and inexpensive. They include: (1) satellite-based interferometric synthetic aperture radar (InSAR) measurements, (2) a new high resolution GPS sensor with millimeter level accuracy, and (3) a new high resolution shape-acceleration-pore pressure (SAPP) arrays. The proposed new health assessment framework will be implemented and benchmarked through an ambitious field implementation plan in the New Orleans area. The benchmark plan also includes a full-scale test of a levee that will be loaded until failure.

Dr. Mourad Zeghal, (Associate Professor, Ph.D. in Civil Engineering and M.A. in Civil Engineering at Princeton University) joined Rensselaer in 1998. Previously, he was a senior engineer and leader of the geohazard group at Aon Risk Technologies. His research interests include: Computational Soil Micro-Mechanics, Geotechnical-System Identification, Seismic Response Monitoring, and Information Technology Applications in Geomechnics. He is active with the Center for Network for Earthquake Engineering Simulation (CEES), Scientific Computation Research Center (SCOREC) and the Inverse Problems Center (IPRPI).

Dr. Tarek Abdoun is Professor and Acting Department Head, Civil & Environmental Engineering at Rensselaer and Associate Director, NEES-NSF Geotechnical Centrifuge Research Center. He holds M.S. and Ph.D. Geotechnical Engineering, Rensselaer Polytechnic Institute; B.S. Structural Engineering, Cairo University. Professor Abdoun primary research interests are centrifuge modeling, soil-structure interaction, soil remediation, field advanced sensing and data visualization. He led Rensselaer's physical modelling research team that clarified the failure mechanisms of some of the New Orleans levees during Hurricane Katrina, providing critical feedback to the corresponding numerical analyses. He is a member of several technical committees and the editorial board of technical Journals; he has over 120 publications and technical reports.

Early detection of dams and dikes anomalies with a fibre-optics based monitoring solution

O. Artières [1], P. Pinettes [2], C. Guidoux [2], Y.-L. Beck [3], J.-R. Courivaud [4], J.-J. Fry [4], G. Dortland [5]

[1]. Tencate Geosynthetics, Bezons, France
[2]. geophy*Consult*, Chambéry, France
[3]. EDG-DTG, Grenoble, France
[4]. EDG-CIH, Chambery, France
[5]. Tencate Geosynthetics, Almelo, The Netherlands

Monitoring the behaviour of new and old embankment dams and dykes is a key issue in the field of dam maintenance. Thanks to the early detection of signs of malfunctioning such as leakage, deformation or settlement, it is possible to keep up with the ageing of the structure, and to react immediately to it when necessery, or and to plan repair works long time in advance.

The GeoDetect® monitoring technology developed by Tencate associated with the design experience and the methods of analysis developed by EDF and geophyConsult allows to detect both internal erosion and instability at an early stage. The GeoDetect® product is based on the combination of a technical textile with embedded fibre optic cables that are connected to appropriate optical instrumentations to measure temperatures and strains of the soil. An important part of this global solution is the design of the system (i.e. the precise location of the fibre optics within the structure, so as to guarantee the best possible sensitivity of the system) and the interpretation of the thermal and strain raw data (i.e. the surch for precursory anomalies, long time before they appear on the raw data). Due to the advection phenomenon, dam temperatures are highly sensitive to leakages. Distributed temperature measurements along buried fibre optics allow the surveillance of large dike sections with a high spatial resolution. The analysis method developed by EDF, based on physico-statistical and signal processing approaches provide a multipurpose surveillance system that is capable of serving both as an early warning system and a long-term monitoring tool over several tens of kilometres.

The current performance of the GeoDetect® global solution has been validated in France and in The Netherlands : the strain resolution can be as little as 0.02% and the temperature resolution as little as 0.1°C, with spatial resolutions of 1 m at up to 20 km distance.

It has been used in two different test series in the recent Dutch experimental IJkdijk project. In the first test series, based on the simulation of a 100 m long macro-instability dyke, the GeoDetect® solution has been the only system among ten others that has been able to detect and localize the start of the dike sliding more than 2 days before its collapse (over 4 days of experimentation). In the second test series, based on the simulation of piping, it has been the only system that has been able to generate real-time alarms, 2 days prior to failure. A post-failure analysis that is now included in real-time data analysis modules has revealed the presence of precursors 5 days before collapse, i.e. only one day after the start of the experimentation. The GeoDetect® monitoring and early warning solution is now used in several real sites, such as canal dikes or flood protection dikes.

After introducing the principle of this monitoring solution, the poster will describe its real performance based on a controlled as well as an industrial site.

Key words: Monitoring, Early warning, Sensing, Dam, Dikes, Fibre optics.

