Venu Govindaraju
Vice President for Research and Economic Development
SUNY Distinguished Professor of Computer Science & Engineering
University at Buffalo, State University of New York (SUNY)
http://www.buffalo.edu/research

Education

PhD	University at Buffalo, State University of New York *Major*: Computer Science (Artificial Intelligence)	1992
MS	University at Buffalo, State University of New York *Major*: Computer Science	1988
BTech	Indian Institute of Technology (IIT) *Major*: Computer Science and Engineering	1986

Key Positions

University at Buffalo, SUNY

Vice President, Research and Economic Development (VPR)	**9/14 - current**
SUNY Distinguished Professor	11/10 - current
Furnas Chair Professor, School of Engineering and Applied Sciences	6/14 – 8/15
Director, Computational Data Science and Engineering (CDSE)	7/13 – 8/15
UB Distinguished Professor	9/08 – 11/10
Director, UB Strategic Strength in Information Technology	1/07 – 8/15
Director, Center for Unified Biometrics and Sensors (CUBS)	1/04 - current
Professor, Department of Computer Science & Engineering	8/02 - current
Associate Professor, Department of Computer Science & Engineering (tenure)	8/00 – 7/02
Research Scientist, Center for Document Analysis and Recognition (CEDAR)	6/92 – 12/03

Professional Summary

Venu Govindaraju, Vice President for Research and Economic Development and SUNY Distinguished Professor of Computer Science and Engineering at the State University of New York (SUNY) at Buffalo, is a recognized authority in the field of Pattern Recognition and Artificial Intelligence. He has received peer honors such as the IAPR/ICDAR Outstanding Achievements (2015), Distinguished Alumnus Award from IIT Kharagpur (2014), the IEEE Technical Achievement Award (2010), and the MIT Global Indus Technovator Award (2004). He is a Fellow of major professional societies such as AAAS, ACM, IAPR, IEEE, and the SPIE. Govindaraju is also a member of the National Academy of Inventors (2015).

Govindaraju is credited with major conceptual and practical advances in Artificial Intelligence. He is a recipient of six best paper awards, and has co-authored six books and over 440 refereed publications. He has served on the editorial boards of several premier journals including the most prestigious IEEE Transactions on Pattern Analysis and Machine Intelligence and has been the Editor-in-Chief of IEEE Biometrics Compendium. Recently he also served as the President of the IEEE Biometrics Council.

Govindaraju has mentored 44 doctoral students as their major advisor and was recently awarded the University at Buffalo's "Excellence in Graduate Student Mentoring Award" (2017). He has been a principal investigator on continuous sponsored funding of nearly $70M over his career. He has given over 100 invited talks, including several keynotes at prestigious venues and think tanks around the world. He was an invited speaker at the Science and Tchnology Committee of the National Academy of Sciences.

I. KEY ADMINISTRATIVE ACCOMPLISHMENTS

I. Education

- Supported an undergraduate "**research abroad"** summer program that features a personalized matching process between students and research mentors, visits to the host country's iconic academic and cultural institutions; students are involved in experiential learning events
- Supported campus-based program designed to introduce **entrepreneurship** as a viable career path to students via the Blackstone Launchpad initiative
- Initiated a "**students recruit students**" program that allows for undergraduate students to be recruited and mentored solely by graduate students and postdocs to break the false barrier of intimidation and shyness; promotes easy exposure to research on campus and getting questions answered without hesitation
- Initiated a "**shadow alumni**" program in partnership with career services that pairs undergraduate students with alumni for students to gain experiential learning in industry; opens avenues for networking and internship and future job prospects
- Oversight of **interdisciplinary programs**: i) Revamping existing bioinformatics undergraduate major (joint between biological sciences and computer science departments); ii) launching of a PhD program in Computational Data Science piggybacking on partner MS departments; iii) development of new graduate certificates in genomic literacy, advanced manufacturing, robotics

II. Research

- UB exceeded $400M in annual research expenditures on the NSF Higher Education Research and Development (HERD) Survey; achieved more than **20% rise in sponsored research** in 5 years
- UB awarded **large competitive research centers** with multi-year funding:
    - NSF Science and Technology Center on Biology with X-Ray Free Electron Lasers- $25M (2013 – 2018); $23M (2018 - 23)
    - New Drug Discovery Center to convert the institutions' scientific breakthroughs into viable pharmaceuticals for commercialization - $35.4M (2018 -)
    - NYSTAR CAT matching funds to support industry R&D at the intersection of big data and health sciences - $10M (2017 - 26)
    - NY State Innovation Hub for technology commercialization and incubation space - $32M
    - NIH Clinical and Translational Science Award- $15M (2015-19); $23M (2019 – 23)
- **Accreditations** (2018): AAHRPP (Association for the Accreditation of Human Research Protection Program); AAALAC (Association for Assessment and Accreditation of Laboratory Animal Care)
- Established a $3M fund to support the "**Buffalo Blue Sky**" program that offers just-in-time seed funding for investigator-led, multidisciplinary research to solve large and complex problems
- Established over a dozen **new research centers** to support star researchers and faculty clusters; launched the Buffalo AI Institute with initial focus on medicine, health, and autonomous vehicles
- Leadership on $10M University investment in the **Communities of Excellence** to develop interdisciplinary teams of collaborating faculty, students and practitioners in diverse fields of advanced manufacturing, global health equities, and precision medicine using research, education and engagement activities to create integrated solutions

- Oversight of the **RENEW institute** ($20M investment) established to address societal challenges in renewable energy, environment, and water; build on existing strengths as well as hire to fill gaps to enhance UB capacity to conduct research and education in this area

III. Economic Development

- Created UB **SWIFT program** to reduce transaction and negotiations time with industry by empowering both parties to set licensing terms at the project planning stage
- Created incentive plan to stimulate **industry engagement**; underline research relevance, generate student internships opportunities; quadrupled SBIR/STTR projects; 4 of the companies licensed UB technology
- Connected dozens of **incubator companies** with UB talent via internships, competitions, consulting opportunities, speaking engagements, and enhanced career fair opportunities; new wave of startups (over 60) co-located on university campus and incubators
- Enabled partner companies to create over **1,500 jobs** in western NY over four years

IV. Recruiting

- Identified departments and areas that match the university's strategic vision of growth and sustainability to make **high profile hires** under the SUNY Empire Innovation Program
- Advocated (successfully) to the provost to consider engagement and commercialization activities in **faculty promotion dossiers** at par with scholarship
- Appointed three Associate Vice Presidents for Research and several (executive) directors
- Chaired search committee to hire over 25 **interdisciplinary faculty** members across decanal units as the director of centrally funded initiatives for building strategic strengths on campus
- Oversight of recruiting a dozen interdisciplinary faculty members under the RENEW initiative
- Established best practices guidelines to ensure **diversity and inclusion** in the recruiting process by persistent messaging, vigilant monitoring, and ensuring diversity in hiring pools

V. Administration

- Chaired **university-wide task force** on Safeguarding University and Faculty Assets and Interests
- Created a Faculty Research Hub for **one-stop faculty support** for pre- and post-award management, financial reporting grant writing, and technology transfer
- **Redefined the roles of staff** to make the units (reporting to VPRED) more efficient, fiscally self-sufficient, and to stay current with the needs of faculty and students and opportunities and challenges presented by the ever-changing research landscape
  - Reorganized Tech Transfer, Sponsored Programs and Services (staff reorganized: 70)
  - Reorganized Research Institute on Addictions to integrate new curricula and clinical services with the research program (staff reorganized: 60)
- Adopted the "**Shared Governance**" model in the Vice President for Research Office
  - Annual retreat camps held with participation from all the center directors and unit heads to allow free exchange of ideas and transparency on all initiatives
  - Quarterly meetings held with all the associate deans for research of the decanal units (12) to vet new policies, respond to faculty needs, and keep the channel of communications with the academic mission of the university open and effective

II. Awards & Honors

- ***Fellow of the AP Academy of Sciences*** (2016).
- *Excellence in Graduate Student Mentoring Award*, University at Buffalo, SUNY (2016).
- ***Fellow of National Academy of Inventors*** (2015).
- *IAPR /ICDAR Outstanding Achievements Award* (2015), "For pioneering contributions to pattern recognition and its application to the fields of handwriting recognition, multilingual document analysis, and biometrics; and for the development of real-time engineered systems".
- *Distinguished Alumnus Award* (2014), Indian Institute Technology Kharagpur, India.
- ***Fellow of SPIE –*** Society for Optics and Photonics (2013), "For contributions to Biometrics".
- ***Fellow of AAAS*** – American Association for the Advancement of Science (2010), "For outstanding contributions in biometrics and document retrieval".
- *IEEE Technical Achievement Award* (2010), "For pioneering contributions to handwriting systems" for sustained achievement over last 10-15 years.
- *UB Visionary Innovator* (2009, 2008, 2004).
- ***Fellow of ACM*** – Association of Computing Machinery, (2009), "For contributions to handwritten document image analysis, recognition, and retrieval".
- *SUNY Chancellor's Award* (2007), "In recognition of outstanding scholarship and creative productivity and significant contribution to institutional quality".
- ***Fellow of IEEE*** - Institute of Electrical and Electronics Engineers, (2006), "For contributions to handwriting recognition".
- ***Fellow of IAPR*** – International Association of Pattern Recognition, (2004), "For contributions to advances in handwriting recognition".
- *MIT Global Indus Technovator Award* (2004), "For pioneering endeavors at the frontiers of technological innovation", MIT Indian Business Club, Cambridge, MA.
- *Business First 40 Under 40 Honoree (2002*).
- *SUNY Research Foundation Scholarship Award* (2002).
- ***Fellow of IETE*** – *Institution of Electronics and Telecommunication Engineers* (2002).
- *IAPR/ ICDAR Outstanding Young Investigator Award* (2001), "For visibly demonstrating the utility of pattern recognition algorithms and for outstanding scientific productivity".

