Arijit Bishnu

Curriculum Vitae

Academic Qualification

Ph.D. in Computer Science from the Indian Statistical Institute in 2003.
Title of the thesis: *Combinatorial Techniques for Digital Image Characterization and Retrieval: Algorithms, Architectures, and Applications*.
Advisor: Prof. Bhargab B. Bhattacharya

Master of Technology in Computer Science from Indian Statistical Institute, Kolkata, India in 1998.

Bachelor of Engineering in Electrical Engineering from Regional Engineering College (currently National Institute of Technology), Durgapur, India in 1995.

Work Experience

After Ph.D.

July, 2011 – present: Associate Professor
Indian Statistical Institute
Kolkata, India

May, 2008 – June, 2011: Assistant Professor
Indian Statistical Institute
Kolkata, India

June, 2005 – May, 2008: Assistant Professor
Computer Science and Engineering Department
Indian Institute of Technology
Kharagpur, India

September, 2003 – May, 2005: Associate
School of Information Science,
Japan Advanced Institute of Science and Technology, Japan

Before Ph.D.

September, 2001 – September, 2003: Research Engineer
Indian Statistical Institute
This was a temporary position funded by an external project of Intel Corp., USA.

July, 1999 – September, 2001: Research Programmer
Indian Statistical Institute
This was a temporary position funded by an external project of Intel Corp., USA.

September, 1998 – July, 1999: Computer Engineer (Category-A)
Indian Statistical Institute
This was a temporary position funded by an external project of Department of Electronics, Govt. of India.

Teaching and Research Activities

Full Semester Courses taught at Indian Statistical Institute from May, 2008 onwards in the M. Tech. (CS) course

- Discrete Mathematics (for three semesters)
- Advanced Algorithms for Graphs and Combinatorial Optimization Problems (taught half of the course for two semesters, full load for one semester)
- Computer Architecture (for one semester)
- Computational Complexity (for one semester)
- Topics in Algorithms and Complexity (for three semesters)
- Probability and Stochastic Processes (for one semester)
- Programming and Data Structures Laboratory (for three semesters)
- Computational Geometry (for one semester)
- Optimization Techniques (for one semester)

Full Semester Courses taught at Indian Institute of Technology, Kharagpur from June, 2005 to May, 2008

- Advanced Algorithms (for three semesters at M. Tech. level)
- Computational Geometry (for three semesters at M. Tech. level)
- Programming and Data Structures Laboratory (for four semesters at B. Tech. level)

Training Programmes and Lectures

- Delivered lectures on *Introduction to Computational Geometry* and *Introduction to Randomized Algorithms* in a series of *Research Promotion Workshops* on *Introduction to Graph and Geometric Algorithms* at NIT, Tiruchirapalli; Institute of Technology, BHU, Varanasi; NIT, Rourkela; Thapar University, Patiala; IIIT, Jabalpur; NIT, Warangal. This lecture series was funded by the National Board of Higher Mathematics.
- Delivered a lecture on the topic *Act locally, change globally: Shape transformations by local interchanges* at the *Silver Jubilee Workshop* on *Introduction to Geometric Algorithms* at the Department of Computer Science and Engineering, Indian Institute of Technology, Kharagpur.

Current Research Interests

- Algorithms with focus to Discrete and Computational Geometry
- Model centric computation
- Discrete Mathematics
- Combinatorial reconfiguration

Past Research Interests

- Geometric algorithms for Sensor Networks
- Digital Geometry
- VLSI implementations and combinatorial techniques for digital imaging applications

- Content based image retrieval
- Fingerprint Image analysis and matching

Research Guidance

Ph.D. Thesis Guidance: A Ph.D. student has been awarded his degree at Indian Institute of Technology, Kharagpur under joint supervision of myself and Prof. Arobinda Gupta of IIT, Kharagpur in April, 2012. The thesis topic is *Geometric Algorithms for Coverage in Wireless Sensor Networks*.