Dr. Olivier Artières is Global Technology Manager of the TenCate GeoDetect® solution, a fiber optics textile composite solution for dikes monitoring. Dr. Artières has been with TenCate Geosynthetics, France for 18 years

Dr. Patrick Pinettes, holds a PhD in geophysics – University of Paris Diderot – Physical Institute of the Globe of Paris (I.P.G.P.). He is General Manager of geophyConsult SAS. The company, launched by him in 2003, focuses on state of the art technologies for the safety of embankments dams, dykes and levees. Dr. Pinettes specializes in risk management, earth sciences, instrumentation and electronics.

GeoBeads, multi-parameter sensor network for levee monitoring

Erik Peters, Alert Solutions, NL

In 2008 Alert Solutions introduced its sensor network GeoBeads for levee monitoring. GeoBeads was developed to provide all essential dynamic parameters for the determination of soil stability.

The fully digital network nodes with MEMS technology sensor devices can scale to a wide area network of measurement locations. Installation methods have been developed complying to geotechnical standards which allow positioning in all relevant underground layers using minimally invasive techniques.

Since the first trials in 2008, the GeoBeads sensor network has been installed in over 15 field projects, providing continuous insight in levee stability and the vulnerability to seasonal or extreme circumstances. Much experience has been gained in positioning of the measurement nodes in relation to local soil build-up and geotechnical risk profiles.

Data availability is immediate and is distributed via the internet. Providing live data of hydraulics and deformations in the underground enables real-time (re)calculation of levee stability under changing circumstances. GeoBeads data has been successfully interfaced to several industry-standard computational models, providing a powerful tool for safety monitoring and maintenance management of infrastructural works.

Using continuous data reduces uncertainty factors in stability assessments supporting the setting of priorities in inspection and optimizing strengthening designs.

Following his degree in Physics from Leiden University, Erik Peters (1971) started his career with Philips and gained extensive experience with semiconductor technology and wireless communication. Subsequently, in a consulting role, he advised companies and organizations on innovation and new product development. In 2006 he founded *the company Alert Solutions to develop sensor networks for real-time infrastructural monitoring. These sensor networks, known as GeoBeads have been installed and are operational in a number of levees, construction sites and mountain slopes, delivering insight into stability and safety.*

Thursday afternoon, 11 November

Theme 2 - ICT

Sensor networks and the semantic web

Kirk Martinez, University of Southampton's Electronics and computer sciences department, UK

Many environmental data sets now exist which have a web interface for people to download subsets of data for their research. A growing number are providing ways for software to download data directly without human intervention – which is extremely useful for modellers for example. However automatic discovery of the web site in the first place is still not commonly possible.

One of the issues of current interest in sensor networks is how to discover and integrate data from a wide range of sources: from legacy information systems or coming from live sensor networks to data available in the Web (i.e., linked data). One way to facilitate disparate data discovery and integration is to describe them semantically. The SemsorGrid4Env project is working on systems where data sources can be located with semantic web technologies while defacto standards can be used to actually access the data. Semantic web techniques allow disparate data sources to be linked using commonly accepted concepts.

By building a demonstration around a coastal flooding scenario we had to build bridges between the terms used by domain experts and those used by data providers and to develop the necessary data integration mechanisms supported by this semantic reconciliation. This paper will describe the issues involved in putting together the system and will illustrate how a linked-data approach can be used.
http://www.semsorgrid4env.eu

Kirk Martinez

Dr Kirk Martinez is a Senior Lecturer in Electronics and Computer Science at the University of Southampton. He gained a BSc in Physics from the University of Reading and a PhD in Image Processing in the department of Electronic Systems Engineering at the University of Essex. Previously he was Arts-Computing Lecturer in University College London & Birkbeck College. He has been involved in nine European projects relating to tecnhology for Cultural Heritage. His research interests include content-based retrieval, the Semantic Web, image processing, Augmented Reality and Sensor Webs.

Common Information Space, a framework for creating and hosting Early Warning System

Bartosz Balis (1), Tomasz Bartynski (2), Marian Bubak (1,3), Marek Kasztelnik (2), Piotr Nowakowski (2)

(1) Institute of Computer Science AGH, Krakow, Poland
(2) ACC CYFRONET AGH, Krakow, Poland
(3) Informatics Institute, University of Amsterdam, The Netherlands

The UrbanFlood project develops an online early warning system (EWS) technology for climate induced disasters in urban areas with support for real time emergency management and routine asset management. The technology is widely applicable, such as farmland area monitoring, volcano and earthquake monitoring; however UrbanFlood validates it for the case of flood risk management in urban areas.

A crucial component of the UrbanFlood platform is the Common Information Space (CIS), a framework for generation of and hosting Early Warning Systems. The CIS facilitates interactions between the components of the EWS which involve the exchange and storage of information and software services (e.g. visualization of data). The Common Information Space represents an approach to interchanging environmental data and software services built around them, with support for relevant GEOSS [1] and Inspire [2] standards related to earth observation [3] as well as standardization efforts coordinated by public bodies.

