



University of HUDDERSFIELD

University of Huddersfield Repository

Ali, Jafar, Fieldhouse, John D., Talbot, Chris J. and Mishra, Rakesh

Thermal discharge of warm water into cooler stagnant water

Original Citation

Ali, Jafar, Fieldhouse, John D., Talbot, Chris J. and Mishra, Rakesh (2009) Thermal discharge of warm water into cooler stagnant water. In: *What Where When: Multi-dimensional Advances for Industrial Process Monitoring*. Proceedings. University of Leeds, Leeds, pp. 227-238.

This version is available at <http://eprints.hud.ac.uk/8230/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>



University of HUDDERSFIELD

University of Huddersfield Repository

Ali, Jafar, Fieldhouse, John D., Talbot, Chris J. and Mishra, Rakesh

Thermal discharge of warm water into cooler stagnant water

Original Citation

Ali, Jafar, Fieldhouse, John D., Talbot, Chris J. and Mishra, Rakesh Thermal discharge of warm water into cooler stagnant water. In: What Where When Multi-dimensional Advances for Industrial Process Monitoring, 23 - 24, June, 2009, University of Leeds, Leeds, UK. (Unpublished)

This version is available at <http://eprints.hud.ac.uk/9893/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>



UNIVERSITY OF LEEDS

What Where When

Multi-dimensional Advances for Industrial Process Monitoring

Tuesday 23 & Wednesday 24 June 2009

PROCEEDINGS



The focus of the event is to explore how we can employ multi-dimensional sensing technologies to enhance process-analysis and control across a broad range of industrial sectors.

Coverage

The Symposium will encompass a wide range of novel approaches that provide new insights through increased spatial, temporal and material and component estimation dimensions; for example, including tomographic and spectrographic methods and data fusion between multiple sensor modes.

Attendees

The Symposium will be of interest to a broad range of scientists, engineers, technologists and industrialists who are keen to explore new approaches to the monitoring and control of industrial processes with a view to achieving benefits of increased productivity, product quality, efficiency and reduced wastage and emissions.

International Advisory Board

Dr G Bolton, Industrial Tomography Systems, UK

Professor X Cai, University of Shanghai, China

Dr Uwe Hampel, Research Centre Dresden-Rossendorf, Germany

Professor Y Hassin, Texas A&M University, USA

Professor D Littlejohn, University of Strathclyde, UK

Professor J Morris, University of Newcastle, UK

Professor A Peyton, University of Manchester, UK

Dr D Rhodes, NexiaSolutions, UK

Dr D Scott, DuPont, USA

Dr M Takei, Nihon University, Japan

Professor Chi-Hwa Wang, The National University of Singapore

Professor J Wang, Shanghai Jiao Tong University, China

Professor X Wang, University of Leeds, UK

Dr C Xie, Schlumberger Cambridge Research, UK

Invited Speakers

Professor Yassin A Hassan, Texas A&M University, USA

Multiscale Flow Structure Measurements for Nuclear System Components Using Particle Image Velocimetry

Dr David Scott, DuPont, USA

The "Thousand Words" Problem: Summarizing Multi-Dimensional Data

Professor Hugh Stitt, Johnson Matthey, UK

Industrial Process Tomography - An Industrial User's View

Professor Xue Z Wang, University of Leeds, UK

Particle Shape and Size Control: Integrating Measurement, Data Mining and Modelling

Organising Committee

Chair: Professor Kevin Roberts - University of Leeds

Co-chair: Professor Antony Peyton - University of Manchester

Members: Professors Mojtaba Ghadiri, Brian Hoyle, Mi Wang, Richard Williams - University of Leeds

Secretary: Dr Robert Hammond - University of Leeds

Venue

University of Leeds, Leeds, UK

www.engineering.leeds.ac.uk/cpd/w3mdm09



EPSRC

Engineering and Physical Sciences
Research Council



IChemE
Process Management & Control
Subject Group



UNIVERSITY OF LEEDS

For further information and enquiries please contact:
W3MDM09 Symposium Secretariat
CPD Unit, Faculty of Engineering
c/o Room 209, School of Civil Engineering
University of Leeds, Leeds, LS2 9JT