Master of Science (M.S.) Thesis Guidance: Guided an MS thesis titled "A Study on Some Measures of Coverage in Wireless Sensor Networks: Geometric Characterization and Algorithms" jointly with Professor Indranil Sengupta, IIT Kharagpur.

Master of Technology (M.Tech.) Thesis Guidance: Guided seven M. Tech. thesis at IIT, Kharagpur and three M. Tech. thesis at ISI, Kolkata.

Academic Activities

Academic Administration

- **Convener, M. Tech. (CS) course revision committee:** The role involved co-ordinating with other members of the committee and other faculty members in redesigning the two year M. Tech. (CS) curriculum and syllabus of the institute.
- **Convener, Placement committee:** The role involved liaising with companies and arranging for campus placements of all postgraduate students of the institute who passed out in 2011.
- **Member, B. Stat. and M. Stat. course revision committee:** The role involves working with other members of the committee and other faculty members in redesigning the three year B. Stat. and two year M. Stat. curriculum and syllabus of the institute.
- **Admission committee:** Served admission committees for the M. Tech. (CS) admission for the years 2009, 2010 and 2015; B. Stat. admission for the year 2011 and 2013; and the JRF (CS) committee for 2014.
- **Academic Council:** Served the Academic Council of the institute for the period 2010-2012 as a nominated member.
- **Conference organization:** Took leading roles in organizing the following conferences at Indian Statistical Institute – ISAAC 2006, FSTTCS 2006, WALCOM 2009, IWCIA 2015.

Professional Work

- **Conferences:** Served Program Committees of WALCOM 2009 and WALCOM 2012.
- **Journal Review:** Reviewed papers for the journals – Theoretical Computer Science, Information Processing Letters, Computational Geometry: Theory and Applications, LNCS Transactions on Computational Science, IEEE Transactions on VLSI, IEEE Transactions on Image Processing.

Full List of Publications

Book Chapter

(B1) A. Bishnu, P. Bhowmick, J. Dey, B. B. Bhattacharya, M. Kundu, C. A. Murthy, and T. Acharya, "Hardware Architecture for Ridge Extraction in Fingerprints", *Advances in Intelligent Information Processing: Tools and Applications*, ISI Platinum Jubilee Series, Statistical Science and Interdisciplinary Research – vol. 2, pp. 213–241, World Scientific, 2008.

Journal

(J1) D. Dash, A. Gupta, A. Bishnu, S. C. Nandy, "Line coverage measures in wireless sensor networks", *Journal on Parallel Distributed Computing (JPDC)*, Elsevier, vol. 74, no. 7, pp. 2596–2614, 2014.

(J2) A. Khan, S. P. Pal, M. Aanjaneya, A. Bishnu, S. C. Nandy, "Diffuse reflection diameter and radius for convex-quadrilateralizable polygons", *Discrete Applied Mathematics*, Elsevier, vol. 161, no. 10-11, pp. 1496–1505, 2013.

(J3) D. Dash, A. Bishnu, A. Gupta, S. C. Nandy, "Approximation algorithms for deployment of sensors for line segment coverage in wireless sensor networks", *Wireless Networks*, Springer, vol. 19, no. 5, pp. 857–870, 2013.

(J4) D. Mondal, A. Kumar, A. Bishnu, K. Mukhopadhyaya, and S. C. Nandy, "Measuring the quality of surveillance in a wireless sensor network", *International Journal of Foundations of Computer Science*, World Scientific, vol. 22, no. 4, pp. 983–998, 2011.

(J5) D. Dash, A. Gupta, and A. Bishnu, "Dynamic maintenance of support coverage in sensor networks", *Parallel Processing Letters*, World Scientific, vol. 20, no. 2, pp. 155–172, June 2010.

(J6) A. Komuravelli, A. Sinha and A. Bishnu, "Connectivity preserving transformations for higher dimensional binary images", *Discrete Applied Mathematics*, (Special issue for 12th International Workshop on Combinatorial Image Analysis), Elsevier, vol. 157, no. 16, pp. 3372–3385, 2009.