The paper presents the concept of the Common Information Space, its structure and the way in which it matches the specific goal of the UrbanFlood project while still maintaining compliance with accepted geospatial information standards and standards for sensor network development [4]. We aim to present the motivation and requirement analysis which have led us to propose the presented architecture of CIS and explain the state of its design and implementation.

In addition to a technical description of the Common Information Space architecture, we also describe the UrbanFlood applications which operate within its scope, showing how each element of the architecture is designed and exploited in support of a unified Early Warning System (EWS) for flood prediction and management. We present the geographically-distributed network of UrbanFlood sensors which feed data to CIS applications and can trigger automatic actions with the help of specific mechanisms provided by CIS.

The Common Information Space and the Early Warning Systems described above are implemented as part of the UrbanFlood project. Thus, the paper explains the problems which the project attempts to solve and outlines future work on CIS in the context of this research initiative.

Acknowledgements. The research presented in this paper has been partially supported by the European Union within the IST-248767 project UrbanFlood.

References

1. Global Earth Observing System of Systems (GEOSS); www.earthobservations.org
2. The Inspire initiative; inspire.jrc.ec.europa.eu
3. United Nations Platform for Space-based Information for Disaster Management and Emergency Response; www.un-spider.org
4. M. Ilyas, Sensor Network Protocols; CRC Press Inc. 2006.

Bartosz Balis obtained his MSc and PhD degrees in Computer Science from the AGH University of Science and Technology, Krakow, Poland. He is employed as Assistant Professor at the Department of Computer Science, AGH, and as researcher at the Academic Computer Centre, CYFRONET AGH. Dr. Balis is co-author of 60 international publications including journal and conference papers and book chapters. His research interests include monitoring and performance analysis of applications, Grid computing, e-Science, scientific workflows.

Machine Learning Methods for Environmental Monitoring and Flood Protection

Alexander Pyayt, Bernhard Lang, Ilya Mokhov, Artem Ozhigin
OOO Siemens, Russia

The most important task of Early Warning Systems (EWS) for the environmental applications is the identification of the development of a critical situation, which affects environment and population, early enough to inform the authorities and general public.

An abnormal behaviour detection approach for dike monitoring based on machine learning methods will be presented. The approach consists of committees of classification models which are trained on measurements from dikes, features derived from measurements, and environmental data. Design of machine learning approach enables online analysis of current dike state for numerous sensors along and inside the dike. This Artificial Intelligence (AI) component is part of the UrbanFlood EWS platform.

Alexander Pyayt has been working for Corporate Technology Department, Siemens LLC since 2009. Corporate Technology Russia contributes to the UrbanFlood research project supported by European Community's 7th Framework Programme. Alexander is responsible for the development of Artificial Intelligence (AI) component - part of early warning system for flood monitoring. He has an MSc degree with honours in Computer Science, and was rewarded several times (2008, 2009) with grant of Saint Petersburg's government for students, PhD students, young scientists, young PhDs. Alexander was rewarded with medal (2008) and diploma (2010) of the Ministry of Education and Science of the Russian Federation.

Artem Ozhigin works for Siemens Corporate Technology department as a senior engineer since 2007. Actively participates in UrbanFlood FP7 project, especially in the development of distributed hosting platform for early warning systems. He has strong background in embedded and dependable system development coming from different domains as avionics and automotive.

The Strength of Solid Data.....

ir. M.T. van der Meer, Fugro Water Services, NL

The key question is how to benefit / add value to high quality area covering and/or real-time data sets in assessing dike strength and its variations in space and time. Some examples will be given of best practices as we see in our projects all over the world to help solve dike and flood problems. E.g. the Urban Flood analysis we do in Norfolk USA to find critical structures like dikes and (earth) dams, and subsequently the necessary integrity testing and monitoring. Being a Dutch company, we gladly participate in the Dutch Flood Control 2015 program, that gives us the opportunity to adress some specific topics, and to benefit from working closely together with other parties.

ir. M.T. van der Meer: Following his BSc graduation at the Technical College in Alkmaar, the Netherlands, Martin worked at the Department of Hydraulic Engineering of the Delft University of Tecnology. He completed his MSc degree in Hydraulic Engineering at the TUD in 1988 and started working with Fugro Ingenieursbureau in the Netherlands. From March 1st 2008 he joined the Management Team of Fugro Water Services as Technical Director. Main tasks are the assessment and implementation of the Fugro strategy and knowledge transfer for the global water markets on Flood Defence, Dams & Reservoirs and Water Resources Management within the Fugro Group. In addition, he is closely involved in the development of the water market in the Netherlands. From March 1st, 2006 he is also a part-time lecturer Geo Risk Management at the Faculty of Civil Engineering and Geosciences of Delft University of Technology.

Theme 3 - Modelling

Coastal Flood Modelling

Robin Newman Emu Ltd, UK

Understanding wind waves is crucial in sea defence strategy as they can directly cause over topping of sea defences, reshape beaches, lead to the failure of both soft and hard defences by undercutting or simply due to the amount of energy imparted into the defence.

