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Session 6 - Environmental Systems: Management and Optimisation

Session 7 - New Methods and Technologies for Medicine and Biology

Session 8 - Embedded System Design and Application

Session 9 - Image Processing, Image Analysis and Computer Vision

Session 10 - Mobile Communications

Session 11 - Education in Computer Science and Automation

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Preface

Dear Participants,

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

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

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

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

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

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.
I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.

Professor Peter Scharff
Rector, TU Ilmenau

Professor Christoph Ament
Head of Organisation

Table of Contents

CONTENTS

Page

6 Environmental Systems: Management and Optimisation

T. Bernard, H. Linke, O. Krol 3
A Concept for the long term Optimization of regional Water Supply Systems
as a Module of a Decision Support System

S. Röll, S. Hopfgarten, P. Li 11
A groundwater model for the area Darkhan in Kharaa river
Th. Bernard, H. Linke, O. Krol basin

A. Khatanbaatar Altantuul 17
The need designing integrated urban water management in cities of Mongolia

T. Rauschenbach, T. Pfützenreuter, Z. Tong 23
Model based water allocation decision support system for Beijing

T. Pfützenreuter, T. Rauschenbach 29
Surface Water Modelling with the Simulation Library ILM-River

D. Karimanzira, M. Jacobi 35
Modelling yearly residential water demand using neural networks

Th. Westerhoff, B. Scharaw 41
Model based management of the drinking water supply system of
city Darkhan in Mongolia

N. Buyankhishig, N. Batsukh 47
Pumping well optimi ation in the Shivee-Ovoo coal mine Mongolia

S. Holzmüller-Laue, B. Göde, K. Rimane, N. Stoll 51
Data Management for Automated Life Science Applications

N. B. Chang, A. Gonzalez 57
A Decision Support System for Sensor Deployment in Water Distribution
Systems for Improving the Infrastructure Safety

P. Hamolka, I. Vrublevsky, V. Parkoun, V. Sokol 63
New Film Temperature And Moisture Microsensors for
Environmental Control Systems

N. Buyankhishig, M. Masumoto, M. Aley 67
Parameter estimation of an unconfined aquifer of the Tuul River basin Mongolia

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

7 New Methods and Technologies for Medicine and Biology

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

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

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

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

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

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

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

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

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

8 Embedded System Design and Application

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

M. Müller, A. Pacholik, W. Fengler 137
Tool Support for Formal System Verification

A. Pretschner, J. Alder, Ch. Meissner 143
A Contribution to the Design of Embedded Control Systems

R. Ubar, G. Jervan, J. Raik, M. Jenihhin, P. Ellervee 147
Dependability Evaluation in Fault Tolerant Systems with High-Level Decision Diagrams

A. Jutmann 153
On LFSR Polynomial Calculation for Test Time Reduction

M. Rosenberger, M. J. Schaub, S. C. N. Töpfer, G. Linß 159
Investigation of Efficient Strain Measurement at Smallest Areas Applying the Time to Digital (TDC) Principle

9 Image Processing, Image Analysis and Computer Vision

J. Meyer, R. Espiritu, J. Earthman 167
Virtual Bone Density Measurement for Dental Implants

F. Erfurth, W.-D. Schmidt, B. Nyuyki, A. Scheibe, P. Saluz, D. Faßler 173
Spectral Imaging Technology for Microarray Scanners

T. Langner, D. Kollhoff 179
Farbbasierte Druckbildinspektion an Rundkörpern

C. Lucht, F. Gaßmann, R. Jahn 185
Inline-Fehlerdetektion auf freigeformten, texturierten Oberflächen im Produktionsprozess

H.-W. Lahmann, M. Stöckmann 191
Optical Inspection of Cutting Tools by means of 2D- and 3D-Imaging Processing

A. Melitzki, G. Stanke, F. Weckend 197
Bestimmung von Raumpositionen durch Kombination von 2D-Bildverarbeitung und Mehrfachlinienlasertriangulation - am Beispiel von PKW-Stabilisatoren