T: + 44 (0)113 343 2494

F: + 44 (0)113 343 2511

E: w3mdm09@leeds.ac.uk

W: www.engineering.leeds.ac.uk/cpd/w3mdm09

Programme Index

Session One: Advances in Tomography and Ultrasound I

The “Thousand Words” Problem: Summarizing Multi-Dimensional Data David M. Scott	1
Process tomography with electron beams U Hampel, F Fischer	13
Scanning acoustic microscopy for mapping the microstructure of soft materials N Parker, M Povey	23
Development of multi-wavelength laser absorption tomography system for monitoring and optimisation of chemical vapour deposition reactors V L Kasyutich, P A Martin	31
Multi-dimensional Visualization of Multiphase Flow using Electric Tomography and Stereoscopic-PIV M Honda, M Takei, T Zhao, J Choi, D Doh	41
Multi-site & Multi-sensing industrial process monitoring devoted to valorization strategy for various origins used oils A Kubiak, T G Mathia, K J Kubiak, S Bouvier	53
Modelling and Measurements of Film Characteristics and Gas Core of Annular Flows Q S Al-Yarubi, G. P. Lucas	62
An X-ray Tomography Study of the Effect of Scale-up of a High Shear Granulator on Granule Structure N Rahmanian, M Ghadiri, X Jia	72
An Impedance Cross Correlation (ICC) device for measuring solids velocity and volume fraction profiles in solids-water flows S Al-Hinai, G P Lucas	85
Wire-mesh sensors for fast visualization of multiphase flows M J da Silva, S Thiele, E Schleicher, U Hampel	98
Towards Nano-Particle Resonance Imaging for Use in Breast Cancer Imaging P Guan, Mi Wang, H I Schlaberg, J I Khan, V Speirs	109
Modelling and Compensating for Acoustic Reverberation Effects in Ultrasonic Tomography Systems S Ellwood, S Freear	120
Impact of Leakage Effects in Electrical Capacitance Tomography due to Short Electrode Length H Zangl, M Neumayer	129

Spatial Resolution Analysis for Real Time Applications in Electrical Tomography M Neumayer, G Steiner, D Watzenig, H Zangl	139
Spectro-tomography for <i>What, Where</i> and <i>When</i> Process Estimation B S Hoyle, M Nahvi	148
A Novel Tomographic Sensing System for High Conductivity Multiphase Flow Measurement J Jia, Mi Wang, H I Schlaberg	161
Using Principle Component Analysis in Electrical Impedance Tomography K Ismail, M Wang, B Hoyle	171
Channel Coding Study for Fast-ultrasonic-tomography F Ayu, S Freear	184

Session Two: Advances in Multidimensional Sensing

Particle Shape and Size Control: Integrating Measurement, Data Mining and Modelling Professor Xue Z. Wang	
Multiscale Flow Structure Measurements for Nuclear System Components using Particle Image Velocimetry Professor Yassin A. Hassan	
Modelling and measurement of the gas flow rate in vertical annular gas-water flow using a ‘Conductance multiphase Venturi A H A M Hasan, G P Lucas	185
Real-time On-line Monitoring of Pulverized Coal in Power Plants X Cai, J Li, X Ouyang, Z Jia, X Fan	197
Development of an ultrasound and electrical tomography platform C Qiu, K Primrose, D McCormack, M Townley, R Tweedie, F Podd	205
Three-Dimensional Monitoring of Combustion Flames Using Digital Imaging and Tomographic Reconstruction Techniques G Gilabert, G Lu, Y Yan	212
Multivariate Statistical Control of Emulsion and Nanoparticle Slurry Processes Based on Process Tomography, Dynamic Light Scattering, and Acoustic Sensor Data R F Li, L Liu, X Z Wang, R Tweedie, K Primrose, J Corbett; F McNeil-Watson	219
Obtaining Multidimensional Particle Size Distributions Using Stereoscopic Imaging Michel Kempkes, Thomas Vetter, Marco Mazzotti	226

Thermal discharge of warm water into cooler stagnant water J Ali, J Fieldhouse, C Talbot and R Mishra	227
Using the four-sensor probe to measuring the bubble velocity vector in bubble water two phase flow X Zhao, G P Lucas; T Leeungculsatien	239
Characterisation of Crystallisation Processes with Electrical Impedance Spectroscopy Y Zhao, M Wang, R B Hammond	251
Implementation of a Fibre Evanescent Wave Spectroscopy (FEWS) Sensor Using Getese Chalcogenide Fibres for Chemical Sensing Xin Jiang, Shaoxiong Shen, Animesh Jha	260
Status Quo of Spectroscopic Techniques in Chemical Engineering Process Monitoring V Ramachandran, M Wang	261
Laboratory and field testing of a new magnetic resonance water cut metering device A Kantzas, S Kruychkov, C MacLeod	274
Measurement of Multiple Properties of Solid and Liquid Phases in Crystallisation Processes Using NIR: Calibration Model Development Using Genetic Algorithm and Support Vector Machine C Y Ma, X Z Wang	281
Morphological Population Balance Models for the Dynamic Evolution of Particle Shape and Size Distribution in Protein Crystallisation J J Liu, C Y Ma, X Z Wang, Y D Hu	287
Study of the Test Method for the Refrigerant Vapor State at the Outlet of the Evaporator L Jian-hua	298
Wireless Sensor Networks for Industrial Processes Trevor York	307