(J7) P. Banerjee, S. Sur-Kolay, A. Bishnu, S. Das, S. C. Nandy and S. Bhattacharjee, "FPGA placement using space filling curves: theory meets practice", *ACM Transactions on Embedded Computing Systems*, (Special Issue on Configuring Algorithms, Processes and Architecture), vol. 9, no. 2, article 12, 2009.

(J8) P. Banerjee, S. Sur-Kolay, and A. Bishnu, "Fast unified floorplan topology generation and sizing on heterogeneous FPGAs", *IEEE Transactions on Computer-Aided Design*, vol. 28, no. 5, pp. 651–661, 2009.

(J9) X. F. Liang, A. Bishnu, and T. Asano, "A robust fingerprint indexing scheme using minutia neighborhood structure and low-order Delaunay triangles", *IEEE Transactions on Information Forensics and Security*, vol. 2, no. 4, pp. 721–733, 2007.

(J10) X. F. Liang, A. Bishnu, and T. Asano, "A combinatorial approach to fingerprint binarization and minutiae extraction using Euclidean distance transform", *International Journal on Pattern Recognition and Artificial Intelligence*, World Scientific, vol. 27, no. 7, pp. 1141–1158, 2007.

(J11) A. Bishnu, and B. B. Bhattacharya, "Stacked Euler vector (SERVE): A gray-tone image feature based on bit-plane augmentation", *IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)*, vol. 29, no. 2, pp. 350–355, 2007.

(J12) S. Dey, B. B. Bhattacharya, M. K. Kundu, A. Bishnu, and T. Acharya, "A co-processor for computing the Euler number of a binary image using divide-and-conquer strategy", *Fundamenta Informaticae*, vol. 76, no. 1-2, pp. 75–89, 2007.

(J13) A. Bishnu, S. Das, S. C. Nandy and B. B. Bhattacharya, "Simple algorithms for partial point set pattern matching under rigid motion", *Pattern Recognition*, Elsevier, vol. 39, no. 9, pp. 1662–1671, 2006.

(J14) A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "A pipeline architecture for computing Euler number of a binary image", *Journal of Systems Architecture*, Elsevier, vol. 51, pp. 470–487, 2005.

(J15) A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Euler vector for search and retrieval of gray-tone images", *IEEE Transactions on Systems, Man, and Cybernetics*, Part B, vol. 35, pp. 801–812, 2005.

(J16) P. Bhowmick, A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Determination of minutiae scores for fingerprint image applications", *International Journal of Image and Graphics*, World Scientific, vol. 5, no. 3, pp. 537–571, July 2005.

Refereed Conference Proceedings

(C1) A. Bishnu, A. Chakrabarti, S. C. Nandy, S. Sen, "On Density, Threshold and Emptiness Queries for Intervals in the Streaming Model", *in Proc.* 35^{th} *Annual Conference on Foundation of Software Technology and Theoretical Computer Science (FSTTCS 2015)*, LIPICS 45, pp. 336–349, Bangalore, India, 2015.

(C2) A. Bishnu, S. Desai, A. Ghosh, M. Goswami, S. Paul, "Uniformity of Point Samples in Metric Spaces Using Gap Ratio", *in Proc.* 12^{th} *Annual Conference on Theory and Applications of Models of Computation (TAMC 2015)*, LNCS vol. 9076, Springer, pp. 347–358, Singapore, 2015.

(C3) D. Dash, A. Bishnu, A. Gupta and S. C. Nandy, "Approximation Algorithms for Deployment of Sensors for Line Segment Coverage in Wireless Sensor Networks", *in Proc.* 4^{th} *International Conference on Communication Systems and Networking (COMSNETS)*, IEEE CS Press, Bangalore, India, 2012.

(C4) D. Dash, A. Bishnu, A. Gupta and S. C. Nandy, "Finding the Quality of Line Coverage of a Sensor Network", *in Proc.* 13^{th} *International Conference on Distributed Computing and Networking (ICDCN)*, LNCS vol. 7129, Springer, pp. 214–217, Hong Kong, China, 2012.