III. CURRICULUM VITAE

A. Publications

❖ Best Paper Awards (7)

1. ICDAR Best Student Paper Award, (Fei Xu) Sydney, Australia, 2019
2. CBDAR Best Paper Award, Sydney, Australia, 2019
3. Data for Development Challenge, National Statistics Prize (Neeti Pokhriyal), Boston, 2015
4. ICFHR, ITESOFT Best Paper Award, Kolkata, India, 2010
5. ICPR, IBM Best Student Paper Award, (X. Peng), Istanbul, Turkey, 2010
6. ICDAR Best Paper Award, Barcelona, 2009
7. ICDAR 1st Place in Line segmentation competition, Barcelona, 2009

❖ Books (6)

1. Handbook of Statistics Vol 35: Cognitive Computing: Theory and Applications, V. V. Raghavan, V. Gudivada, V. Govindaraju, and C. R. Rao (eds.), Elsevier 2017 (in print).
2. Handbook of Statistics Vol 33: Big Data, V. Govindaraju, V. V. Raghavan, and C. R. Rao (eds.), Elsevier 2016.
3. Handbook of Statistics Vol 31: Machine Learning Theory and Applications, C. R. Rao & V. Govindaraju (eds.), Elsevier 2013.
4. Multibiometrics for Human Identification. B. Bhanu & V. Govindaraju (eds.), Cambridge University Press 2011.
5. Indic OCR- Document Recognition & Retrieval. V. Govindaraju & S. Setlur (eds.), Springer 2009.
6. Biometrics: Sensors, Systems, and Algorithms. N. Ratha & V. Govindaraju (eds.), Springer 2007.

❖ Journal Papers (82)

1. D. Mohan, N. Sankaran, N. Lakshminarayana, S. Setlur, and V. Govindaraju, “Domain adaptive representation learning for facial action unit recognition”, *Journal of Pattern Recognition*.
2. R. Radhakrishnan, S. Setlur, N. Sankaran, and V. Govindaraju, “An adaptive framework for metadata analysis in documents”, Special Issue on Deep Learning, International Journal of Document Analysis and Recognition (in review).
3. A. Shivram, B. Zhu, M. Nakagawa, and V. Govindaraju, “Unconstrained online handwriting recognition using conditional random fields: A multi-expert design”, Journal of Pattern Recognition (in review).
4. R. Pandey, Y. Zhou, and V. Govindaraju, “Transactions on pattern analysis and machine intelligence”, Special Issue on Learning with Shared Information for Computer Vision and Multimedia Analysis (in review).
5. Y. Zhou, D. Arpit, I. Nwogu and V. Govindaraju, “Is joint training better for deep auto- encoders?”, Neural Networks, 2015 (in review).
6. D. Arpit, Y. Zhou, H. Ngo and V. Govindaraju, “Why regularized auto-encoders learn sparse representations?”, Journal of Machine Learning Research (in review).
7. N. Narayanan, S. Setlur, and V. Govindaraju, “CAN: Composite Appearance Network and a Novel Evaluation Metric for Person Tracking”, IEEE Transactions on Biometrics, Behavioral and Identity Science (in review).

2019

8. N. Narayan, N. Sankaran, S. Setlur, V. Govindaraju, "Learning Deep Features for Online Person Tracking Using Non-overlapping Cameras: A survey, *Image Vision and Computing*, pp. 222-235, 2019.
9. Y. Zhen, V. Govndaraju, Q. Zheng, and Y. Wang, "Trusted Computing Editorial", IEEE Access Special Section, 2019.
10. B. Urala Kota, K. Davila, A. Stone, S. Setlur, V. Govindaraju, "Generalized Framework for Summarization of Fixed-Camera Lecture Videos by Detecting and Binarizing Handwritten Content", IJDAR-ICDAR Special Issue 2019.

2018

11. C. Liu, G. Fink, V. Govindaraju, and L. Jin, "Special Issue on Deep Learning for Document Analysis and Recognition", *International Journal for Document Analysis and Recognition.*

2017

12. N. Pokhriyal, K. Tayal, I. Nwogu and V. Govindaraju, "Cognitive-biometric recognition from language usage: A feasibility study", *Transactions on Information Forensics and Security,* Vol. 12, No. 1, 2017.
13. Gaurav Kumar, Venu Govindaraju, "Bayesian background models for keyword spotting in handwritten documents", *Pattern Recognition* 64: 84-91, 2017.

2014

14. S. Wshah, G. Kumar, and V. Govindaraju, "Statistical script independent word spotting in offline handwritten documents", *Journal of Pattern Recognition*, Vol. 47, No. 3, pp. 1039-1050, 2014.
15. V. Menon, B. Jayaraman, and V. Govindaraju, "Probabilistic spatio-temporal retrieval in smart spaces" *Special issue of Journal of Ambient Intelligence and Humanized Computing*, Vol. 5, No. 3, pp. 383-392, 2014.

2013

16. X. Peng, S. Setlur, V. Govindaraju and R. Sitaram, "Handwritten text separation from annotated machine printed documents using Markov random fields", *International Journal on Document Analysis and Recognition,* Vol. 16*,* No. 1, pp. 1-16 , 2013.
17. U. Porwal, and V. Govindaraju, "Semi supervised framework for writer identification using structural learning", *IET Biometrics*, Vol. 2, No. 4, pp. 208-215, 2013.
18. M. Malgireddy, I. Nwogu, and V. Govindaraju, "Language motivated approach to action recognition", *Journal of Machine Learning Research*, Vol. 14, No. 1, pp. 2189-2212, 2013.
19. A. Shivram, C. Ramaiah, and V. Govindaraju, "A hierarchical Bayesian approach to online writer identification", *IET Biometrics, Special Issue on Handwriting Recognition*, Vol. 2, No. 4, pp. 191-198, 2013.
20. Y. Zhou, I. Inwogu, and V. Govindaraju, "Labeling Spain with Stanford", *IEEE Transactions on Image Processing*, Vol. 22, No. 12, pp. 5362-5371, 2013.
21. V. Menon, B. Jayaraman, and V. Govindaraju, "Enhancing biometric recognition with spatio-temporal reasoning in smart environments", *Journal of Personal and Ubiquitous Computing, Springer*, Vol. 17, No. 5, pp. 987-998, 2013.

2012

22. X. Peng, S. Setlur, V. Govindaraju, and R. Sitaram, "Using a boosted tree-classifier for text segmentation in hand-annotated documents", *Pattern Recognition Letters, Special Issue of Award Winning Papers,* Vol. 33, No. 7, pp. 943-950, 2012.

2011

23. V. Menon, B. Jayaraman, and V. Govindaraju, "The 3 R's of cyber-physical spaces", *IEEE Computer*, Vol. 44, No. 9, pp. 73-79, 2011.
24. V. Menon, B. Jayaraman and V. Govindaraju, "Spatio-temporal querying in smart spaces", *Procedia Computer Science*, Elsevier Press, Vol. 10, pp. 366-373, 2011.
25. H. Cao, A. Bhardwaj, and V. Govindaraju, "Unconstrained handwritten document retrieval", *International Journal for Document Analysis and Recognition*, *Special Issue on Noisy Text Analytics, Springer*, Vol. 14, No. 2, pp. 145-157, 2011.

2010

26. P. Mansukhani, S. Tulyakov, and V. Govindaraju, "A framework for efficient fingerprint identification using a minutiae tree", *IEEE Systems Journal- Special Issue on Biometrics*, Vol. 4, No. 2, pp. 126-137, 2010.
27. V. Menon, B. Jayaraman, and V. Govindaraju, "Multimodal identification and tracking in smart environments", *Special Issue on Multimodal Systems, Services and Interfaces for Ubiquitous Computing in the Journal of Personal and Ubiquitous Computing*, Springer, Vol. 14, No. 8, pp. 685-694, 2010.
28. R. Chandrasekhar, J. C. Miecznikowski, D. P. Gaile, V. Govindaraju, F. V. Bright, and K. F. Sellers, "Xerogel package", *Chemometrics and Intelligent Laboratory Systems*, Elsevier Press, Vol. 96, No. 1, pp. 70-74, 2010.
29. A. Rusu, A. Thomas, and V. Govindaraju, "Generation and use of handwritten CAPTCHAs", *International Journal of Document Analysis and Recognition*, Springer, Vol. 13, No. 1, pp. 49-64, 2010.
30. S. Tulyakov, C. Wu, and V. Govindaraju, "On the difference between optimal combination functions for verification and identification systems", *International Journal Pattern Recognition and Artificial Intelligence*, Vol. 24, No. 2, pp. 173-191, 2010.