Session Three: Advances in Tomography and Ultrasound II

Industrial Process Tomography – An Industrial User’s View Professor Hugh Stitt	
Combination of magnetic resonance and x-ray tomography for bitumen reservoir characterization J Bryan, J Wang, S Kruychkov, A Kantzas	308
Estimation of non-stationary velocity fields using Electrical Impedance Tomography A Lipponen, A Seppänen, J P Kaipio	323

Use of MCNP Simulation for the Tomographic Inspection of Airport Luggage Using Neutron and Gamma Ray Methods	341
G Zhang, R G van Silfhout, A J Peyton, M J Joyce, M D Aspinall, A J Boston, P J Nolan, N P Hawkes	
The Physics of nano-Particle Resonance Imaging	354
J I Khan, H I Schlberg, M Wang	
Flow Metering with Fast Electrical Impedance Tomography and an Electromagnetic Flowmeter in a Vertical Air-Water Flow	363
H Li, M Wang, H I Schlberg	
A novel method of determining mass flow rate and flow features in vertical slurry pipeline transport	375
B Munir, M Wang, U Zafar	
Ultrasonic Array Research Platform (U-ARP)	388
Ben Raiton, Steven Freear	
Measurement methods of Ultrasound Vibration Potential signals for imaging applications	389
H I Schlberg, M Wang, P Guan, J I Khan	
Pseudo-inverse Flow Pattern Reconstruction for ECT	402
S Liu, Q Chen, Q Qiu, J Lei, Z Han, J Li, J Li	
Experimental Validation of Over-zero Switching Method	408
Y Ma, Y Lai, M Wang, J Jia	
Spectral Induced Polarization and Imaging of Water Distribution during Desaturation of Sand	417
F H Haegel, O Esser, K Breede, J A Huisman, H Vereecken, E Zimmermann, W Glaas, J Berwix	
Image reconstruction in Electrostatic Tomography using a prior knowledge from ECT	431
B Zhou, S Wang, C Xu, Y Wu	
Multi- Sensing Strategy to Enhance Process in Terms of Reliability and Performances – Case of Tribological Focus on New Compressors Generation	441
T.G. Mathia, K Kubiak, V. Génissieux	
Construction methods of 4D mathematical models 3D bodies on a basis interlineation, interflatation, blending approximation and wavelets	443
O M Lytvyn, Y I Pershina, O P Nechuyviter, O O Litvin, S I Kulyk	

Index of Papers

01	The “Thousand Words” Problem: Summarizing Multi-Dimensional Data David M. Scott	1
02	Modelling and Measurements of Film Characteristics and Gas Core of Annular Flows Q S Al-Yarubi, G. P. Lucas	62
03	An X-ray Tomography Study of the Effect of Scale-up of a High Shear Granulator on Granule Structure N Rahmanian, M Ghadiri, X Jia	72
04	Obtaining Multidimensional Particle Size Distributions Using Stereoscopic Imaging Michel Kempkes, Thomas Vetter, Marco Mazzotti	226
05	Process tomography with electron beams U Hampel, F Fischer	13
06	Multi-dimensional Visualization of Multiphase Flow using Electric Tomography and Stereoscopic-PIV M Honda, M Takei, T Zhao, J Choi, D Doh	41
07	Thermal discharge of warm water into cooler stagnant water J Ali, J Fieldhouse, C Talbot and R Mishra	227
08	An Impedance Cross Correlation (ICC) device for measuring solids velocity and volume fraction profiles in solids-water flows S Al-Hinai, G P Lucas	85
09	Using the four-sensor probe to measuring the bubble velocity vector in bubble water two phase flow X Zhao, G P Lucas; T Leeungculsatien	239
10	Modelling and measurement of the gas flow rate in vertical annular gas-water flow using a ‘Conductance multiphase Venturi A H A M Hasan, G P Lucas	185
11	Wire-mesh sensors for fast visualization of multiphase flows M J da Silva, S Thiele, E Schleicher, U Hampel	98
12	Towards Nano-Particle Resonance Imaging for Use in Breast Cancer Imaging P Guan, Mi Wang, H I Schlaberg, J I Khan, V Speirs	109
13	Modelling and Compensating for Acoustic Reverberation Effects in Ultrasonic Tomography Systems S Ellwood, S Freear	120