Wave measurement is in itself complex as the data are affected by a wide variety of factors and are reported as statistics. The most common statistic used is the "Significant Wave Height" however this can be defined in multiple ways and can be misleading when looking at coastal defence. It does not give a clear indication of the energy of the wave climate, the wave lengths, how large the largest waves are or the expected total height of the waves reaching the coast.

In an effort to better understand the impact of specific wave climates, monitoring networks such as the Channel Coastal Observatory Network of some 35 sites around the Southern UK, have been established to monitor the wave heights close to the coast. These sites are mainly wave monitoring sites using wave rider buoys in approximately 10m water depth; in addition there are coastal monitoring sites attached to piers or other fixed structures in depth of as little as 0.3m. Many of these sites have collocated equipment therefore making direct comparison of the waves as they propagate inshore possible. In addition to these existing systems the SSG4Env project has installed systems to compare the various wave measurement techniques, deployed instrumentation to better understand the wave propagation inshore and is now planning a campaign designed to acquire data on wave overtopping.

The overtopping study is being supported by Southampton Electronics and Computer Science department and unique networked sensors are being designed to be installed along a section of sea defence. These will then feedback data on water levels at the sea defence. They are designed to be inexpensive and to be installed as a network; this can then be varied to focus the data on areas at risk of overtopping. All current overtopping models used in the UK assume that if overtopping occurs it will occur at all points along a sea defence or none. The aim is therefore to establish where and under what circumstances overtopping will occur and to design a system that will allow long sections of sea defence to be monitored in real time.

Robin Newman is the Principal Scientist and Manager of Emu Limited's MetOcean Section. He has over 16 years experience in the measurement and analysis of Meteorological and Oceanographic data and has designed systems which underpin one of the largest network of coastal monitoring stations in Europe. This network includes the Channel Coastal Observatory system and several monitoring networks for private companies. He has also developed a comprehensive software system for analysing Meteorological and Oceanographic data with a specific interest in wave mathematics.

The UrbanFlood multiscale modelling cascade and Virtual Dike for simulation of dike stability under dynamic hydraulic loading

Valeria Krzhizhanovskaya[1], Natalia Melnikova [1], Ben Gouldby [2]

[1]University of Amsterdam, NL; [2]HR Wallingford, UK

Modelling and simulation plays a crucial role in the decision support for early warning systems. We present a cascade of models and simulations developed within the UrbanFlood project for scenario-based prediction of dike failures, inundation and damage assessment.

Depending on the scenario alert levels (Quiet Monitoring, Alert, Alarm), simulations of increasing model detail and fidelity are invoked. The choice of required level of detail will be automated by the decision-support workflow. The modelling chain starts from a stream of live sensor data, pre-filtered by the AI module. Sensor parameters are used as input data in simulation modules.

First, we briefly describe the four modelling cascade components: dike reliability analysis, dike breaching, water discharge calculation, and flood simulator. Three of these modules have already been integrated into the Common Information Space, thus allowing seamless access from any geographical location and on-demand resource allocation from any of the computing Clouds.

The second part of our presentation will describe the Virtual Dike, an advanced multiscale multi-model simulation lab for expert users and model developers. This virtual lab is used for validation of all the models involved in the modelling cascade, and serves as a research field for experiment planning and understanding the underlying physical processes influencing dike stability and failure. Real-life experiments are used to develop and validate the models of dike macro-stability, erosion, wave over-topping, seepage and piping effects. Comparison of simulation results with the experimental data allow determining the material properties and computational model parameters that best represent real-life dikes, with all their inhomogeneities and special features.

In the first stage of the project, we have studied the structural stability of the sea dike in Eemshaven a.k.a. LiveDike, under different conditions, including tidal water loading, seasonal weather change and storm surges. The problem required modeling of coupled fluid-structure interaction, with non-linear dike material properties.

The fluid part of the model describes the dynamics of flow through porous soil, with Richards equation for wetting and drying of the area above the phreatic surface. Van Genuchten model is used to describe the properties of unsaturated soil. Storage coefficient of the soil depends on the deformation of the pores, which is obtained from the structural dynamics simulation.

The structural part of the model describes deformation dynamics of the dike under tidal pressure load, gravity and volumetric pore pressure load obtained from flow simulation. Elastic and elasto-plastic rheological models are used for describing soil and clay properties. Dike stability is evaluated by the Mohr-Coloumb failure criterion.

Phreatic surface changes its location and shape in response to the sea water level that oscillates over the tides or grows during the storm surges. Water level sensor data are applied as input parameter for the model. Pore pressure sensor data is used for tuning model parameters.

Two-dimensional simulations have been performed for four different LiveDike cross-sections. Numeric results (pore pressure values) are in good agreement with the pressure sensor data in the second section of the dike that was used for model calibration. Sensors form other sections give quite different digital data. The reason for this difference is not clear with the current input information. Soil build-up looks similar for 2^{d}, 3^{d} and 4^{th} sections, therefore cannot explain the differences between sensor data in these sections. We plan to investigate this issue with the LiveDike stakeholders.