2009

31. F. Farooq, A. Bharadwaj, and V. Govindaraju, "Using topic models for OCR correction", *International Journal of Document Analysis and Recognition*, Springer, Vol. 12, No. 3, pp. 153- 164, 2009.
32. A. Thomas, A. Rusu, and V. Govindaraju, "Synthetic handwritten CAPTCHAs", *The Journal of Pattern Recognition*, *Special Issue on Handwriting Recognition*, Elsevier Press, Vol. 42, No. 12, pp. 3365-3373, 2009.
33. F. Farooq, D. Jose, and V. Govindaraju, "Phrase based direct model for improving handwriting recognition accuracies", *The Journal of Pattern Recognition*, *Special Issue on Handwriting Recognition*, Elsevier Press, Vol. 42, No. 12, pp. 3271-3277, 2009.
34. H. Cao, A. Bharadwaj, and V. Govindaraju, "A probabilistic method for keyword retrieval in handwritten document images", *The Journal of Pattern Recognition*, *Special Issue on Handwriting Recognition*, Elsevier Press, Vol. 42, No. 12, pp. 3374-3382, 2009.
35. S. Kompalli, S. Setlur, and V. Govindaraju, "Devanagari OCR using a recognition driven segmentation framework and stochastic language models", *International Journal on Document Analysis and Recognition*, Springer, Vol. 12, No. 2, pp. 123-138, 2009.
29. R. N. Rodrigues, L. L. Ling, and V. Govindaraju, "Robustness of multimodal biometric fusion methods against spoof attacks", *Journal of Visual Languages and Computing, Special Issue on Advances in Multimodal Biometric Systems*, Elsevier Press, Vol. 20, No. 3, pp. 169-179, 2009.
30. R. Milewski, A. Bharadwaj, and V. Govindaraju, "Automatic recognition of handwritten medical forms for search engines", *International Journal of Document Analysis and Recognition*, Springer,

Vol. 11, No. 4, pp. 203-218, 2009.

31. H. Cao and V. Govindaraju, "Preprocessing of low quality handwritten carbon forms using Markov Random Fields", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 31, No. 7, pp. 1184-1194, 2009.
32. R. V. Yampolskiy and V. Govindaraju, "Strategy-based behavioural biometrics: A novel approach to automated identification", *International Journal of Computer Applications in Technology, Special Issue on: Automated Identification Technology,* Vol. 35, No. 1, pp. 29-41,2009.

2008

33. S. Tulyakov and V. Govindaraju, "Use of identification trial statistics for the combination of biometric matchers", *IEEE Transactions on Information Forensics and Security,* IEEE Signal Processing Society Press, Vol. 3, No. 4, pp. 719-733, 2008.
34. R. Milewski and V. Govindaraju, "Binarization and cleanup of handwritten text from carbon copy medical form images", *The Journal of Pattern Recognition*, Elsevier Publishers, Vol. 41, No. 4, pp. 1308-1315, 2008.
35. R. V. Yampolskiy and V. Govindaraju, "Behavioural biometrics: A survey and classification", *International Journal of Biometrics*, Inderscience Publishers, Vol. 1, No. 1, pp. 81-113, 2008.

2007

36. S. Tulyakov, F. Farooq, P. Mansukhani, and V. Govindaraju, "Symmetric hash functions for secure fingerprint biometric systems", *Pattern Recognition Letters*, Elsevier Publishers, Vol. 28, No. 16, pp. 2427-2436, 2007.
37. R. V. Yampolskiy and V. Govindaraju, "Embedded noninteractive continuous bot detection", *ACM Computers in Entertainment (CIE)*, Vol. 5, No. 4, 2007.
38. S. Chikkerur, A. Cartwright, and V. Govindaraju, "Fingerprint image enhancement using STFT analysis", *The Journal of Pattern Recognition*, Elsevier Publishers, Vol. 40, No. 1, pp. 198-211, 2007.
39. R. N. Rodrigues, L. L. Ling, and V. Govindaraju, "Robustness of multimodal biometric fusion methods against spoof attacks", *Journal of Visual Languages and Computing. Special* Issue *on Advances in Multimodal Biometric Systems*, Elsevier Press, Vol. 20, No. 3, pp. 169-179, 2009.
40. R. Milewski, A. Bharadwaj, and V. Govindaraju, "Automatic recognition of handwritten medical forms for search engines", *International Journal of Document Analysis and Recognition*, Springer, Vol. 11, No. 4, pp. 203-218, 2009
41. R. V. Yampolskiy and V. Govindaraju, "Computer security: A survey of methods and systems", *Journal of Computer Science*, Vol. 3, No. 7, pp. 478-486, 2007.
42. R. V. Yampolskiy and V. Govindaraju, "Direct and indirect human computer interaction based biometrics", *Journal of Computers*, Vol. 2, No. 10, pp. 76-88, 2007.
43. K. Bowyer, V. Govindaraju, and N. Ratha, "Guest editorial: Introduction to the special issue on recent advances in biometric systems", *IEEE Transactions on Systems, Man, and Cybernetics – Part B*, Vol. 37, No. 5, pp. 1091-1093, 2007.

2006

44. Z. Shi and V. Govindaraju, "A chaincode based scheme for fingerprint feature extraction", Pattern Recognition Letters, Elsevier Press, Vol. 27, pp. 462-468, 2006.
45. L. Lorigo and V. Govindaraju, "Offline Arabic handwritten recognition: A survey", *IEEE Transaction on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 28, No. 5, pp. 712-724, 2006.
46. S. Kompalli, S. Setlur, and V. Govindaraju, "Multi-font Devanagari OCR using recognition driven

segmentation", *Vivek – A Quarterly Journal of Artificial Intelligence*, National Centre for Software Technology, Vol. 16, No. 3, pp. 18-25, 2006.

47. H. Xue and V. Govindaraju, "Hidden Markov models combining discrete symbols and continuous attributes in handwriting recognition", *IEEE Transaction on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 28, No. 3, pp. 458-462, 2006.

2005

48. H. Lei and V. Govindaraju, "Matching and retrieving sequential patterns under regression", *International Journal on Web Intelligence and Agent Systems*, IOS Press, Vol. 3, No. 4, pp. 261-270, 2005.
49. T. Jea and V. Govindaraju, "A minutia-based partial fingerprint recognition system", *The Journal of Pattern Recognition*, Elsevier Publishers, Vol. 38, No. 10, pp. 1672-1684, 2005.
50. H. Lei and V. Govindaraju, "A comparative study on the consistency of features in on-line signature verification", *Pattern Recognition Letters*, Elsevier Press, Vol. 26, No. 15, pp. 2483-2489, 2005.
51. A. Teredesai and V. Govindaraju, "GP-based secondary classifiers", *The Journal of Pattern Recognition*, Pergamon Publishers, Vol. 38, No. 4, pp. 505-512, 2005.

2002

52. H. Xue and V. Govindaraju, "On the dependence of handwritten word recognizers on lexicons", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 24, No. 12, pp. 1553-1564, 2002.
53. V. Govindaraju, P. Slavik, and H. Xue, "Lexicon density as a measure for performance evaluation of handwritten recognizers", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 24, No. 6, pp. 789-800, 2002.
54. S. Setlur, V. Govindaraju, A. Lawson, and S. Srihari, "Large scale address recognition systems-truthing and tools", *International Journal of Document Analysis and Recognition*, Springer-Verlag, Vol. 4, No. 3, pp. 154-169, 2002.
55. J. Park and V. Govindaraju, "Use of adaptive segmentation in phrase recognition", *The Journal of Pattern Recognition*, Pergamon Publishers, Vol. 35, No. 1, pp. 245-252, 2002.
56. Y. Wu, K. Ianakiev, and V. Govindaraju, "Improved to k-nearest neighbor classification", *The Journal of Pattern Recognition*, Pergamon Press, Vol. 35, No. 10, pp. 2311-2318, 2002.
57. R. Kasturi, L. O. Gorman, and V. Govindaraju, "Document image analysis: A primer", *Saadhana*, Vol. 27, No. 1, pp. 3-22, 2002.

2001

58. P. Slavik and V. Govindaraju, "Equivalence of methods for slant and skew correction in word recognition applications", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 23, No. 3, pp. 323-325, 2001.
59. S. Madhvanath and V. Govindaraju, "The role of holistic paradigms in handwritten word recognition", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 23, No. 2, pp. 149-164, 2001.
60. S. Madhvanath, K. Sunder, and V. Govindaraju, "Syntactic methodology of pruning large lexicons in cursive script recognition", *Journal of Pattern Recognition*, Pergamon Publishers, Vol. 34, No. 1, pp. 37-46, 2001.

2000

61. V. Govindaraju and K. Ianakiev, "Potential improvement of classifier accuracy by using fuzzy measures", *IEEE Transactions on Fuzzy Systems*, IEEE Neural Networks Council, Vol. 8, No. 6, pp. 679-

690, 2000.