14	Characterisation of Crystallisation Processes with Electrical Impedance Spectroscopy Y Zhao, M Wang, R B Hammond	251
16	Impact of Leakage Effects in Electrical Capacitance Tomography due to Short Electrode Length H Zangl, M Neumayer	129
17	Spatial Resolution Analysis for Real Time Applications in Electrical Tomography M Neumayer, G Steiner, D Watzenig, H Zangl	139
18	Spectro-tomography for <i>What, Where</i> and <i>When</i> Process Estimation B S Hoyle, M Nahvi	148
19	The Physics of nano-Particle Resonance Imaging J I Khan, H I Schlaberg, M Wang	354
20	A Novel Tomographic Sensing System for High Conductivity Multiphase Flow Measurement J Jia, Mi Wang, H I Schlaberg	161
21	Scanning acoustic microscopy for mapping the microstructure of soft materials N Parker, M Povey	23
22	Development of multi-wavelength laser absorption tomography system for monitoring and optimisation of chemical vapour deposition reactors V L Kasyutich, P A Martin	31
23	Implementation of a Fibre Evanescent Wave Spectroscopy (FEWS) Sensor Using Getese Chalcogenide Fibres for Chemical Sensing Xin Jiang, Shaoxiong Shen, Animesh Jha	260
24	Status Quo of Spectroscopic Techniques in Chemical Engineering Process Monitoring V Ramachandran, M Wang	261
25	Using Principle Component Analysis in Electrical Impedance Tomography K Ismail, M Wang, B Hoyle	171
26	Channel Coding Study for Fast-ultrasonic-tomography F Ayu, S Freear	184
27	Flow Metering with Fast Electrical Impedance Tomography and an Electromagnetic Flowmeter in a Vertical Air-Water Flow H Li, M Wang, H I Schlaberg	363
28	A novel method of determining mass flow rate and flow features in vertical slurry pipeline transport B Munir, M Wang, U Zafar	375

29	Laboratory and field testing of a new magnetic resonance water cut metering device A Kantzas, S Kruchkov, C MacLeod	274
30	Combination of magnetic resonance and x-ray tomography for bitumen reservoir characterization J Bryan, J Wang, S Kruchkov, A Kantzas	308
31	Ultrasonic Array Research Platform (U-ARP) Ben Raiton, Steven Freear	388
32	Measurement methods of Ultrasound Vibration Potential signals for imaging applications H I Schlaberg, M Wang, P Guan, J I Khan	389
33	Three-Dimensional Monitoring of Combustion Flames Using Digital Imaging and Tomographic Reconstruction Techniques G Gilabert, G Lu, Y Yan	212
34	Estimation of non-stationary velocity fields using Electrical Impedance Tomography A Lipponen, A Seppänen, J P Kaipio	323
35	Pseudo-inverse Flow Pattern Reconstruction for ECT S Liu, Q Chen, Q Qiu, J Lei, Z Han, J Li, J Li	402
36	Measurement of Multiple Properties of Solid and Liquid Phases in Crystallisation Processes Using NIR: Calibration Model Development Using Genetic Algorithm and Support Vector Machine C Y Ma, X Z Wang	281
37	Multivariate Statistical Control of Emulsion and Nanoparticle Slurry Processes Based on Process Tomography, Dynamic Light Scattering, and Acoustic Sensor Data R F Li, L Liu, X Z Wang, R Tweedie, K Primrose, J Corbett; F McNeil-Watson	219
38	Morphological Population Balance Models for the Dynamic Evolution of Particle Shape and Size Distribution in Protein Crystallisation J J Liu, C Y Ma, X Z Wang, Y D Hu	287
39	Real-time On-line Monitoring of Pulverized Coal in Power Plants X Cai, J Li, X Ouyang, Z Jia, X Fan	197
41	Study of the Test Method for the Refrigerant Vapor State at the Outlet of the Evaporator L Jian-hua	298
42	Experimental Validation of Over-zero Switching Method Y Ma, Y Lai, M Wang, J Jia	408
43	Construction methods of 4D mathematical models 3D bodies on a basis interlineation, interflatation, blending approximation and wavelets O M Lytvyn, Y I Pershina, O P Nechuyviter, O O Litvin, S I Kulyk	443

