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Assistant Professor

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EDUCATION***Ph.D. in Electrical and Computer Engineering***¹

April 2009

Concordia University, Montreal, Canada.

Dissertation: *Probabilistic modeling of wavelet coefficients for processing of image and video signals.*

Supervisors: Professor M. Omair Ahmad and Professor M. N. S. Swamy

Five full-length papers in IEEE/IET Transactions and eight papers in proceedings of international conferences have already been published or in-press from the doctoral research. The external examiner, Professor Rui J. P. Figueiredo of the University of California, Irvine has judged the work of the thesis as “outstanding” and a “new invention”. The thesis won the Distinguished Doctoral Dissertation Prize as the best thesis defended in Science and Engineering of Concordia University in 2009.

M.Sc. in Electrical and Electronic Engineering

May 2002

Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

Dissertation: *Improved wavelet-based image denoising algorithm using adaptive center weighted median filter.*

Supervisor: Professor Md. Kamrul Hasan

One full-length paper in a reputed international journal and two papers in proceedings of an international conference were published from the master’s research.

B.Sc. in Electrical and Electronic Engineering

September 1999

BUET, Dhaka, Bangladesh.

Ranked 3rd among 117 graduating students.**AREAS OF RESEARCH INTERESTS**

My research experiences and interests cover the challenging issues of modeling and processing techniques of visual/multimedia signals such as image and video in the area of biomedical (e.g., ultrasound, MRI, mammography, computer tomography, and X-ray), geosciences (e.g., SAR), genetics (e.g., cDNA microarray), astronomy, security, surveillance, and communication. I am particularly interested in the following:

- Development of mathematically tractable and computationally efficient probabilistic models for the visual signals that describe essential variability of a signal (e.g., motion in a video) by considering the higher order statistics of the data samples.
- Application of these models in various real-world processing techniques such as reduction of noise and speckle, restoration, registration, fusion, detection of edge and texture, enhancement, copyright protection, encryption, compression, classification, pattern recognition, stabilization, and segmentation.
- Statistical analysis of these signals in the space-time and various transform domains such as the DFT, DCT, wavelet, and curvelet in their multidimensional representations (e.g., 2D and 3D).

¹ The defense of doctoral thesis was held on the 1st of April 2009.

CAREER HISTORY

- **Visiting Research Fellow**, part-time, Identity, Privacy, and Security Institute, Edward S. Rogers Sr. Department of Electrical and Computer Engineering, University of Toronto, Toronto, Canada (January 2012 – todate).
- **Assistant Professor**, full-time, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh (August 2002 – August 2003, July 2009 – todate).
- **Research Assistant**, full-time, Concordia University, Montreal, Canada (September 2003 – June 2009).
- **Course Assistant**, part-time, Concordia University, Montreal, Canada (September 2004 – December 2008).
- **Teaching Assistant**, part-time, Concordia University, Montreal, Canada (January 2004 – December 2008).
- **Teaching Fellow**, part-time, Concordia University, Montreal, Canada (January 2004 – December 2008).
- **Member**, part-time, Bureau of Research, Testing and Consultations, BUET, Bangladesh (August 2002 – August 2003, July 2009 – todate).
- **Assistant Professor**, part-time, North South University, Dhaka, Bangladesh (September 2009 – April 2010).
- **Assistant Professor**, part-time, Islamic University of Technology, Dhaka, Bangladesh (August 2002 – August 2003).
- **Lecturer**, full-time, BUET, Dhaka, Bangladesh (November 1999 – August 2002).
- **Lecturer**, part-time, Ahsanullah University of Science and Technology, Dhaka, Bangladesh (August 2001 – August 2002).