F. Boochs, Ch. Raab, R. Schütze, J. Traiser, H. Wirth 203
3D contour detection by means of a multi camera system

M. Brandner 209
Vision-Based Surface Inspection of Aeronautic Parts using Active Stereo

H. Lettenbauer, D. Weiss 215
X-ray image acquisition, processing and evaluation for CT-based
dimensional metrology

K. Sickel, V. Daum, J. Hornegger 221
Shortest Path Search with Constraints on Surface Models of In-the-ear Hearing Aids

S. Husung, G. Höhne, C. Weber 227
Efficient Use of Stereoscopic Projection for the Interactive Visualisation
of Technical Products and Processes

N. Schuster 233
Measurement with subpixel-accuracy: Requirements and reality

P. Brückner, S. C. N. Töpfer, M. Correns, J. Schnee 239
Position- and colour-accurate probing of edges in colour images
with subpixel resolution

E. Sparrer, T. Machleidt, R. Nestler, K.-H. Franke, M. Niebelschütz 245
Deconvolution of atomic force microscopy data in a special measurement
mode – methods and practice

T. Machleidt, D. Kapusi, T. Langner, K.-H. Franke 251
Application of nonlinear equalization for characterizing AFM tip shape

D. Kapusi, T. Machleidt, R. Jahn, K.-H. Franke 257
Measuring large areas by white light interferometry at the nanopositioning and
nanomeasuring machine (NPMM)

R. Burdick, T. Lorenz, K. Bobey 263
Characteristics of High Power LEDs and one example application in
with-light-interferometry

T. Koch, K.-H. Franke 269
Aspekte der strukturbasierten Fusion multimodaler Satellitendaten und
der Segmentierung fusionierter Bilder

T. Riedel, C. Thiel, C. Schmullius 275
A reliable and transferable classification approach towards operational land
cover mapping combining optical and SAR data

B. Waske, V. Heinzel, M. Braun, G. Menz 281
Classification of SAR and Multispectral Imagery using Support Vector Machines

V. Heinzel, J. Franke, G. Menz 287
Assessment of differences in multisensoral remote sensing imageries caused by discrepancies in the relative spectral response functions

I. Aksit, K. Bünger, A. Fassbender, D. Frekers, Chr. Götze, J. Kemenas 293
An ultra-fast on-line microscopic optical quality assurance concept for small structures in an environment of man production

D. Hofmann, G. Linss 297
Application of Innovative Image Sensors for Quality Control

A. Jablonski, K. Kohrt, M. Böhm 303
Automatic quality grading of raw leather hides

M. Rosenberger, M. Schellhorn, P. Brückner, G. Linß 309
Uncompressed digital image data transfer for measurement techniques using a two wire signal line

R. Blaschek, B. Meffert 315
Feature point matching for stereo image processing using nonlinear filters

A. Mitsiukhin, V. Pachynin, E. Petrovskaya 321
Hartley Discrete Transform Image Coding

S. Hellbach, B. Lau, J. P. Eggert, E. Körner, H.-M. Groß 327
Multi-Cue Motion Segmentation

R. R. Alavi, K. Brieß 333
Image Processing Algorithms for Using a Moon Camera as Secondary Sensor for a Satellite Attitude Control System

S. Bauer, T. Döring, F. Meysel, R. Reulke 341
Traffic Surveillance using Video Image Detection Systems

M. A-Megeed Salem, B. Meffert 347
Wavelet-based Image Segmentation for Traffic Monitoring Systems

E. Einhorn, C. Schröter, H.-J. Böhme, H.-M. Groß 353
A Hybrid Kalman Filter Based Algorithm for Real-time Visual Obstacle Detection

U. Knauer, R. Stein, B. Meffert 359
Detection of opened honeybee brood cells at an early stage

10 Mobile Communications

K. Ghanem, N. Zamin-Khan, M. A. A. Kalil, A. Mitschele-Thiel — 367
Dynamic Reconfiguration for Distributing the Traffic Load in the Mobile Networks