(C5) S. Sadhu, A. Bishnu, S. C. Nandy and P. P. Goswami, "Cluster connecting problem inside a polygon", *in Proc.* 22^{nd} *Canadian Conference on Computational Geometry (CCCG)*, pp. 265–268, Manitoba, Canada, 2010.

(C6) B. K. Bhattacharya, A. Bishnu, O. Cheong, S. Das, A. Karmakar and J. Snoeyink, "Computation of Non-dominated Points Using Compact Voronoi Diagrams", *in Proc. Workshop on Algorithms and Computation (WALCOM)*, LNCS vol. 5942, Springer, pp. 102–112, Dhaka, Bangladesh, 2010.

(C7) A. Bishnu, S. Das, S. C. Nandy and B. B. Bhattacharya, "A Simple Algorithm for Approximate Partial Point Set Pattern Matching under Rigid Motion", *in Proc. Workshop on Algorithms and Computation (WALCOM)*, LNCS vol. 5942, Springer, pp. 102–112, Dhaka, Bangladesh, 2010.

(C8) A. Ghosh, R. Shah, A. Bishnu and B. B. Bhattacharya, "Algorithms for Biological Cell Sorting with a Lab-on-a-chip", *in Proc. World Congress on Nature and Biologically Inspired Computing, (NaBIC 2009)*, pp. 104–109, Coimbatore, India, 2009.

(C9) A. Komuravelli, A. Sinha, and A. Bishnu, "Connectivity Preserving Voxel Transformation", *in Proc.* 12^{th} *International Workshop on Combinatorial Image Analysis (IWCIA)*, LNCS vol. 4958, Springer, pp. 1–12, Buffalo, New York, USA, 2008.

(C10) B. Prasad, A. Bishnu, and T. Asano, "Linear Boundary and Corner Detection using Limited Number of Sensor Rows", *in Proc.* 12^{th} *International Workshop on Combinatorial Image Analysis (IWCIA)*, LNCS vol. 4958, Springer, pp. 250–261, Buffalo, New York, USA.

(C11) A. Duttagupta, A. Bishnu, and I. Sengupta, "Maximal Breach in Wireless Sensor Networks: Geomteric Characterization and Algorithms", *in Proc.* 3^{rd} *International Workshop on Algorithmic Aspects of Wireless Sensor Networks (ALGOSENSORS)*, LNCS vol. 4837, Springer, pp. 126–137, Wroclaw, Poland, 2007.

(C12) P. Banerjee, S. Sur-Kolay, and A. Bishnu, "Floorplanning in Modern FPGAs", *in Proc.* 20^{th} *International Conference on VLSI Design*, IEEE CS Press, pp. 893–898, Bangalore, India, 2007.

(C13) A. Duttagupta, A. Bishnu, and I. Sengupta, "Optimisation Problems Based on the Maximal Breach Path Measure for Wireless Sensor Network Coverage", *in Proc.* 3^{rd} *International Conference on Distributed Computing and Internet Technology*, LNCS vol. 4317, Springer, pp. 27–40, Bhubaneshwar, India, 2006.

(C14) X. F. Liang, T. Asano, and A. Bishnu, "Distorted Fingerprint Indexing Using Delaunay Triangle and Minutiae Detail", *in Proc.* 3^{rd} *International Symposium on Voronoi Diagrams in Science and Engineering (ISVD 2006)*, IEEE CS Press, pp. 217–223, Banff, Alberta, Canada, July, 2006.

(C15) P. K. Bhunre, C. A. Murthy, A. Bishnu, B. B. Bhattacharya, and M. K. Kundu, "A hybrid data and space partitioning technique for similarity queries on bounded clusters", *in Proc. Pattern Recognition and Machine Intelligence*, LNCS vol. 3776, Springer, Berlin, pp. 544–550, Kolkata, India, 2005.