Other plans for the future include: 3D simulation; modeling different failure mechanisms based on the IjkDijk experiments; prediction of sensor data dynamics based on external data (seasonal changes in tides, meteorological forecasts); integrating the code into the Common Information Space and the Early Warning System.

Dr. Valeria Krzhizhanovskaya is a researcher at the University of Amsterdam (UvA) and an Associate Professor at St. Petersburg State Polytechnic University (StPSPU). In the Urban Flood project, she is leading the Modelling and Simulation team. Ph.D. in Computational Science from UvA and M.Sc. in Applied Mathematics and Physics from StPSPU. Research interests include modelling and simulation of multiphysics multiscale processes, with special emphasis on plasma, fluid dynamics and solid mechanics; parallel distributed computing; Grid, Cloud, ICT.

Natalia Melnikova is a PhD student in the University of Amsterdam since 2010, working on the Virtual Dike project. She received her M.Sc. degree in Applied Mechanics in 1999 from St. Petersburg Polytechnic University, Russia. Since 1999, Natalia has been working as a programmer in the Polytechnic University.

Use of artificial intelligence methods in complex flood defence reliability analysis

Ben Gouldby[1] (HR Wallingford), Greer Kingston[1] (HR Wallingford), Pieter van Gelder[2]

[1]HR Wallingford, UK; [2]Technical University Delft, NL

Flood defence structures can, and do, fail. Assessing their likelihood of failure is an integral component within comprehensive flood risk analysis. There are however, many different mechanisms by which defences can fail and these mechanisms can be complex. Whilst there are many different simplified empirical equations that seek to describe the failure processes, often, in practice, more complex models are required to appropriately simulate the complex physical processes that are in action. Invariably these complex models require significant computational run time.

Reliability analysis involves integrating probability density functions of the hydraulic loads and structural resistance, over the failure space (ie exceedence of the limit state). Analytical integration approaches are generally in inappropriate due to the complexities of the limit state, and statistical simulation methods (monte carlo analysis) are frequently used to undertake the integration. Monte Carlo simulation requires many different simulations to be undertaken with the computationally demanding failure models. In practice this is not possible in many cases due to the computational burden.

Artificial Intelligence methods can be used to approximate complex physical process models, at a fraction of the computational cost and can also be used to identify regions of the parameter space that are of most importance in determining failure likelihood, thereby increasing computational efficiencies.

This paper describes how a neural network has been used to approximate the PLAXIS geotechnical stability finite element model and then used within the context of a reliability analysis. A genetic algorithm has been used to train the neural network in the vicinity of the Limit State, where it is most important for determining failure probability. The use of the GA further decreases the computational burden. The methods are demonstrated on the 17th Street Canal levee in New Orleans, that failed during Hurricane Katrina.*Ben Gouldby*

Ben Gouldby is a Principal Scientist within the Flood Management Group at HR Wallingford, where he leads the technical development of risk and uncertainty methods and their application to flood related problems. He has led the technical development of the national flood risk assessment method that has been applied annually by the UK Environment Agency, since 2004, to asses fluvial and coastal flood risk in England and Wales.

Friday morning, 12 November

Theme 4 – Application & Implementation

Empowering Stakeholders in Flood Management and Response

M. Clark, C. Hutton

The world of flood management and response is in flux, and the information systems that support the management process are both driving and responding to that change. In the popular view, the main changes affecting flooding relate to the hazard process system itself, and are frequently articulated in the context of global climate change (though broader environmental and land-use changes can be equally important). Perhaps the most significant aspect of this evolution in the present setting is that it potentially increases the intensity, frequency and uncertainly of flood events - all of which impinge on information system design, application and utilisation. But three other aspects challenge us more directly in the context of the SSG4Env Flood Case Study:

1. FLOOD MANAGEMENT CHANGE has been fundamental and widespread over the last decade and beyond. Initially, this took the form of a progressive transition from an engineering-led structural response to flooding, dominated by concepts of flood defence. As non-structural and soft engineering approaches have increased in importance, the role of the stakeholder both as impacted population and response implementation partner has become much more prominent. To cope with uncertainty, management is becoming markedly more adaptive rather than predictive and this, too, puts pressure on monitoring and informing - with immediate implications for the stakeholder. Finally, and in some ways co-incidentally, there

is a strong trend in developed countries for the management system to become more information-led and participatory rather than expert-led and prescriptive, which impacts massively on information system design.