TEACHING EXPERIENCE

Assistant Professor

**Department of Electrical and Electronic Engineering (EEE)
Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh**

Aug. 2002 – Aug. 2003
Jul. 2009 – todate

- As a full-time faculty member, I have taught or engaged in teaching the following:

Postgraduate lecture course:

EEE 6002 (Selected Topics in Electrical and Electronic Engineering
EEE 6209 (Digital Image Processing)

Undergraduate lecture courses:

EEE 311 (Digital Signal Processing I)
EEE 301 (Continuous Signals and Linear Systems)
EEE 103 (Electrical Circuits II)

- In addition to these lecture courses, I taught or engaged in teaching for the following

Undergraduate laboratory courses:

EEE 418 (Digital and Satellite Communication Engineering Sessional)
EEE 312_old (Electronic Circuits III Sessional)
EEE 102 (Electrical Circuits I Sessional)
EEE 312_new (Digital Signal Processing I Sessional)

- Besides the lecture and laboratory courses, I have supervised or engaged in supervising the following

Postgraduate thesis (completed):

Image Registration Algorithm Using Statistics of Curvelet Coefficients (One master's student)

Undergraduate thesis (completed):

Detection and Classification of Vehicles from Video Using Time-Spatial Images (Three fourth-year undergraduate students)

Undergraduate thesis (in progress):

Segmentation of Volumetric Images Using 3D Discrete Wavelet Transform (Two fourth-year undergraduate students)

Classification of Image Texture Using Probabilistic Distance Metric of Wavelet Coefficients (Two fourth-year undergraduate students)

Assistant Professor

Sep. 2009 – todate

**Department of Electrical Engineering and Computer Science
North South University, Dhaka, Bangladesh**

- As a part-time faculty member, I taught the following

Undergraduate lecture course

ETE 423 (Principles of Telecommunication Networks)

- I am supervising the following

Undergraduate thesis (completed):

A Robust Image Encryption Technique for Real-Time Applications (Two undergraduate students)

Course Assistant

Sep. 2004 – Dec. 2008

**Department of Electrical and Computer Engineering (ECE)
Concordia University, Montreal, Canada**

I helped to develop the following course materials

Undergraduate courses

Lecture notes, Quiz, Mid-Terms of ENGR 233 (Applied Advanced Calculus)

Laboratory Manual for the Experiments of COEN 315 (Digital Electronics)

Teaching Assistant

Jan. 2004 – Dec. 2008

**Department of ECE
Concordia University, Montreal, Canada**

Helped in understanding the concepts and solving the problems of the materials of the following

Undergraduate lecture courses

ELEC 273 (Basic Circuit Analysis)

ELEC 275 (Principles of Electrical Engineering)

ELEC 370 (Modeling and Analysis of Physical Systems)

ELEC 312 (Electronics-II)

Teaching Fellow

Jan. 2004 – Dec. 2008

**Department of ECE
Concordia University, Montreal, Canada**

As an instructor, I taught the following

Undergraduate laboratory courses

ELEC 273 (Basic Circuit Analysis)

ELEC 275 (Principles of Electrical Engineering)
ELEC 370 (Modeling and Analysis of Physical Systems)

Assistant Professor

Aug. 2002 – Aug. 2003

Department of EEE

Islamic University of Technology, Dhaka, Bangladesh

- As a part-time faculty member, I taught the following

Undergraduate lecture course

EEE 411 (Digital Signal Processing)

- I helped to develop the following course materials and conducted the following

Undergraduate laboratory courses

Laboratory Manual for the Experiments of EEE 412 (Digital Signal Processing Sessional)

Lecturer

Nov. 1999 – Aug. 2002

Department of EEE

BUET, Dhaka, Bangladesh

- As a full-time faculty member, I taught the following

Undergraduate lecture courses:

EEE 267 (Electrical and Electronic Technology)

EEE 213 (Electronic Circuits II)

EEE 311 (Electronic Circuits III)

- In addition to these lecture courses, I taught the following

Undergraduate laboratory courses:

EEE 214 (Electronic Circuits II Sessional)

EEE 312 (Electronic Circuits III Sessional)

EEE 314 (Telecommunication Engineering Sessional)

EEE 316 (Industrial Electronics Sessional)

EEE 332 (Electrical Machines III Sessional)