62. X. Wang, V. Govindaraju, and S. Srihari, "Holistic recognition of handwritten character pairs", *Journal of Pattern Recognition*, Pergamon Publishers, Vol. 33, No. 12, pp. 1967-1974, 2000.
63. J. Park, V. Govindaraju, and S. Srihari, "OCR in a hierarchical feature space", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 22, No. 4, pp. 400-406, 2000.

1999

64. S. Madhvanath, E. Kleinberg, and V. Govindaraju, "Holistic verification of handwritten phrases", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 21, No. 12, pp. 1344-1356, 1999.
65. S. Madhvanath, G. Kim, and V. Govindaraju, "Chain code processing for handwritten word recognition", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 21, No. 9, pp. 928-932, 1999.
66. D. Bouchaffra, V. Govindaraju, and S. Srihari, "Recognition of strings using non-stationary Markovian models: An application in ZIP code recognition", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 21, No. 10, pp. 990-999, 1999.
67. D. Bouchaffra, V. Govindaraju, and S. Srihari, "A methodology for mapping scores to probabilities", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 21, No. 9, pp. 923-927, 1999.
68. S. Madhvanath and V. Govindaraju, "Reference lines for holistic recognition of handwritten words", *Journal of Pattern Recognition*, Pergamon Press, Vol. 32, No.12, pp. 2021-2028, 1999.
69. G. Kim, V. Govindaraju, and S. Srihari, "Architecture for handwritten text recognition systems", *International Journal of Document Analysis and Recognition*, Springer Verlag, Vol. 2, No. 1, pp. 37-44, 1999.

1998

70. G. Kim and V. Govindaraju, "Handwritten phrase recognition as applied to street name images", *Journal of Pattern Recognition*, Pergamon Press, Vol. 31, No. 1, pp. 41-51, 1998.
71. G. Sheikoaslami, S. Srihari, V. Govindaraju, "Computer-aided graphology and Persian handwriting", *Computer Magazine*, Vol. 9, No. 61, pp. 43-46, 1998. (in Arabic).

1997

72. Z. Shi and V. Govindaraju, "Segmentation and recognition of connected handwritten numeral strings", *Journal of Pattern Recognition*, Pergamon Press, Vol. 30, No. 9, pp. 1501-1504, 1997.
73. G. Kim and V. Govindaraju, "A lexicon driven approach to handwritten word recognition for real-time applications", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, IEEE Computer Society Press, Vol. 19, No. 4, pp. 366-379, 1997.
74. G. Kim and V. Govindaraju, "Bank check recognition using cross validation between legal and courtesy amounts", *International Journal on Pattern Recognition and Artificial Intelligence*, World Scientific Publishing Company, Vol. 11, No. 4, pp. 657-674, 1997.
75. S. Madhvanath, E. Kleinberg, and V. Govindaraju, "Empirical design of a multi-classifier thresholding control strategy for recognition of handwritten street names", *International Journal of Pattern Recognition and Artificial Intelligence*, World Scientific Publishing Company, Vol. 11, No. 6, pp. 933-946, 1997.

1996

76. V. Govindaraju, "Locating human faces in photographs", *The International Journal of Computer*

Vision, Kluwer Academic Publishers, Vol. 19, No. 2, pp. 129-146, 1996.

77. Z. Shi and V. Govindaraju, "Character image enhancement using selective region growing", *Pattern Recognition Letters*, Elsevier Science Publishers, Vol. 17, pp. 523-527, 1996.
78. V. Govindaraju and R. Krishnamurthy, "Holistic handwritten word recognition using temporal features derived from off-line images", *Pattern Recognition Letters*, Elsevier Science Publishers, Vol. 17, pp. 537-540, 1996
79. S. Madhvanath, V. Govindaraju, and S. N. Srihari, "Recognition of handwritten US Census forms", *International Journal of Imaging Systems & Technology*, John Wiley & Sons, Inc., Vol. 7, pp. 312-319, 1996.

1995

80. S. Setlur and V. Govindaraju, "Generating manifold samples from handwritten words", *Pattern Recognition Letters*, Elsevier Science Publishers, Vol. 15, pp. 901-905, 1995.

1991

81. V. Govindaraju and R.K. Srihari, "Automatic face recognition in news photo database", *Advanced Imaging*, Miller Freeman, Inc., Vol. 5, No. 11, pp. 22-26, 1991.

1989

82. S. Srihari and V. Govindaraju, "Textual image analysis using the Hough transform", *International Journal of Machine Vision and Applications*, Kluwer Academic Publishers, Vol. 2, No. 3, pp. 141- 153, 1989.

❖ **Book Chapters (29)**

2019

1. N. Shankaran, "Learning representations for cryptographic hash based face template protection", *Deep Learning-Based Face Analytics*, Ratha, Chellappa, and Patel (editors), Springer.
2. S. Tulyakov, and V. Govindaraju: "Fusion of Recognition Systems", *Handbook on Computer Vision*, Ikeuchi (editors), Springer.

2018

3. Urala Kota B. et al, "Automated Extraction of Data from Binary Phase Diagrams for Discovery of Metallic Glasses. In: Fornés A., Lamiroy B. (editorss) Graphics Recognition. Current Trends and Evolutions. *Lecture Notes in Computer Science*, vol 11009. Springer.

2017

4. R. Pandey, Y. Zhou, and V. Govindaraju, "Learning représentations for cryptographic hash based face template protection", *Deep Learning for Biometrics*, *Advances in Computer Vision and Pattern Recognition*, B. Bhanu and A. Kumar (editors), Springer.
5. M. R. Malgireddy, I. Nwogu, and Venu Govindaraju: "Language-Motivated Approaches to Action Recognition", *Gesture Recognition*, Escalera, Guyon, Athitsos (editors), Springer, 155-181, 2017.

2015

6. V. Govindaraju, I. Nwogu, and S. Setlur, "Document informatics for scientific learning and accelerated discovery", *Handbook of Statistics, Big Data Analytics*, V. Govindaraju and C. R. Rao (editors), Elsevier, Vol. 33, pp. 3-28, 2015.
7. N. Pokhriyal, I. Nwogu, and V. Govindaraju, "A large-scale study of language usage as a cognitive

biometric trait", *Handbook of Statistics, Big Data Analytics,* V. Govindaraju, V. Raghavan, and CR Rao (editors), Elsevier, Vol. 33, pp. 69-88, 2015.

2013

8. S. Tulyakov, and V. Govindaraju, "Matching score fusion methods", Handbook of Statistics, *Machine Learning*, V. Govindaraju and C. R. Rao (editors), Elsevier, Vol. 31, pp. 151-175, 2013.
9. I. Nwogu and V. Govindaraju, "Conditional random fields for scene labeling", Handbook of Statistics, *Machine Learning*, V. Govindaraju and C. R. Rao (editors), Elsevier, Vol. 31, pp. 227-247, 2013.

2012

10. Z. Shi, S. Setlur, and V. Govindaraju, "Pre-processing issues in Arabic OCR", *Guide to OCR for Arabic Scripts*, V. Margner and H. E. Abed (editors), Springer, pp. 79-102, 2012.

2011

11. M. G. Frank, C. J. Maccario, and V. Govindaraju, "Behavior and security", *Protecting Airline Passengers in the Age of Terrorism,* P. Seidenstat and F. X. Splane (editors), pp. 86-106, 2011.
12. S. Tulyakov and V. Govindaraju, "Predicting performance in large-scale identification systems by score resampling", *Multibiometrics for Human Identification*, Bhanu and V. Govindaraju (editors), pp. 363-378, 2011.

2010

13. A. O. Thomas and V. Govindaraju, "Biometrics in security", *Encyclopedia of Cryptography and Security*, H. C. A. van Tilborg and S. Jajodia (editors), Springer, Vol. 2, 2010.

2009

14. M. G. Frank, M. O' Sullivan, C. Hurley, V. Govindaraju, and I. Pavlidis, "Deception, behavior, and technology", *Handbook of Science and Technology for Homeland Security*, J. Voeller (editor), John Wiley & Sons, 2009.
15. R. V. Yampolskiy and V. Govindaraju, "Game playing tactic as a behavioral biometric for human identification", *Behavioral Biometrics for Human Identification: Intelligent Applications,* L. Wang and X. Geng (editors), IGI Global, 2009.
16. R. V. Yampolskiy V. Govindaraju, "Taxonomy of behavioral biometrics", *Behavioral Biometrics for Human Identification: Intelligent Applications,* L. Wang and X. Geng (editors), IGI Global 2009.
17. O. Mukhtar, S. Setlur, and V. Govindaraju, "Experiments with Urdu text recognition", *Guide to OCR for Indic Scripts,* V. Govindaraju and S. Setlur (editors), Springer, pp. 163-171, 2009.
18. Z. Shi, S. Setlur, and V. Govindaraju, "Digital image enhancements of Indic historical manuscripts", *Guide to OCR for Indic Scripts,* V. Govindaraju and S. Setlur (editors), Springer, pp. 249-267, 2009.
19. A, Bharadwaj, S. Setlur, and V. Govindaraju, "Keyword spotting and retrieval in Indic documents", *Guide to OCR for Indic Scripts*, V. Govindaraju and S. Setlur (editors), Springer, pp. 285-299, 2009.
20. V. Govindaraju, S. Setlur, "Indic OCR landscape", *Guide to OCR for Indic Scripts,* (Preface), V. Govindaraju and S. Setlur (editors), Springer 2009.
21. A. Bharadwaj, S. Setlur, and V. Govindaraju, "Keyword spotting and indexing in Sanskrit documents", *Topics in Sanskrit Computational Linguistics*, P. Scharf and G. Huet (editors), Springer, pp. 403-416, 2009.
22. S. Tulyakov and V. Govindaraju, "Issues and advances in biometrics", *Annals of Emerging Research in Information Assurance, Security and Privacy Services*, H. Rao and S. Upadhyaya (editors), Elsevier, pp. 41-60, 2009.