N. Z.-Khan, M. A. A. Kalil, K. Ghanem, A. Mitschele-Thiel — 373
Generic Autonomic Architecture for Self-Management in Future Heterogeneous Networks

N. Z.-Khan, K. Ghanem, St. Leistritz, F. Liers, M. A. A. Kalil, H. Kärst, R. Böringer — 379
Network Management of Future Access Networks

St. Schmidt, H. Kärst, A. Mitschele-Thiel — 385
Towards cost-effective Area-wide Wi-Fi Provisioning

A. Yousef, M. A. A. Kalil — 391
A New Algorithm for an Efficient Stateful Address Autoconfiguration Protocol in Ad hoc Networks

M. A. A. Kalil, N. Zamin-Khan, H. Al-Mahdi, A. Mitschele-Thiel — 397
Evaluation and Improvement of Queueing Management Schemes in Multihop Ad hoc Networks

M. Ritzmann — 403
Scientific visualisation on mobile devices with limited resources

R. Brecht, A. Kraus, H. Krömker — 409
Entwicklung von Produktionsrichtlinien von Sport-Live-Berichterstattung für Mobile TV Übertragungen

N. A. Tam — 421
RCS-M: A Rate Control Scheme to Transport Multimedia Traffic over Satellite Links

Ch. Kellner, A. Mitschele-Thiel, A. Diab — 427
Performance Evaluation of MIFA, HMIP and HAWAII

A. Diab, A. Mitschele-Thiel — 433
MIFAv6: A Fast and Smooth Mobility Protocol for IPv6

A. Diab, A. Mitschele-Thiel — 439
CAMP: A New Tool to Analyse Mobility Management Protocols

11 Education in Computer Science and Automation

S. Bräunig, H.-U. Seidel 447
Learning Signal and Pattern Recognition with Virtual Instruments

St. Lambeck 453
Use of Rapid-Control-Prototyping Methods for the control of a nonlinear MIMO-System

R. Pittschellis 459
Automatisierungstechnische Ausbildung an Gymnasien

A. Diab, H.-D. Wuttke, K. Henke, A. Mitschele-Thiel, M. Ruhwedel 465
MAeLE: A Metadata-Driven Adaptive e-Learning Environment

V. Zöppig, O. Radler, M. Beier, T. Ströhla 471
Modular smart systems for motion control teaching

N. Pranke, K. Froitzheim 477
The Media Internet Streaming Toolbox

A. Fleischer, R. Andreev, Y. Pavlov, V. Terzieva 485
An Approach to Personalized Learning: A Technique of Estimation of Learners Preferences

N. Tsyrelchuk, E. Ruchaevskaia 491
Innovational pedagogical technologies and the Information educational medium in the training of the specialists

Ch. Noack, S. Schwintek, Ch. Ament 497
Design of a modular mechanical demonstration system for control engineering lectures

N. Buyankhishig / N. Batsukh

Pumping well optimization in the Shivee-Ovoo coal mine Mongolia

INTRODUCTION

The Shivee-Ovoo coal mine is located in Sumber sum of Gobi-Sumber aimag. Surface is hilly with elevation 1180-1230m above sea level (Fig 1). The study area is characterized by extremely continental climate with short hot summer and cold winter, seasonal and annual variation is high, always windy, and sometimes wind velocity reaches to 20m/s, dominant wind direction is from northwest. Total rainfall varies from mm in 150. Approximately 90% of the rainfall occurs between June and August. Average monthly temperature ranges from -3.0 ^{o}C in January to 15.7^{o}C in August.