Lecturer

Aug. 2001 – Aug. 2002

Department of EEE

Ahsan Ullah University of Science and Technology, Dhaka, Bangladesh

- As a part-time faculty member, I taught the following

Undergraduate laboratory courses:

EEE 454 (Industrial Electronics Sessional)

EEE 334 (Measurement and Instrumentation Sessional)

RESEARCH EXPERIENCE

Assistant Professor (or Faculty research)

Apr. 2010 – todate

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

As a faculty member of the Department of Electrical and Electronic Engineering, I have been supervising several undergraduate students for their thesis. In these research works, I am focusing on developing real-time video surveillance system, biometric identification system, and biomedical imaging system. My target is also to manage research grants from various available sources so that a significant level of research output may be realized. Some of the notable achievements and progresses are:

- A research grant has been obtained from Ministry of Science and Information & Communication Technology, Bangladesh, for doing research in the area of fingerprint, face, voice, and iris-based biometric identification system.
- A research grant has been obtained from Higher Education Quality Enhancement Project of the Ministry of Education supported by World Bank for the development of low-cost ultrasound-based elasticity imaging system for early cancer detection.
- A research output on detection and classification of vehicles from a video using time-spatial image has been published in an international conference and the advanced version of this algorithm is in process of filing for a patent and submitting in a journal.
- A research on the development of image registration algorithm using the statistics of curvelet coefficients is underway.
- A research is going on segmentation of volumetric images such as ultrasound using 3D wavelet transform.
- A research is going on texture classification of image database using probabilistic distance metric of wavelet coefficients.
- Another research on development of robust encryption algorithm of image and video for real-time operation is also in progress.

Ph.D. student (or Ph.D. works)
Concordia University, Montreal, Canada

Sept. 2003 – Apr. 2009

As a Ph.D. student of the Multimedia Signal Processing Research Group at the Department of Electrical and Computer Engineering, I have been responsible for conducting research on the processing of image and video signals with special references to their space-time-frequency representations, statistical modeling, developing various estimation and detection techniques, experimentations, and performance studies. Specifically,

- A unified probabilistic model for the wavelet coefficients of the image and video signals has been developed using the Gauss-Hermite expansion². An important motivation for using such expansion is that an appropriate number of parameters that are functions of the higher-order moments of data samples can be used for a better modeling performance.
- The performance of the probabilistic model has been investigated in various types of wavelet representations such as orthogonal/biorthogonal, real/complex, and separable/non-separable. In particular, the statistics of the data samples are analyzed in terms of the transformation matrices and mathematical operations of the transform.
- The performance of the developed model has been studied in several estimation techniques such as denoising (reducing additive white Gaussian noise), despeckling (reducing multiplicative and correlated noise), deblurring (restoration from the degradation due to point spread function), and fusion (obtain an informative signal from multi-sensed data). Estimation performances have been evaluated on several data sources that include natural images and video, medical images, and remote sensing images.
- The performance of the developed model has also been studied in the case of the detection of edge and textures and the detection of watermark for copyright protection.

M.Sc. Student (or M.Sc. works)
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

May 2000 – May 2002

As an M.Sc. student of the Signal Processing Research Group at the Department of Electrical and Electronic Engineering, I was responsible for conducting research on the image processing with concentrations given to image filtering, contrast enhancement, and neural network-based image compression.

² This expansion has been used in view of the fact that empirical model of the wavelet coefficients that have non-compact support, resembles the standard Gaussian function.