2. STAKEHOLDER CHANGE has developed alongside this evolution in management strategy, with superficial consultation (information flowing largely upwards) being replaced by stakeholder engagement (two-way information flow) and, potentially, stakeholder empowerment (participatory decision making and risk sharing). As behaviour change emerges as the primary flood response rather than structural defence, the stakeholder becomes the pivotal partner not just a marginal and marginalised player. The information system no longer has to supply "facts" or even just information, it has to engage with the attitudinal development that is the real key to behaviour change and its sustainability. With the emergence of crowd-sourcing as a potential source of quasi real-time flood information, stakeholder participation is raised to an entirely new level. Web-delivered systems are entering a new era!

3. INFORMATION SYSTEM CHANGE is the inevitable precursor and consequence of this process - and the flood management case study in SSG4Env tackles just one aspect of this - the increasing need to support multi-criteria decisions and behaviours by integrating data sources into rich information products. The stakeholders for the technology now categorise into users (who provide information services) and end users (who employ these information services to make behaviour-influencing decisions). The chosen stakeholder partners for the project represent mainly the users rather than end-users - and they include both specifically-coastal and more general flood information interests.

Professor Mike Clark is is currently Professor of Geography and Director of the Geodata Institute. He has been a member of staff in the School of Geography, at the University of Southampton since 1965.Qualifications: B.A. (Geography) Southampton 1962; Ph.D. (Science) Southampton 1965; MIEEM. His research interests include catchment and coastal zone management, and permafrost data and hydrology.

Improvement of the inspection of dikes by GMS in the Czech Republic

V. Beneš[1], Z. Boukalová[2],

[1]*G IMPULS Praha spol. s r.o., Czech Republic*
[2]*VODNÍ ZDROJE, a.s., Czech Republic* and *REGIONAL ENVIRONMENTAL CENTER, ČR*

In the practice of river basin management, the condition of flood control dikes is usually inspected by means of 3 basic techniques:

- visual inspection
- analysis of airborne or satellite photographs
- repeated levelling of fix points on the top of the dikes or LIDAR technic

These techniques, neverthelesss, mostly fail to bring the information on the inner structure and material composition of the dikes or on hidden defects that also may be the reason leading to dike failure during floods. These may include material defects in the dike body or subsoil (such as contact of heterogeneous materials, the occurrence of highly permeable layers, etc.) or the existence of “illegal” distribution systems inside the dike body. The knowledge of the material composition and inner structure of the dikes is one of the important prerequisites allowing to prepare the optimum design of the dike reconstruction and repair.

The effective tool which may complement the information on the inner structure and material composition of the dikes is the geophysical measurement. The Geophysical Monitoring System GMS is an advanced and complex methodology of investigation, properly complementing the above mentioned techniques of dike inspections. The basis of the GMS methodology is combination of fast and cheap techniques for the basic description of long dike segments with more exacting methods for detailed description of problematic dike segments. In particular, combination of appropriate geoelectric methods, such as the dipole electromagnetic profiling (DEMP) with resistivity tomography (RT), in case of need complemented by another independent method such as one of the seismic methods or microgravimetry, is used.

At present, GMS system in the Czech Republic is being introduced in 3 of 5 river basin areas. Since 2004 (starting year of GMS system introduction), approx. 330 km of flood control dikes in the Morava River Basin Area, 120 km of dikes in the Odra River Basin Area and 50 km of dikes in the Labe River Basin Area have been measured. These are the largest risk posing segments which regulate watercourses in the vicinity of bigger towns. The database has been growing, at present it includes approx. 20 % of the total volume of the dikes in the Czech Republic.

Key words: dikes, inspection, geophysical investigation (GMS, DEMP, RT)

Dr. Vojtech Beneš, geophysicist, is a graduate of the Faculty of Science of Charles University in Prague, Department of Applied Geophysics. He works with G IMPULS Praha s.r.o. – the firm is engaged in the complex geophysical investigation for civil engineering and engineering geology, environmental protection, prospecting for mineral resources and hydrogeology, and specializes in the application of the geophysical methods for the investigation of earthfill dams and dikes, application of the geophysical methods for the monitoring of the status of undermined areas, microgravimetric modelling.

Dr. Zuzana Boukalová (hydrogeologist) graduated at the Faculty of Science of Charles University in Prague, Department of Hydrogeology and Engineering Geology. She is Head of the International Department of VODNÍ ZDROJE, a.s. and Director of the REGIONAL ENVIRONMENTAL CENTER ČR. She has over 20 years experience in applied research in water resources engineering, groundwater vulnerability, pollution control, IWRM, wetlands characterisation and flooding prevention. Main research interests are related to groundwater hydrogeology, impacts of drainage and land-use, groundwater vulnerability, IWRM and water quality issues, and application of the geophysical methods for the investigation of earthfill dams and dikes.

Dr. Boukalová and Dr. Beneš were members of the team which designed the GMS methodology under the IMPACT and FLOODSite projects.

LiveDijk Eemshaven: the first sensor network in a sea dike

Sander Bakkenist[1], Christiaan Jacobs[2]

[1]BZ Innovation Management BV; [2]Water Board Noorderzijlvest, NL

The project 'LiveDijk Eemshaven' is aimed at the practical application of sensor management systems in sea defenses. The project is located in the western dike that protects Eemshaven, a sea harbour in the north of the Netherlands.