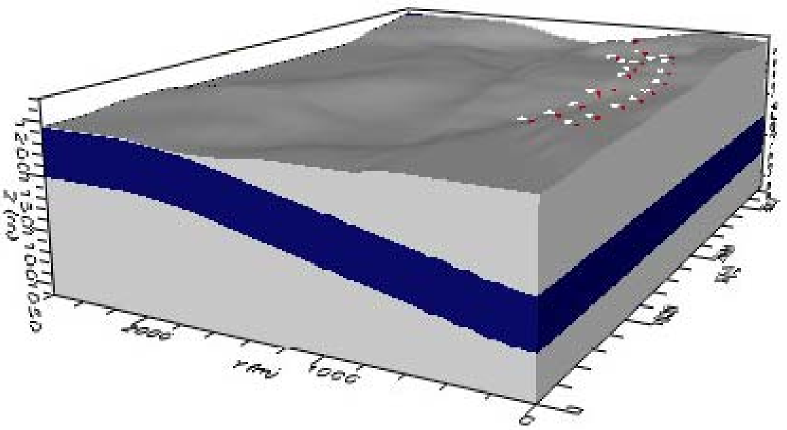

Fig 1. Coal deposit of the Shivee-Ovoo

Hydrogeological condition

Geologically the area belongs to Mesozoic formations, which are filled Choir graben basin, originated proterozoic geosynclinal and Dundgobi uplift zone. Foundation of Choir basin, coal bearing formation, cut by faults and consist of Jurassic volcanic sedimentary, Permian volcanic rocks [2].

Choir basin filled by Lower Cretaceous volcanic, sedimentary rocks and upper Cretaceous, sedimentary rocks, Shainshand formation. The Cretaceous rocks in the study area consists of, from oldest to youngest, the Bayanerkhet, the Tevshyn gobi and the Sainshand formations. Cretaceous rocks covered by Quaternary deposits. Tevshyn

Gobi formation, which belongs to the Lower Cretaceous, consists of alternating beds of sandstones, siltstone and coal. Sand grains range from fine to coarse and the degree of cementation vary. Upper Cretaceous rocks are distributed in high elevated areas, and consists of gray sand, brown to light gray clay and yellow gray sandstones. The groundwater in the aquifer occurs under confined condition that overlying confining layers of clay stone and siltstone [1]. Geologists of Central geological expedition carried out exploration in coal mine and evaluated coal resources in 1986 [1].

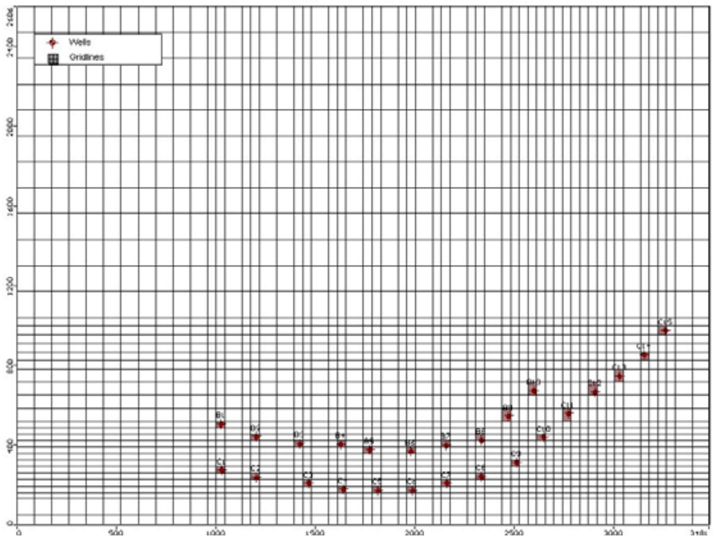

Fig 2. Dewatering well location

Based on aquifer test, Jadambaa.N determined hydraulic conductivity ranges from 0.0081 to 0.1m/d in siltstone and clay stone. Hydraulic conductivity in sandstone varies between 0.12-0.75m/d. For the model, hydraulic conductivity in overlying layer of coal bearing formation is taken averages 0.054m/d, $6.24*10^{-7}$m/s. No one has investigated vertical hydraulic conductivities, although vertical hydraulic conductivities are likely lower than horizontal hydraulic conductivities in sedimentary rocks due to compaction. Vertical hydraulic conductivity is taken 10^{-8}m/s based on previous investigation. Horizontal hydraulic conductivity of coal bearing formation is estimated by pump test value is $5.035*10^{-6}$m/s, vertical hydraulic conductivity is 10^{-7}m/s [2]. Geoecological institute is estimated confined storativity of 0.0065 for pump test in the coal bearing formation.