44	Spectral Induced Polarization and Imaging of Water Distribution during Desaturation of Sand F H Haegel, O Esser, K Breede, J A Huisman, H Vereecken, E Zimmermann, W Glaas, J Berwix	417
45	Image reconstruction in Electrostatic Tomography using a prior knowledge from ECT B Zhou, S Wang, C Xu, Y Wu	431
46	Multi- Sensing Strategy to Enhance Process in Terms of Reliability and Performances – Case of Tribological Focus on New Compressors Generation T.G. Mathia, K Kubiak, V. Génissieux	441
47	Wireless Sensor Networks for Industrial Processes Trevor York	307
48	Multi-site & Multi-sensing industrial process monitoring devoted to valorization strategy for various origins used oils A Kubiak, T G Mathia, K J Kubiak, S Bouvier	53
49	Development of an ultrasound and electrical tomography platform C Qiu, K Primrose, D McCormack, M Townley, R Tweedie, F Podd	205
50	Use of MCNP Simulation for the Tomographic Inspection of Airport Luggage Using Neutron and Gamma Ray Methods G Zhang, R G van Silfhout, A J Peyton, M J Joyce, M D Aspinall, A J Boston, P J Nolan, N P Hawkes	341

Index of Authors

Al-Hinai, S	85	Kubiak, K J	53
Al-Yarubi, Q S	62	Kylik, S I	443
Ali, J	227	Lai, Y	408
Aspinall, M D	341	Leeungulsatien, T	239
Ayu, F	184	Lei, J	402
Berwix, J	417	Li, H	161, 363
Boston, A J	341	Li, J	197
Bouvier, S	53	Li, R F	219
Breede, K	417	Lipponen, A	323
Bryan, J	308	Litvin, O O	443
Cai, X	197	Liu, J J	287
Cheen, Q S	402	Liu, L	219
Choi, J	41	Liu, S	402
Corbett, J	219	Lu, G	212
da Silva, M J	98	Lucas, G P	62, 85, 239, 185
Ding, Y	72	Lytvyn, O M	443
Doh, D	41	Ma, C Y	281, 287
Ellwood, S	120	Ma, Y	408
Esser, O	417	MacLeod, C	274
Fan, X	197	Martin, P A	31
Fieldhouse, J	227	Mathia, T G	441, 53
Fischer, F	13	Mazzotti, M	226
Freear, S	120	McCormack, D	205
Genissieux, V	53	McNeil-Watson, F	219
Ghadiri, M	72	Mihalkin, V V	443
Gilabert, G	212	Mishra, R	227
Glaas, W	417	Munir, B	375
Guan, P	109, 354, 389	Nahvi, M	148
Haegal, F H	417	Nechuyviter, O P	443
Hammond, R B	251	Neumayer, M	129, 139
Hampel, U	13, 98	Nolan, P J	341
Hasan, A H A M	185	Ouyang, X	197
Hassan, Y A	Invited 3	Parker, N	23
Hawkes, N P	341	Pershina, Y I	443
Honda, M	41	Peyton, A J	341
Hoyle, B S	148, 171	Podd, F	205
Hu, Y D	287	Povey, M	23
Huisman, J A	417	Primrose, K	219, 205
Ismail, K	171	Qiu, Q	205
Jha, A	260	Rahmanian, N	72
Jia, J	161, 408	Raiton, B	388
Jia, X	72	Ramachandran, V	261
Jia, Z	197	Schlaberg, H I	109, 354, 161, 363, 389
Jiang, X	260	Schleicher, E	98
Jian-hua, L	298	Scott, D M	Invited 1
Joyce, M J	341	Seppanen, A	323
Kaipo, J P	323	Shen, S	260
Kantzas, A	274, 308	Speirs, V	109
Kasyutich, V L	31	Steiner, G	139
Kempkes, M	226	Stitt, H	Invited 4
Khan, J I	109, 354, 389	Takei, M	41
Kruchkov, S	274, 308	Talbot, C	227
Kubiak, A	53		

Thiele, S	98
Townley, M	205
Tweedie, R	219, 205
Van Silfhout, R G	341
Vereecken, H	417
Vetter, T	226
Wang, J	308
Wang, M	109, 251, 354, 161, 261, 171, 363, 375, 389, 408
Wang, S	431
Wang, X.Z	Invited 2, 281, 219, 287
Watzenig, D	139
Wu, Y	431
Xu, C	431
Yan, Y	212
York, D	72
York, T	307
Zafar, U	375
Zangl, H	129, 139
Zhang, G	341
Zhao, T	41
Zhao, X	239
Zhao, Y	251
Zhou, B	431
Zimmermann, E	417