ADMINISTRATIVE EXPERIENCE

Assistant Professor

Apr. 2010 – todate

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

As a faculty member of the Department of Electrical and Electronic Engineering, I have been serving in several administrative positions both inside the university and national organizations. Some of the notable positions are:

- Serving as Associate Project Counterpart for the grant obtained from Ministry of Science and Information & Communication Technology, Bangladesh, for ‘Laboratory Development for Biometric Identification and Imaging System’ at Bangladesh University of Engineering and Technology (Amount: 4,00,000 BDT; Duration: Nov. 2009 – Dec. 2010).
- Serving as Associate Project Counterpart for the grant obtained from Higher Education Quality Enhancement Project of Ministry of Education, Bangladesh, for the ‘Development of An Ultrasound-Based Elasticity Imaging System for Early Cancer Detection’ at Bangladesh University of Engineering and Technology (Amount: 91,48,000 BDT; Duration: Jan 2011 – Dec. 2013).
- Serving as a Member of Board of Accreditation for Engineering and Technical Education, Institute of Engineers of Bangladesh (Dec. 2009 – Aug. 2010).
- Serving as Assistant Provost for the Ahsan Ullah Residential Hall of BUET (Apr. 2010 – todate).
- Serving as a member of Technical Specification Committee for the procurement of electronic equipments for the Special Branch, Bangladesh Police (Jul 2010 – Jun 2011).
- Serving as a member of Technical Specification Committee and Tender Evaluation Committee for the procurement, installation, and commissioning of studio and camera for the Parliament Bangladesh Television (May 2011 – todate).

SCHOLARSHIPS/FELLOWSHIPS/AWARDS

- Distinguished Doctoral Dissertation Prize, Concordia University, Canada (Apr. 2010).
- Postdoctoral Fellowship, Natural Sciences and Engineering Research Council (NSERC), Canada (Received on Apr. 2009).
- Student Travel Grant Award to attend the 42nd IEEE International Symposium on Circuits and Systems, Concordia University, Canada (Apr. 2009).
- Faculty of Engineering and Computer Science Graduate Scholarship, Concordia University, Canada (Sep. 2008 – Apr. 2009).
- Student Travel Grant Award to attend the 41st IEEE International Symposium on Circuits and Systems, Concordia University, Canada (May 2008).
- Carolyn and Richard Renaud Teaching Assistantship Award, Concordia University, Canada (Sep. 2007 – Apr. 2008).
- Faculty of Engineering and Computer Science Graduate Scholarship, Concordia University, Canada (Sep. 2006 – Apr. 2007).
- Finalist: Student Paper Competition Award, the 49th IEEE International Mid-West Symposium on Circuits and Systems, PR, USA (Aug. 2006).
- Doctoral Teaching Assistantship Award, Concordia University, Canada (Sep. 2004 – Dec. 2004).
- Concordia University Graduate Fellowship, Concordia University, Canada (Sep. 2003 – Aug. 2006).
- International Tuition Fee Remission Award, Concordia University, Canada (Sep. 2003 – Aug. 2006).

- Best Student Paper Award: Travel Grant, the 3rd International Symposium on Communication System, Network and Digital Signal Processing, Staffordshire, UK (Jul. 2002).
- University Merit Scholarship, Bangladesh University of Engineering and Technology (BUET), Bangladesh (Jun. 1994 – Aug.1999).
- Dean's List Award, BUET, Bangladesh, (Jun. 1994 – Aug.1999).
- Board Scholarship, Ministry of Education, Bangladesh, (Jan. 1986 – Dec. 1992).

PROFESSIONAL ACTIVITIES

- Member, Institute of Engineers of Bangladesh (Jun 2010 – todate).
- Student Member, American Statistical Association (Jun. 2007 – Jun. 2008).
- Reviewed several papers for the IEEE Signal Processing Letters, IEEE Transactions on Image Processing, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Audio, Speech, and Language Processing, IEEE Transactions on Circuits and Systems: Regular Paper, Journal of Electronic Imaging from SPIE, Journal of Medical and Biological Engineering and Computing from Springer (May 2007 – todate).
- Reviewed research grant application for American University of Beirut, Lebanon (Apr. 2010 – May 2010).
- Attended the Workshop on Fundamental Concepts of Fire Fighting and Formulation of Legislation Regarding Hazardous Fire, BUET-Japan Institute of Disaster Prevention and Urban Safety, Bangladesh (Jan. 2011).
- Attended Teaching Assistant Workshop, Center for Teaching and Learning Services, Concordia University, Canada (Aug. 2007).
- Attended training course on Teachers' Appreciation Workshop, Directorate of Continuing Education, BUET, Bangladesh (Sep. 2001).
- Completed a short course on ORACLE 8i Developer 6, Institute of Information and Communication Technology, BUET, Bangladesh (May 2001 – Jun. 2001).