After the full-scale tests of sensor technology in her test facilities, Stichting IJkdijk together with waterboard Noorderzijlvest and STOWA achieved a next step towards monitoring systems for dikes by installing sensors in 600 m of a fully functioning sea dike belonging to the waterboard.

The project has three main goals: installing sensor technology in a real sea dike, running a sensor network for a prolonged period of time and confirming the usability of sensor data under all relevant circumstances. The presentation gives end-user feedback on both installation and running the system in its first year. It provides first-hand insights in the do's and don'ts of large scale implementation of a sensor network for an existing dike.

Christiaan Jacobs is a coastal engineer. He works as a policy advisor for the waterboard Noorderzijlvest, the Netherlands. His main task is to translate developments regarding defense against flooding to practical policies to be used by his waterboard. As project leader for the waterboard, he has been involved in the LiveDijk Eemshaven project from the start.

Monitoring of embankments in the UK

Jonathan Simm, HR Wallingford, UK

This presentation will cover the work carried out for UrbanFlood to date and how it relates to the aspirations of flood warning and asset management in the UK.

Jonathan Simm (Eur Ing MEng MICE MCIWEM MIEI FCIArb) is a technical director of the Flood Management Group at HR Wallingford. He has considerable experience in the preparation of guidance manuals for engineers. Publications have included; 'Manual on the use of Timber in Coastal and River Engineering', 'Manual on the use of rock in coastal and shoreline engineering', 'Beach Management Manual', and 'Sustainable use of new and recycled materials in coastal and fluvial construction'. He is now involved in the International Levee Manual, and, of course, in the UrbanFlood project.

General

Demonstrations

Interactive simulation and visualisation for early warning systems: live demo on a multitouch table

Rob Belleman[1], Fajran Iman Rusadi[1], Gleb Shirshov[1], Valeria Krzhizhanovskaya[1], Jeroen Broekhuijzen[2]

[1] University of Amsterdam, NL; [2]TNO, NL

The goal of a Decision Support System (DSS) is to help decision-makers in making informed decisions in the case of emergencies. In this demonstration we present a DSS for flood disasters. The system includes several simulation modules and visualization components that are integrated into an interactive graphical environment. One of the demonstrated simulation modules is the Flood Simulator developed by HR Wallingford for predicting inundation dynamics in the case of dike failure.

The Flood Simulator uses a Digital Terrain Model (DTM) that describes the elevation of the topography at the area selected for simulation, in this case the Amsterdam Watergraafsmeer area. Small corrections have been made to the DTM to correct for data acquisition errors and to add missing structures (tunnels, buildings). The DTM is pre-processed into a simulation grid consisting of Inundation Zones (IZ). The dynamics of water discharge through the breached dike (the "hydrograph") is calculated by a breaching model. The output of an inundation simulation contains the time series of water level and discharge velocities in all IZ. The simulation output data is visualised here on a Microsoft Surface multi-touch table.

The Flood Simulator runs on a Virtual Machine and can be easily copied or moved to a Cloud service, e.g. the SARA Clouds. We will show simulations of flood dynamics in different parts of Amsterdam, including the Science Park. Recently, a dike has been equipped with sensors located in the Amsterdam Gaasperplas area. Flood simulations of this area, as well as the Eemshaven LiveDike area, are being prepared for simulation.

Our plans for the future include the development of a web-based interface to the Decision-Support System that will provide added flexibility and convenience to stakeholders and public authorities.

Robert Belleman is a senior researcher in the Computational Science research group of the University of Amsterdam. He received his PhD in 2003 from the University of Amsterdam for his work on Interactive Exploration in Virtual Environments. Since then, he has worked in several national and international projects on visual problem-solving environments for the interactive exploration of large data and parameter spaces.

Fajran Iman Rusadi obtained his master's degree in Computational Science in 2009 from the University of Amsterdam. He is now a scientific programmer for the UrbanFlood project at the Computational Science research group of the University of Amsterdam.

Gleb Shirshov will receive his M.Sc. degree in February 2011 from St. Petersburg State Polytechnic University, Russia. Since 2009, he has been working as a junior researcher in the Ioffe Physical Technical Institute, St. Petersburg, Russia, under the Federal Program of "Innovative Russia". Within the UrbanFlood project, Gleb is working on implementation of the modelling components in the UrbanFlood environment, integration of the modules into the Common Information Space, and porting them to the Cloud infrastructure.