(C16) X. F. Liang, A. Bishnu, and T. Asano, "A near-linear time algorithm for binarization of fingerprint images using distance transforms", *in Proc. 10th Intl. Workshop on Combinatorial Image Analysis, IWCIA 2004*, LNCS vol. 3322, Springer, pp.197–208, Auckland, New Zealand, 2004.

(C17) A. Bishnu, S. Das, S. C. Nandy, and B. B. Bhattacharya, "An Improved Algorithm for Point Set Pattern Matching under Rigid Motion", *in the* 5^{th} *Conf. on Algorithms and Complexity (CIAC), 2003*, LNCS vol. 2653, Springer, pp. 36–45, Rome, Italy, 2003.

(C18) A. Bishnu, P. Bhowmick, J. Dey, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Combinatorial Classification of Pixels for Ridge Extraction in a Gray-scale Fingerprint Image", *in Proc. Third Indian Conf. on Computer Vision, Graphics and Image Processing (ICVGIP), Allied Publishers Pvt. Ltd.*, pp. 451–456, Ahmedabad, India, 2002.

(C19) P. Bhowmick, A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Determination of Minutiae Scores for Fingerprint Image Applications", *in Proc. Third Indian Conf. on Computer Vision, Graphics and Image Processing (ICVGIP), Allied Publishers Pvt. Ltd.*, pp. 463–468, Ahmedabad, India, 2002.

(C20) A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Euler Vector: A Combinatorial Signature for Gray-Tone Images", *in Proc.* 3^{rd} *Intl. Conf. on Information Technology: Coding and Computing (ITCC), IEEE CS Press*, pp. 121–126, Las Vegas, April 2002.

(C21) A. Bishnu, P. K. Bhunre, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "Content-Based Image Retrieval: Related Issues Using Euler Vector", *Accepted for publication in Intl. Conf. on Image Processing (ICIP), IEEE CS Press*, 2002.

(C22) A. Bishnu, B. B. Bhattacharya, M. K. Kundu, C. A. Murthy, and T. Acharya, "On-Chip Computation of Euler Number of a Binary Image for Efficient Database Search", *in Proc. Intl. Conf. on Image Processing (ICIP), IEEE CS Press*, vol. III, pp. 310–313, Greece, 2001.

(C23) A. Bishnu, and B. B. Chaudhuri, "Segmentation of Bangla Hand-written text into characters by recursive contour following", *in Proc. Intl. Conf. on Document Analysis and Recognition (ICDAR)*, Bangalore, India, September, 1999.

Patents Granted

(P1) T. Acharya, B. B. Bhattacharya, A. Biswas, P. Bhowmick, A. Bishnu, S. Das, M. K. Kundu, C. A. Murthy and S. C. Nandy, "Fingerprint Minutiae Matching using Scoring Techniques", United States Patent 7,359,532, April 15, 2008.

(P2) T. Acharya, B. B. Bhattacharya, P. Bhowmick, A. Bishnu, J. Dey, M. K. Kundu, and C. A. Murthy, "Method and Apparatus for Providing a Binary Fingerprint Image", United States Patent 7,136,515, November 14, 2006.

(P3) T. Acharya, B. B. Bhattacharya, P. Bhowmick, A. Bishnu, J. Dey, M. K. Kundu, and C. A. Murthy, "Architecture for Processing Fingerprint Images ", United States Patent 7,133,575, November 7, 2006.

(P4) T. Acharya, B. B. Bhattacharya, A. Bishnu, M. K. Kundu, and C. A. Murthy, “Computing the Euler Number of a Binary Image”, United States Patent 7,027,649, April 11, 2006.

(P5) T. Acharya, B. B. Bhattacharya, P. Bhowmick, A. Bishnu, J. Dey, M. K. Kundu and C. A. Murthy, “Architecture for Processing Fingerprint Images”, United States Patent 6,795,592, September 21, 2004.

(P6) T. Acharya, B. B. Bhattacharya, A. Bishnu, M. K. Kundu and C. A. Murthy, “Image Retrieval Using Distance Measure”, United States Patent 6,681,060, January 20, 2004.

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