2008

23. H. Cao and V. Govindaraju, "Indexing and retrieval of handwritten documents", *Document Image Processing,* B. B. Chowdhury (editor), World Scientific Publishers, 2008.
24. S. Tulyakov, Stefan Jaegar, V. Govindaraju, and D. Doermann, "Classifier combination survey", *Machine Learning in Document Analysis and Recognition,* S. Marinai (editor), Springer, pp. 361-386, 2008. (Invited).
25. S. Tulyakov and V. Govindaraju, "Learning matching score dependencies for classifier combination", *Machine Learning in Document Analysis and Recognition*, S. Marinai (editor), Springer, pp. 305-332, 2008. (Invited).

2003

26. R. Manmatha and V. Govindaraju, "Handwriting recognition", *Encyclopedia on Human Computer Interaction*, W. Bainbridge (editor), Berkshire Publications, 2003. (Invited).

2002

27. K. Ianakiev and V. Govindaraju, "Deriving pseudo-probabilities of correctness given scores", *Pattern Recognition and String Matching*, D. Chen and X. Cheng, (editors), Kluwer Publishers, pp. 281, 2002.

1997

28. D. Niyogi, S. N. Srihari, and V. Govindaraju, "Analysis of printed forms", *Handbook of Character Recognition and Document Image Analysis,* H. Bunke and S. P. Wang (editors), pp. 485-502, 1997.

1991

29. S. Srihari and V. Govindaraju, "Pattern recognition: a survey", *Encyclopedia of Computer Science*, A. Ralston (editor), Van Nostrand Reinhold, New York, NY, pp. 1034-1041, 1991.

❖ **Conference, Workshop, and Symposium Papers (327)**

Full paper reviewed for acceptance

2019

1. F. Xu, K. Davila, S. Setlur and V. Govindaraju "Content Extraction from Lecture Video via Speaker Action Classification based on Pose Information", International Conference on Document Analysis and Recognition (ICDAR), Sydney, Australia, 2019.
2. S. Tulyakov, D. D. Mohan, S. Setlur, and V. Govindaraju, "Significant Feature Based Representation for Template Protection", IEEE CVPR Workshop on Biometrics, Long Beach, CA, 2019.
3. S. Tulyakov, N. Sankaran,, S. Setlur, and V. Govindaraju, "Utilizing Template Diversity for Fusion of Face Recognizers", International Conference of Identity, Security, and Behavior Analysis, Hyderabad, India, 2019.
4. K. Davila, R. Joshi, S. Setlur, V. Govindaraju and R. Zanibbi, "Visual Search using Line-of-Sight Graphs: Application to Math Formula Images", European Conference on Information retrieval, Cologne, Germany, 2019.
5. N. N. Lakshminarayana, N. Sankaran, S. Setlur, V. Govindaraju, "Multimodal Deep Feature Aggregation for Facial Action Unit Recognition Using Visible Images and Physiological Signals", IEEE International Conference on Automatic Face and Gesture Recognition, Lille, France,2019.
6. N. Sankaran, D. D. Mohan, S. Setlur, V. Govindaraju, " Representation Learning Through Cross-Modality Supervision", IEEE International Conference on Automatic Face and Gesture Recognition, Lille, France, 2019.

2018

7. K. W. Lee, N. Sankaran, S. Setlur, N. Napp, V. Govindaraju, IEEE International Conference on Advanced Video and Signal-based Surveillance, "Wardrobe Model for Long Term Re-identification and Appearance Prediction", 2018.
8. N. N. Lakshminarayana, D. D. Mohan, N. Sankaran, S. Setlur, and V. Govindaraju, "Multi-modal Conditional Feature Enhancement for Facial Action Unit Recognition", ICML Workshop on Domain Adaptation for Visual Understanding, Sweden 2018.
9. B. U. Kota, K. Davila, A. Stone, S. Setlur and V. Govindaraju, "Automated Detection of Handwritten Whiteboard Content on Lecture Videos for Summarization", International Conference on Handwriting Recognition, Niagara Falls, NY, 2018.
10. K. Ravi, V. Ravi, S. Setlur and V. Govindaraju, "Article citation sentiment analysis using deep learning", IEEE International Conference Series on Cognitive Informatics and Cognitive Computing, Berkeley, CA, 2018.
11. N. Narayanan, S. Setlur, and V. Govindaraju, "Re-identification for Online Person Tracking by Modeling Space-Time Continuum", IEEE Computer Society Workshop on Biometrics - Computer Vision and Pattern Recognition, Salt Lake City, UT 2018.
12. R. Radhakrishnan Nair, N. Sankaran, B. Urala, S. Tulyakov, S. Setlur and V. Govindaraju, "Knowledge Transfer using Neural network based approach for Handwritten Text Recognition", International Workshop on Document Analysis and Systems, Vienna, Austria (DAS 2018).
13. N. Shankara,. S. Setlur, and V. Govindaraju, "Metadata-based Feature Aggregation Network for Face Recognition", 11th IAPR International Conference on Biometrics, Gold Coast, Australia (ICB 2018).

2017

14. B.U. Kota, S. Setlur, A. Dasgupta, S. Broderick, V. Govindaraju, and K. Rajan, "Automated analysis of phase diagrams", 12th IAPR International Workshop on Graphics Recognition, GREC, 2017.
15. R. R. Nair, N. Sankaran, B. U. Kota, S. Tulyakov, S. Setlur, and V. Govindaraju, "Using transfer learning for handwritten text transcription in historical documents", 4th IAPR International Workshop on Historical Document Imaging and Processing, 2017.
16. S. Tulyakov, N. Sankaran, S. Setlur, and V. Govindaraju, "Score Normalization in Stratified Biometrics Systems", IEEE International Joint Conference in Biometrics (IJCB 2017), Denver, CO, 2017.
17. N. Narayanan, N. Sankaran, D. Arpit, K. Dantu, S. Setlur, and V. Govindaraju, "Person Re-identification for Improved Multi-Person Multi-Camera Tracking by Continuous Entity Association, CVPRW, HI, 2017.
18. N. Lakshminarayana, N. Narayanan, N. Napp, and V. Govindaraju, "A Discriminative Spatio-temporal Mapping of Face for Liveness Detection", IEEE International Conference on Identity, Security and Behavioral Analysis, Delhi, India, 2017.

2016

19. R. Rathin, B. Urala, I. Nwogu, and V. Govindaraju, "Segmentation of highly unstructured handwritten documents using a neural network technique", 23rd International Conference on Pattern Recognition (ICPR 2016), Cancun, Mexico, 2016.
20. D. Arpit, Y. Zhou, H. Ngo, and V. Govindaraju, "Why regularized auto-encoders learn sparse representation?, 33rd International Conference on Machine Learning (ICML 2016), New York, NY, 2016.
21. D. Arpit, Y. Zhou, B. Kota, and V. Govindaraju "Normalization propagation: A parametric technique for removing internal covariate shift in deep networks", 33rd International Conference on Machine Learning (ICML 2016), New York, NY, 2016.
22. R. R. Nair, N. Sankaran, I. Nwogu, and V. Govindaraju "Understanding line plots using Bayesian network", 12th IAPR International Workshop on Document Analysis Systems, Santorini, Greece, pp.

108-113, 2016.

23. R. Pandey and V. Govindaraju "Deep secure encoding for face template protection", CVPR Biometrics Workshop, Las Vegas, NV, pp. 9-15, 2016.
24. D. Arpit, C. Ramaiah, and V. Govindaraju, "Subspace learning via low rank projections for dimensionality reduction", 8th IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2016), Niagara Falls, NY, 2016.