Generating Early Warning Systems: Live examples of three different Early Warning Systems

Jeroen Broekhuijsen[1], Bartosz Balis[2], Artem Ozhigin[3], Alexander Payayt[3], Tomasz Bartynski[2], Marek Kaztelnik[2]

[1] TNO, NL; [2]Cyfronet, Poland; [3] Siemens, Russia

Interactive simulation and visualisation for early warning systems: live demo on a multitouch table

Rob Belleman[1], Fajran Iman Rusadi[1], Gleb Shirshov[1], Valeria Krzhizhanovskaya[1], Jeroen Broekhuijzen[2]

[1] University of Amsterdam, NL; [2]TNO, NL

SemsorGrid4Env Flood Demonstrator

Jason Sadler, Craig Hutton, Oles Kit (GeoData)

List of Participants

Name	Organisation	Country
Tarek Abdoun	Rensselaer Polytechnic Institute	USA
Evert van den Akker	TNO Informatie en Communicatietechnologie	NL
Olivier Artieres	TenCate Geosynthetics France S.A.S.	France
Sander Bakkenist	BZ Innovatiemanagement BV	NL
Bartosz Balis	Cyfronet AGH	Poland
Jackie Banks	Environment Agency	UK
Robert Belleman	UvA	NL
Adam Belloum	UvA	NL/Alg.
Dr. Vojtech Benes	G IMPULS Praha, spol. s r.o.	CZE
Harry Bos	VolkerWessels Telecom	NL
Dr. Zuzana Boukalova	Regional Environmental Center CR	CZE
Jacqueline Bredius	STOWA	NL
Jeroen Broekhuijsen	TNO ICT	NL
Marian Bubak	Cyfronet AGH	Poland
Filip Cejka	VODNÍ ZDROJE, a.s.	CZE
Professor Mike Clark	GeoData (university of Southampton)	UK
Gerrit Dortland	TenCate Geosynthetics Netherlands bv	NL
Edouard Durand	Centre d'Etudes Techniques de l'Equipement Normandie Centre (CETE NC)	France
Alex Frazer	Electronics and Computer Science (University of Southampton)	UK
Ben Gouldby	HR Wallingford Ltd.	UK
Cor Groeneweg	YSI	NL
Prisca Haemers	Rijkswaterstaat, Centre for Water Management	NL
Bram Havers	IBM Global Business Services	NL
Craig J. Hickey	National Center for Physical Acoustic, University of Mississippi	USA
Dr. Craig Hutton	GeoData (university of Southampton)	UK
Marc Igigabel	CETMEF (Centre d'Etudes Techniques Maritimes et Fluviales)	France
Christiaan Jacobs	Waterschap Noorderzijlvest	NL
Ed King	YSI	NL
Tijs de Kler	SARA	NL
Andre Koelewijn	Deltares	NL
Valeria Krzhizhanovskaya	UvA	RU / NL
Bernhard Lang	OOO Siemens	Russia
Fabrice Lecornu	Ifremer	France
Kirk Martinez	Electronics and Computer Science (University of Southampton)	UK
Martin van der Meer	Fugro Water Services	NL
Robert Meijer	TNO ICT	NL
Natalia Melnikova	UvA	RU / NL

Name	Organisation	Country
Ilya Mokhov	OOO Siemens	Russia
Mark Morris	HR Wallingford Ltd.	UK
Robin Newman	SSG4Env - Emu Ltd.	UK
Artem Ozhigin	OOO Siemens	Russia
Nico Pals	TNO ICT	NL
Mark Pehlig	Fugro Ingenieursbureau B.V.	NL
Bob Pengel	STOWA	NL
Erik Peters	Alert Solutions BV	NL
Patrick Pinettes	TenCate France	France
Reinhard Pohl	Technische Universität Dresden	DU
Ing. R.D. (Rob) van Putten	Waternet Ingenieursbureau	NL
Alexander Pyayt	OOO Siemens	Russia
Niall Quinn	University of Southampton	UK
Samantha Roe	SSG4Env - Emu Ltd.	UK
Fajran Iman Rusadi	UvA	NL/?
Simone van Schijndel	Deltares - Delft Hydraulics	NL
Dr. Baldev Setia	MM Engineering College, Nat. Inst.of Technology Kurukshetra	India
Warren Shallcross	SunWater Limited ACN 131 034 985	AUS
Michael Sharp	USACE, Engineer Research & Development Center	USA
Gleb Shirshov	UvA	RU/ NL
Jonathan Simm	HR Wallingford Ltd.	UK
ir L.J.M. Smeets	Agentschap NL	NL
Rémy Tourment	CEMAGREF Groupement d'Aix en Provence	France
Roelof Versteeg	Idaho National Laboratory, University Idaho	USA
Pepijn van der Vliet	Alert Solutions BV	NL
Reinhard Vogt	Hochwasserschutzzentrale Köln	DU
Matt Wadey	University of Southampton	UK
Ludolph Wentholt	STOWA	NL
H. Wiering	VolkerWessels/Landustrie?	NL
Grazyna Wojcieszko	European Commission	EU
Prof. Mourad Zeghal	Rensselaer Polytechnic Institute	USA
Wouter Zomer	BZ Innovatiemanagement BV	NL

Total participants: 69