According to the hydrostratigraphy and conceptual model, three layers are designed in the model. Each layer has 57 rows 36 columns for a total of 2052 cells in the model (Fig 2). Cell thickness depended on elevation of contact between the different layers.

The boundary conditions are constant head in coal bearing formations and uniform recharge in upper boundary, whereas no-flow conditions were imposed on the lower boundary.

Report of hydrgeological investigation done by Geoecological Institute is notes that 6-7 percentage of precipitation recharges groundwater system. Recharge is 10.5mm/y.

Main purpose of the study is to determine pumping well rate in the Shivee-Ovoo coal mine. We used well optimization code of Visual MODFLOW Pro, a widely used finite difference flow code developed by Dr.Chunmiao Zheng and Patrick Wang from the University of Alabama [5]. Pumping well optimization was developed under steady state condition [4]. Objective of this optimization model was to maximize the total pumping rate. Strongly Implicit Procedure (SIP) and Slice-Successive Overrelaxation Package (SOR) solvers are used for solving numerical equation. Both solvers are solving a large system of simultaneous linear equations by iterations. Results solving by SOR and SIP methods are shown in table 1and 2.

Table 1

Well	Ñ1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Discharge, m^3/d	1000	1000	741	838	1000	967	768	903	967	838	999	903	1000	999	999

After optimization a new dewatering system was installed parallel to the B dewatering wells 160m. Distance between wells is 160m. When total extraction is 13 922m^3/d drawdown will be 25-65m near open pit (Fig 3).

Table 2

Well	Ñ1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Discharge, m^3/d	1000	871	870	0	709	741	935	0	516	999	806	96	1000	999	515

If 10057m^3 water pumps per day from 15 wells groundwater drawdown will be lowered from 10 to 40m.

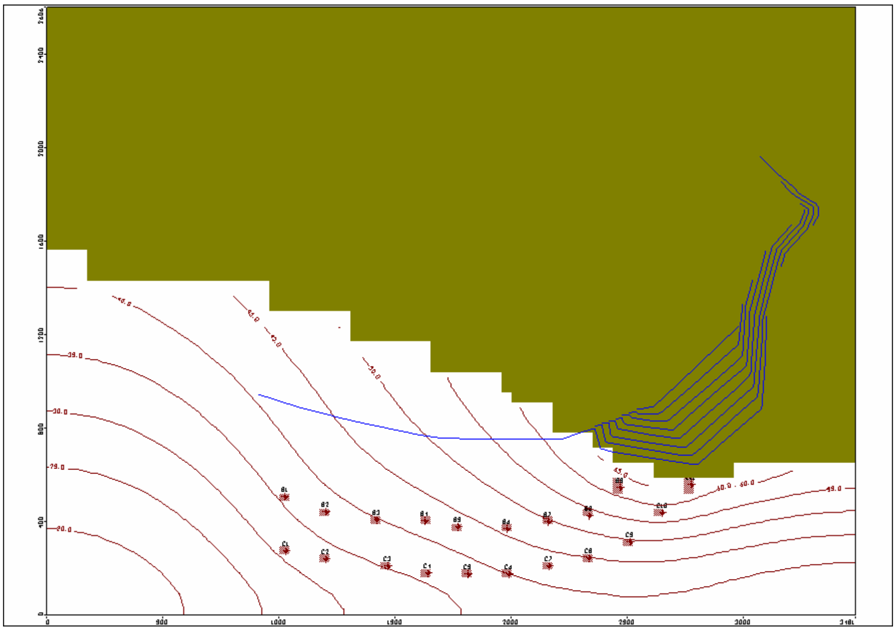

Fig 3. Groundwater drawdown near open pit

Conclusion

When 13922cubic meters water pumped from 15 wells per day its drawdown was 25-65m below surface near the open pit. The result shows that groundwater level is under coal bearing formations when mine is producing 2 millions tons of coal a year in east and south part of the mine. During 15 years exploitation these dewatering wells will be hold groundwater level at calculated depth and sustain good working condition in the pit.

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