2015

25. N. Narayanan and V. Govindaraju, "Deep learning for keypoints detection in unconstrained face imagery", IEEE Western New York Image Processing Workshop, Rochester, NY, 2015. (Best student paper).
26. B. Zhu, A. Shivram. M. Nakagawa, and V. Govindaraju, "Online handwritten cursive word recognition using segmentation-free and segmentation-based methods", ACPR 2015, Kuala Lumpur, Malaysia, pp. 161-165, 2015.
27. N. Pokhriyal, W. Dong, and V. Govindaraju, "Virtual networks and poverty analysis in Senegal", NetMob, MIT Media Lab, Boston, MA, 2015.
28. R. Radhakrishnan, N. Sankaran, I. Nwogu, and V. Govindaraju, "Automated analysis of line plots in documents", International Conference and Document Analysis and Recognition (ICDAR), France, pp. 796-800, 2015.
29. C. Ramaiah, R. Plamondon, and V. Govindaraju, "A sigma-lognormal model for character level handwritten CAPTCHA generation", International Conference and Document Analysis and Recognition (ICDAR), France, pp. 966-970, 2015.
30. J. Hartloff, M. Morse, B. Zhang, T. Effland, J. Cordaro, J. Schuler, S. Tulyakov, A. Rudra and V. Govindaraju, "A multiple server scheme for fingerprint fuzzy vaults", IEEE Computer Vision and Pattern Recognition, Biometrics Workshop (CVPRW), Boston, MA, pp. 119-127, 2015.
31. R. K. Pandey and V. Govindaraju, "Secure face template generation via local region hashing", International Conference on Biometrics, Phukut, Thailand, pp. 299-304, 2015.

2014

32. A. Shivram, T. Khit, S. Natarajan, and V. Govindaraju, "Statistical relational training for handwriting recognition", International Conference on Inductive Logic Programming, Nancy, France, 2014.
33. D. Arpit, I. Nwogu, V. Govindaraju, "Dimensionality reduction with subspace structure preservation", Neural Information Processing Systems (NIPS), Montreal, Canada, 2014.
34. Y. Zhou, U. Porwal, H. Ngo, C. Zhang, C. Re, L. Nguyen, and V. Govindaraju, "Parallel feature selection inspired by group testing", Neural Information Processing Systems (NIPS), Montreal, Canada, 2014.
35. N. Pokhriyal, I. Inwogu, and V. Govindaraju, "Use of language as a cognitive biometric trait", International Journal of Biometrics, Clearwater, FL, 2014.
36. J. Hartloff, A. Rudra, S. Tulyakov, and V. Govindaraju, "Secure fingerprint with generic local structures", CVPR Biometrics Workshop, Columbus, OH, pp. 84-89, 2014.
37. D. Arpit, I. Nwogu, G. Srivastava and V. Govindaraju, "An analysis of random projections in cancelable biometrics", ICML Workshop on Learning, Security and Privacy, Beijing, China, 2014.
38. C. Ramaiah, R. Plamondon, and V. Govindaraju, "A sigma-lognormal model for handwritten text CAPTCHA generation", 22nd International Conference on Pattern Recognition (ICPR), Stockholm, Sweden, pp. 250-255, 2014.
39. G. Kumar, and V. Govindaraju, "Bayesian active learning for keyword spotting in handwritten documents", 22nd International Conference on Pattern Recognition (ICPR), Stockholm, Sweden, pp. 2041-2046, 2014.
40. A. Shivram, C. Ramaiah, and V. Govindaraju, "Data sufficiency for online writer identification: A

comparative study of writer-style space vs. feature space models", 22nd International Conference on Pattern Recognition (ICPR), Stockholm, Sweden, pp. 3121-3125, 2014.

41. G. Kumar, and V. Govindaraju, "A Bayesian approach to script independent multilingual keyword spotting", International Conference on Handwriting Recognition, Greece, pp. 357-362, 2014.
42. D. Arpit, G. Srivastava, and V. Govindaraju, "Randomized subspace learning algorithms with subspace structure preservation guarantees", CoRR, 1401.4489, 2014.
43. G. Kumar, S. Wshah, and V. Govindaraju, "Variational dynamic background model for keyword spotting in handwritten documents", Document Recognition and Retrieval XXI, San Jose, CA, 2014.
44. C. Ramaiah, and V. Govindaraju, "A hierarchical framework for accent based writer identification", Document Analysis Systems (DAS), Tours- Loire Valley, France, pp. 21-25, 2014.
45. U. Porwal, C. Ramaiah, A. Kumar, and V. Govindaraju, "Multiclass learning for writer identification using error-correcting codes", Document Analysis Systems (DAS), Tours- Loire Valley, France, pp. 16-20, 2014.

2013

46. S. P. Satheesan, S. Tulyakov, and V. Govindaraju, "A feature information based approach for enhancing score-level fusion in multi-sample biometric systems", National Conference on Computer Vision, Pattern Recognition, Image Processing, and Graphics, Jodhpur, India, 2013.
47. X. Peng, H. Cao, S. Setlur, V. Govindaraju, and P. Natarajan, "Multilingual OCR research and applications: An Overview", 4th ICDAR Workshop on Multilingual OCR", Washington, D. C., 2013.
48. X. Cheng, S. Tulyakov, and V. Govindaraju, "Minutiae-based matching and state model for combination in fingerprint matching system", IEEE CVPR Workshop on Biometrics, Portland, OR, pp. 92-97, 2013.
49. C. Ramaiah, A. Shivram, and V. Govindaraju, "A Bayesian framework for modeling accents in handwriting", International Conference on Document Analysis and Recognition (ICDAR 2013), Washington, D.C., pp. 917-921, 2013.
50. A. Shivram, C. Ramaiah, S. Setlur, and V. Govindaraju, "IBM_UB_1: A dual mode unconstrained English handwriting dataset", International Conference on Document Analysis and Recognition (ICDAR 2013), Washington, D.C., pp. 13-17, 2013.
51. A. Shivram, B. Zhu, S. Setlur, M. Nakagawa, and V. Govindaraju, "Segmentation based online word recognition: A conditional random field driven beam search strategy", International Conference on Document Analysis and Recognition (ICDAR 2013), Washington, D.C., pp. 852-856, 2013.
52. B. Zhu, A. Shivram, S. Setlur, V. Govindaraju, and M. Nakagawa, "Online handwritten cursive word recognition using segmentation-free MRF in combination with P2DBMN-MQDF", International Conference on Document Analysis and Recognition (ICDAR 2013), Washington, D.C., pp. 349- 353, 2013.
53. Z. Shi, S. Setlur, and V. Govindaraju, "Table cell detection and content extraction from degraded document images", International Conference on Document Analysis and Recognition (ICDAR 2013), Washington, D.C., 2013.
54. C. Ramaiah, R. Plamondon, and V. Govindaraju, "Handwritten CAPTCHA generation based on the Sigma-Lognormal model", International Graphonomics Society, Nara, Japan, 2013.
55. K. Hong, M. Voelz, V. Govindaraju, B. Jayaraman and U. Ramachandran, "A distributed framework for spatio-temporal analysis on large-scale camera networks", 3rd International Workshop on Cyber-Physical Networking Systems (CPNS 2013), Philadelphia, PA, 2013.
56. J. Hartloff, M. Bileshi, S. Tulyakov, J. Dobler, A. Rudra, and V. Govindaraju, "Towards fingerprints as strings: Secure indexing for fingerprint matching", International Conference on Biometrics, Spain, pp. 1-6, 2013.

57. J. Hartloff, M. Bileshi, S. Tulyakov, J. Dobler, A. Rudra, and V. Govindaraju, “Security analysis for fingerprint fuzzy vaults”, SPIE Biometrics and Surveillance Technology for Human and Activity Identification, Baltimore, MD, 2013.
58. G. Kumar, S. Wshah, and V. Govindaraju, “Segmentation free keyword spotting framework using dynamic background model”, SPIE Symposium on Document Recognition and Retrieval XX", San Jose, CA 2013.

2012

59. Z. Shi, S. Setlur, and V. Govindaraju, “Model based table cell detection and content extraction from degraded document images”, Workshop on Document Analysis and Recognition, Mumbai, India, pp. 62-67, 2012.
60. V. Menon, B. Jayaraman, and V. Govindaraju, “Spatio-temporal querying in smart spaces”, 3rd International Conference on Ambient Systems, Networks and Technologies, (ANT-2012), Niagara Falls, Ontario, Vol. 10, pp. 366-373, 2012.
61. X. Cheng, S. Tulyakov, and V. Govindaraju, “Utilization of matching score vector similarity measures in biometric systems”, 7th IEEE Computer Vision and Pattern Recognition (CVPR), Workshop on Biometrics, Providence, RI, pp. 111-116, 2012.
62. S. Wshah, G. Kumar, and V. Govindaraju, “Multilingual word spotting in offline handwritten documents”, International Conference on Pattern Recognition (ICPR), Tsukuba City, Japan, 2012.
63. U. Porwal, Y. Zhou, and V. Govindaraju, “Handwritten Arabic text recognition using Deep Belief Networks”, International Conference on Pattern Recognition (ICPR), Tsukuba City, Japan, 2012.
64. A. Shivaram, C. Ramaiah, U. Porwal, and V. Govindaraju, “Modeling writing styles for online writer identification: A hierarchical Bayesian approach”, 13th International Conference on Frontiers of Handwriting Recognition (ICFHR), Bari, Italy, 2012.
65. U. Porwal, C. Ramaiah, A. Shivaram, and V. Govindaraju, “Structural learning for writer identification in offline handwriting”, 13th International Conference on Frontiers of Handwriting Recognition (ICFHR), Bari, Italy, 2012.
66. S. Wshah, G. Kumar, and V. Govindaraju, “Script independent word spotting in offline handwritten documents based on Hidden Markov Models”, 13th International Conference on Frontiers of Handwriting Recognition (ICFHR), Bari, Italy, 2012.
67. G. Kumar, Z. Shi, S. Setlur, V. Govindaraju, and S. Ramachandrula, “Keyword spotting framework using dynamic background model”, 13th International Conference on Frontiers of Handwriting Recognition (ICFHR), Bari, Italy, pp. 582-587, 2012.
68. U. Porwal, A. Shivaram, C. Ramaiah, and V. Govindaraju, “Ensemble of biased learners for offline Arabic handwriting recognition”, 10th IAPR International Workshop on Document Analysis and Systems (DAS), Gold Coast, Australia, pp. 322-326, 2012.
69. C. Ramaiah, U. Porwal, and V. Govindaraju, “Accent detection in handwriting based on writing styles”, 10th IAPR International Workshop on Document Analysis and Systems (DAS), Gold Coast, Australia, pp. 312-316, 2012.
70. A. Kashyap, S. Tulyakov, and V. Govindaraju, “Facial Behavior as a soft biometric”, 5th IAPR International Conference on Biometrics (ICB), New Delhi, India, pp. 147-151, 2012.
71. U. Porwal, S. Rajan, and V. Govindaraju, "An oracle based co-training framework for writer identification in offline handwriting”, SPIE Symposium on Document Recognition and Retrieval XIX, San Jose, CA, 2012.
72. C. Ramaiah and V. Govindaraju, "Handwritten document age classification based on handwriting styles”, SPIE Symposium on Document Recognition and Retrieval XIX, San Jose, CA, 2012.
73. M. R. Malgireddy, I. Inwogu, and V. Govindaraju, “A temporal Bayesian model for classifying, detecting, and localizing activities in video sequences”, IEEE Computer Vision and Pattern