CONFERENCE/TECHNICAL PRESENTATIONS

- Presented a paper in the 42nd IEEE International Symposium on Circuits and Systems, Taipei, Taiwan, Republic of China (May 2009).
- Presented a paper in the 1st International Symposium on Digital Life Technologies, Tainan, Taiwan, Republic of China (May 2009).
- Presented a paper in the 51st IEEE International Mid-West Symposium on Circuits and Systems, Knoxville, TN, USA (Aug. 2008).
- Presented a paper in the 41st IEEE International Symposium on Circuits and Systems, Seattle, WA, USA (May 2008).
- Presented a paper in the 14th IEEE International Conference on Image Processing, San Antonio, TX, USA (Sep. 2007).
- Presented a paper in the 8th Joint Statistical Meeting, Salt Lake City, UT, USA (Jul. 2007).
- Presented research works at the Department of Electrical and Electronic Engineering, Bangladesh University of Engineering and Technology, Bangladesh (Feb. 2007).
- Presented a paper in the 49th IEEE International Mid-West Symposium on Circuits and Systems, San Juan, PR, USA (Aug. 2006).

- Presented a paper in the 3rd IEEE International North-East Workshop on Circuits and Systems, Quebec City, QC, Canada (Jun. 2005).
- Presented research works in Visual Information Processing Group, Imperial College, London, UK (Jul. 2002).
- Presented two papers in the 3rd International Symposium on Communication System, Network and Digital Signal Processing, Staffordshire, UK (Jul. 2002).

COURSES COMPLETED IN GRADUATE PROGRAM

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|---|--|
| 1) Doctoral Seminar | 7) Advanced Digital Signal Processing |
| 2) Doctoral Research Proposal | 8) Advanced Telecommunication Engineering |
| 3) Advanced Stochastic Processes for Communications and Signal Processing | 9) Engineering Analysis |
| 4) Digital Video Processing | 10) Testing of VLSI Circuits |
| 5) Adaptive Signal Processing | 11) Compound Semiconductor Devices |
| 6) Detection and Estimation Theory | 12) Semiconductor Materials and Heterostructures |

PUBLICATIONS

Articles Published or Accepted in Refereed Journals:

1. Nafi Ur Rashid, Niluthpol Chowdhury Mithun, and **S. M. Mahbubur Rahman**, "Detection and classification of vehicles from video using multiple time-spatial images," in press of *IEEE Transactions on Intelligent Transportation Systems*, DOI (identifier) 10.1109/TITS.2012.2186128, Jan. 2012.
2. Sanjit Roy, Tamanna Howlader, and **S. M. Mahbubur Rahman**, "Image fusion technique using multivariate statistical model for wavelet coefficients," in press and available online of *Signal Image and Video Processing*, Springer, July 2011.
3. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Contrast-based fusion of noisy images using discrete wavelet transform," *IET Image Processing*, vol. 4, no. 5, pp. 374-384, May 2010.
4. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "A new statistical detector for DWT-based additive image watermarking using the Gauss-Hermite expansion," *IEEE Transactions on Image Processing*, vol. 18, no. 8, pp. 1782-1796, Aug. 2009.
5. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Bayesian wavelet-based image denoising using the Gauss-Hermite expansion," *IEEE Transactions on Image Processing*, vol. 17, no. 10, pp. 1755-1771, Oct. 2008.
6. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Statistics of 2D DT-CWT coefficients for Gaussian distributed signal," *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 55, no. 7, pp. 2013-2025, Aug. 2008.
7. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Video denoising based on inter-frame statistical modeling of the wavelet coefficients," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 17, no. 2, pp. 187-198, Feb. 2007.