Recognition Workshop (CVPR), Providence, RI, pp. 43-48, 2012.

2011

74. M. R. Malgireddy, I. Nwogu, S. Ghosh, and V. Govindaraju, "A generative framework to investigate the underlying patterns in human activities", International Conference on Computer Vision (ICCV), Combinatorial Image Analysis Workshop, Spain, pp. 1472-1479, 2011.
75. X. Cheng, S. Tulyakov, and V. Govindaraju, "Combination of multiple samples utilizing identification model in biometric systems", 4th International Joint Conference on Biometrics (IJCB), Washington, D.C., 2011. (31 oral papers out of 324 submissions)
76. U. Porwal and V. Govindaraju, "A co-training based framework for writer identification in offline handwriting", 1st International Workshop on Automatic Forensic Handwriting Analysis, Beijing, China, pp. 36-40, 2011.
77. V. Menon, B. Jayaraman, and V. Govindaraju, "Spatio-temporal reasoning in biometrics based smart environments", 2nd International Conference on Ambient Systems, Networks and Technologies (ANT), Niagara Falls, Canada, Procedia Computer Science 5, pp. 378-385, 2011.
78. X. Cheng, S. Tulyakov, and V. Govindaraju, "Multiple-sample fusion of matching scores in biometric systems", 6th IEEE Computer Vision and Pattern Recognition (CVPRW) Biometrics Workshop, Colorado Springs, CO, pp. 120-125, 2011.
79. X. Cheng, S. Tulyakov, and V. Govindaraju, "Combination of user- and enrollee-specific statistical information in verification systems", 6th IEEE Computer Vision and Pattern Recognition Biometrics Workshop (CVPRW), Colorado Springs, CO, pp. 126-131, 2011.
80. N. Bhaskaran, I. Nwogu, M. Frank, and V. Govindaraju, "Lie to me: Deceit detection via online behavioral learning", 9th IEEE Conference on Face and Gesture Recognition, Santa Barbara, CA, pp. 24-29, 2011.
81. M. R. Malgireddy, I. Nwogu, S. Ghosh, and V. Govindaraju, "A shared parameter model for gesture and sub-gesture analysis", 14th International Workshop on Combinatorial Image Analysis, Madrid, Spain, pp. 483-493, 2011.
82. N. Bhaskaran, I. Nwogu, M. G. Frank and V. Govindaraju, "Deceit detection via online behavioral learning", ACM Symposium on Applied Computing, Tachung, Taiwan, pp. 29-30, 2011.
83. D. You, S. Antani, and V. Govindaraju, "Automatic identification of ROI in figure images toward improving hybrid (text and image) biomedical document retrieval", 18th Annual SPIE Symposium on Document Recognition and Retrieval, San Jose, CA, 2011.
84. X. Peng, S. Setlur, V. Govindaraju and R. Sitaram, "Binarization of camera-captured document using A MAP approach", 18th Annual SPIE Symposium on Document Recognition and Retrieval, San Jose, CA, 2011.
85. Z. Shi, and V. Govindaraju, "Image enhancement for degraded binary document images", IEEE International Conference of Document Analysis and Recognition, Beijing, China, pp. 895-899, 2011.
86. D. You, S. Antani, D. Deemer-Fushman, V. Govindaraju, and G. Thoma "Detecting figure-panel labels in medical journal articles using MRF", IEEE International Conference of Document Analysis and Recognition, Beijing, China, pp. 967-971, 2011.

2010

87. X. Peng, S. Setlur, V. Govindaraju, and R. Sitaram, "Markov random fields based segmentation for hand-held devices captured document image", 7th Indian Conference on Computer Vision and Image Processing, Chennai, India, pp. 71-76, 2010.
88. R. Rodrigues, K. Kamat, and V. Govindaraju, "Evaluation of biometric spoofing in multimodal systems", 4th IEEE International Conference on Biometrics: Theory Applications and Systems (BTAS), Washington, D.C., 2010.

89. I. Nwogu, V. Govindaraju and C. Brown, “Syntactic image parsing using ontology and semantic descriptions”, 5th IEEE Conference on Computer Vision and Pattern Recognition Biometrics Workshop (CVPRW), San Francisco, CA, pp. 41-48, 2010.
90. A. Chowirappa, R. Rodrigues, and V. Govindaraju, “Generation of handwriting by active shape modeling and global local approximation (GLA) adaptation”, 12th IAPR International Conference on Handwriting Recognition, Kolkata, India, pp. 206-211, 2010.
91. A. Bhardwaj, A. O. Thomas, Y. Fu and V. Govindaraju, “Retrieving handwriting styles: A content based approach to handwritten document retrieval”, 12th IAPR International Conference on Handwriting Recognition, Kolkata, India, pp. 265-270, 2010.
92. A. O. Thomas, S. Chaudhury, and V. Govindaraju, “Leveraging the mixed-text segmentation problem to design secure handwritten CAPTCHAs”, 12th IAPR International Conference on Handwriting Recognition, Kolkata, India, pp. 13- 18, 2010.
93. A. Bhardwaj, Y. Fu and V. Govindaraju, “Document age estimation using hierarchical subspace learning techniques”, 24th Annual Conference on Neural Information Processing Systems, Workshop on Topic Models: Text and Beyond, Vancouver, Canada, 2010.
94. Z. Shi, S. Setlur, and V. Govindaraju, “Removing rule-lines from binary handwritten Arabic document images using directional local profile”, 20th International Conference of Pattern Recognition, Istanbul, Turkey, pp. 1916-1919, 2010.
95. X. Peng, S. Setlur, V. Govindaraju, and R. Sitaram, “Text separation from mixed documents using a tree-structured classifier”, 20th International Conference of Pattern Recognition, Istanbul, Turkey, pp. 241-244, 2010.
96. M. Malgireddy, J. Corso, S. Setlur, V. Govindaraju, and D. Mandalapu, “A framework for hand gesture recognition and spotting using sub-gesture modeling”, 20th International Conference of Pattern Recognition (ICPR), Istanbul, Turkey, pp. 3780-3783, 2010.
97. S. Weshah, V. Govindaraju, H. Li, and Y. Cheng, “A novel lexicon reduction method for Arabic handwriting recognition”, 20th International Conference of Pattern Recognition (ICPR), Istanbul, Turkey, pp. 2865-2868, 2010.
98. G. Kumar, S. Tulyakov, and V. Govindaraju, “Combination of hash functions for secure fingerprint matching”, 20th International Conference of Pattern Recognition (ICPR), Istanbul, Turkey, pp. 890-893, 2010.
99. J. Koh, V. Govindaraju, and V. Chaudhury, “A robust iris localization method using an active contour model and Hough transform”, 20th International Conference of Pattern Recognition (ICPR), Istanbul, Turkey, pp. 2852-2856, 2010.
100. S. Tulyakov and V. Govindaraju, “Predicting performance in large-scale identification systems by score resampling”, International Biometrics Performance Conference, NIST, Gaithersburg, MD, 2010.
101. R. Rodrigues and V. Govindaraju, “Assessment of biometrics robustness against spoof attacks”, International Biometrics Performance Conference, NIST, Gaithersburg, MD, 2010.
102. X. Peng, S. Setlur, V. Govindaraju and R. Sitaram, “Overlapped text segmentation using Markov random field and aggregation”, 9th International Workshop on Document Analysis and Systems, Boston, MA, pp. 129-134, 2010.
103. A. Bhardwaj, M. Malgireddy, S. Setlur, V. Govindaraju and S. Ramachandrula, “Latent Dirichlet allocation based writer identification in offline handwriting”, 9th International Workshop on Document Analysis and Systems, Boston, MA, pp. 357-362, 2010.
104. I. Nwogu, M. Frank, and V. Govindaraju, “An automated process for deceit detection”, 7th SPIE Symposium on Biometric technology for Human Identification, Orlando, FL, 2010.
105. D. You, S. Antani, D. Demner-Fushman, V. Govindaraju, and G. R. Thoma, “Biomedical article retrieval using multimodal features and image annotations in region-based CBIR”, 17th SPIE Symposium on Document Recognition and Retrieval, San Jose, CA, 2010.