8. **S. M. Mahbubur Rahman** and Md. Kamrul Hasan, "Wavelet-domain iterative center weighted median filter for image denoising," *Signal Processing, Elsevier Science Publishers*, vol. 83, no. 5, pp. 1001-1012, May 2003.

Articles Submitted in Refereed Journals:

1. Md Mushfiqul Alam, Tamanna Howlader, and **S. M. Mahbubur Rahman**, "Entropy-based image registration method using the curvelet transform," submitted in *Image and Vision Computing, Elsevier Science Publishers*, paper number - IMAVIS-D-12-00007, Jan. 2012.

Articles Published in Proceedings of Refereed Conferences, Symposiums, Meetings or Workshops:

1. Nafi Ur Rashid, Niluthpol Chowdhury Mithun, Bhadhan Roy Joy, and **S. M. Mahbubur Rahman**, "Detection and classification of vehicles from a video using time-spatial image," in *Proceedings of 6th International Conference on Electrical and Computer Engineering*, Dhaka, Bangladesh, pp. 502-505, Dec. 2010.
2. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "A new bivariate MAP estimator for DT-CWT-based video denoising," in *Proceedings of 42nd IEEE International Symposium on Circuits and Systems*, Taipei, Taiwan, Republic of China, pp. 517-520, May 2009.
3. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "A new contrast-based fusion scheme for noisy images using wavelet transform," in *Proceedings of 1st International Symposium on Digital Life Technologies*, Tainan, Taiwan, Republic of China, pp. 108-111, May 2009.
4. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Improved image restoration using wavelet-based denoising and Fourier-based deconvolution," in *Proceedings of 51st IEEE International Mid-West Symposium on Circuits and Systems*, Knoxville, TN, USA, pp. 249-252, Aug. 2008.
5. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Statistical detector for wavelet-based image watermarking using modified GH PDF," in *Proceedings of 41st IEEE International Symposium on Circuits and Systems*, Seattle, WA, USA, pp. 712-715, May 2008.
6. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Locally adaptive wavelet-based image denoising using the Gram-Charlier prior function," in *Proceedings of 14th IEEE International Conference on Image Processing*, San Antonio, TX, USA, vol. 3, pp. 549-552, Sep. 2007.
7. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Bayesian wavelet-based despeckling of ultrasound medical images using the Gauss-Hermite expansion," in *Proceedings of 8th Joint Statistical Meetings*, Salt Lake City, UT, USA, pp. 1718-1725, Jul. 2007.
8. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Wavelet-based video denoising using Gauss-Hermite density function," in *Proceedings of 49th IEEE International Mid-West Symposium on Circuits and Systems*, San Juan, PR, USA, vol. 1, pp. 592-595, Aug. 2006.
9. **S. M. Mahbubur Rahman**, M. Omair Ahmad, and M. N. S. Swamy, "Wavelet-domain image denoising algorithm using series expansion of coefficient p.d.f. in terms of Hermite polynomials," in *Proceedings of 3rd International IEEE North-East Workshop on Circuits and Systems*, Quebec City, QC, Canada, pp. 271-275, Jun. 2005.
10. **S. M. Mahbubur Rahman** and Md. Kamrul Hasan, "Improved wavelet-based image denoising algorithm using iterative center weighted median filter," in *Proceedings of 3rd International Symposium on Communication System, Network and Digital Signal Processing*, Staffordshire, UK, pp. 304-307, Jul. 2002.

11. M. R. Huq, M. I. H. Bhuiyan, M. M. Rahman, **S. M. M. Rahman**, and M. K. Hasan, "An improved memoryless vector quantizer using LBG algorithm and neural networks for image compression," in *Proceedings of 3rd International Symposium on Communication System, Network and Digital Signal Processing*, Staffordshire, UK, pp. 264-267, Jul. 2002.

REFEREES

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[Capacity: Ph.D. thesis co-supervisor]
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