2009

106. A. Bhardwaj, M. Malgireddy, S. Setlur, V. Govindaraju and R. Sitaram, "Writer identification in offline handwriting using topic models", NIPS Workshop on Topic Models: Text and Beyond, Vancouver, BC, 2009.
107. R. Rodriguez, J. Corso, and V. Govindaraju, "Unconstrained face recognition using MRF Priors and Manifold Traversing", 3rd IEEE Conference on Biometrics, Theory, Algorithms, and Systems, Washington, D.C., pp. 86-91, 2009.
108. J. Xu, V. Singh, V. Govindaraju and D. Neogi, "A hierarchical classification model for document categorization", 11th International Conference on Document Analysis and Recognition, Barcelona, Spain, pp. 486- 490, 2009.
109. Z. Shi, S. Setlur, and V. Govindaraju, "A steerable directional local profile technique for extraction of handwritten Arabic text lines", 11th International Conference on Document Analysis and Recognition, Barcelona, Spain, pp. 176-180, 2009.
110. X. Peng, S. Setlur, V. Govindaraju, and S. Ramachandrula, "Markov random field based text identification from annotated machine printed documents" 11th International Conference on Document Analysis and Recognition, Barcelona, Spain, pp. 431-435, 2009.
111. S. Wshah, Z. Shi, and V. Govindaraju, "Segmentation of Arabic handwriting based on both contour and skeleton segmentation", 11th International Conference on Document Analysis and Recognition, Barcelona, Spain, pp. 793-797, 2009.
112. Z. Shi and V. Govindaraju, "Robust fingerprint matching using spiral partitioning scheme", International Conference on Biometrics, Sassari, Italy, pp. 647-655, 2009.
113. S. Tulyakov and V. Govindaraju, "Neural network optimization for combinations in identification systems", 8th International Workshop on Multiple Classifier Systems, Reykjavik, Iceland, pp. 418-427, 2009.
114. J. Xu, V. Singh, V. Govindaraju, and D. Neogi, "A cascade multiple classifier system for document categorization", 8th International Workshop on Multiple Classifier Systems, Reykjavik, Iceland, pp. 458-467, 2009.
115. X. Peng, S. Setlur, V. Govindaraju, and S. Ramachandrula, "Text identification from mixed documents using weighted features", 14th Conference of the International Graphonomics Society, Dijon, France, 2009.
116. Z Shi, S. Setlur, and V. Govindaraju, "Writer identification of Arabic documents by multi-scale modeling", 14th Conference of the International Graphonomics Society, Dijon, France, 2009.
117. D. You, Z. Shi, V. Govindaraju and A. Blatt "Line removal and handwritten word recognition of police accident report forms", 10th International Conference on Digital Government Research, Pueblo, Mexico, pp. 317-318, 2009.
118. A. Bharadwaj, and V. Govindaraju, "Script identification of handwritten word images", 16th SPIE Symposium on Document Recognition and Retrieval, San Jose, CA, 2009.

2008

119. Z. Zhang, S, Tulyakov, and V. Govindaraju, "Combining facial skin mark and eigenfaces for face recognition", 2nd International Conference on Biometrics, Alghero, Italy, pp. 424-433, 2009.
120. H. Cao, R. Prasad, P. Natarajan, and V. Govindaraju, "Nested state indexing in pairwise Markov networks for fast handwritten document image rule-line removal", 16th IEEE International Conference on Image Processing, Cairo, Egypt, pp. 2009-2012, 2009.
121. S. Tulyakov and V. Govindaraju, "Enrolled template specific decisions and combinations in verification systems", 2nd IEEE Conference on Biometrics: Theory, Applications, and Systems (BTAS 08), Washington, D.C., 2008.

122. J. Li, S. Tulyakov, and V. Govindaraju, “Fingerprint matching using correlation and thin-plate spline deformation model”, 2nd IEEE Conference on Biometrics: Theory, Applications, and Systems (BTAS 08), Washington, D.C., 2008.
123. J. Li, S. Tulyakov, F. Farooq, J. Corso, and V. Govindaraju, “Integrating minutiae based fingerprint matching with local mutual information”, 19th International Conference on Pattern Recognition, Tampa, FL, 2008.
124. A. Bharadwaj, F. Farooq, H. Cao, and V. Govindaraju, “Topic based language models for OCR correction”, 2nd ACM Workshop on Analytics of Unstructured Noisy Data, SIGIR, Singapore, pp. 107-112, 2008.
125. F. Farooq, G. Chandalia, and V. Govindaraju, “Lexicon reduction in handwriting recognition using topic categorization”, 8th International Workshop on Document Analysis Systems, Nara, Japan, 2008.
126. S. Tulyakov, and V. Govindaraju, “Comparison of combination methods utilizing T- normalization and second best score model”, IEEE Computer Vision and Pattern Recognition, Biometrics Workshop, Anchorage, AL, 2008.
127. F. Farooq, D. Jose, and V. Govindaraju, “Phrase based direct model for improving handwriting recognition accuracies”, 11th International Conference on Frontiers of Handwriting Recognition (ICFHR 08), Montreal, Canada, pp. 3271-3277, 2008.
128. A. Thomas and V. Govindaraju, “Generation and performance evaluation of synthetic handwritten CAPTCHAs”, 11th International Conference on Frontiers of Handwriting Recognition (ICFHR 08), Montreal, Canada, 2008.
129. H. Cao, A. Bharadwaj, and V. Govindaraju, “A probabilistic method for keyword retrieval in handwritten document images”, 11th International Conference on Frontiers of Handwriting Recognition (ICFHR 08), Montreal, Canada, pp. 3374-3382, 2008.
130. H. Lei and V. Govindaraju, “Relative pattern recognition for noisy handwritten numeral recognition”, 11th International Conference on Frontiers of Handwriting Recognition (ICFHR 08), Montreal, Canada, 2008.
131. V. Menon, B. Jayaraman, and V. Govindaraju, “Integrating recognition and reasoning in smart environments”, 4th IET Conference on Intelligent Environments, Seattle, WA, p. 35, 2008.
132. V. Menon, B. Jayaraman, and V. Govindaraju, “Biometrics driven smart environments: Abstract framework and evaluation”, 5th International Conference on Ubiquitous Intelligence and Computing (UIC-08), Oslo, Norway, pp. 75-89, 2008.
133. H. Cao and V. Govindaraju, “Processing and retrieving handwritten medical forms”, ACM Digital Government Research Conference, Montreal, Canada, pp. 371-372, 2008.
134. R. V. Yampolskiy and V. Govindaraju, “Behavioral biometrics for verification and recognition of malicious software agents”, 5th SPIE Symposium on Biometric technology for Human Identification, Orlando, FL, 2008.
135. R. V. Yampolskiy and V. Govindaraju, “Generation of artificial biometric data enhanced with spatio-temporal and environmental information”, 5th SPIE Symposium on Biometric technology for Human Identification, Orlando, FL, 2008.
136. Z. Shi, and V. Govindaraju, “Modeling biometric systems using the general pareto distribution (GPD)”, 5th SPIE Symposium on Biometric technology for Human Identification, Orlando, FL, 2008.
137. P. Mansukhani and V. Govindaraju, “Selecting optimal classification features for SVM based elimination of incorrectly matched minutiae”, 5th SPIE Symposium on Biometric technology for Human Identification, Orlando, FL, 2008.
138. R. V. Yampolskiy and V. Govindaraju, “Behavioral biometrics for recognition and verification of game bots”, 8th Annual European Game-On Conference on simulation and AI in Computer Games, Bologna, Italy, 2008.

139. A. Bharadwaj, D. Jose, and V. Govindaraju, “Script independent word spotting in multilingual documents”, 2nd International Workshop on Cross Lingual Information Access, Hyderabad, India, pp. 48-54, 2008.
140. A. Bharadwaj, S. Kompalli, S. Setlur, and V. Govindaraju, “An OCR based approach for word spotting in Devanagari documents”, 15th SPIE Symposium on Document Recognition and Retrieval XV, San Jose, CA, 2008.
141. K. V. U. Reddy and V. Govindaraju, “Form classification”, 15th SPIE Symposium on Document Recognition and Retrieval XV, San Jose, CA, 2008.
142. D. Jose, A. Bhardwaj, and V. Govindaraju, “Transcript mapping for handwritten English documents”, 15th SPIE Conference on Document Recognition and Retrieval, San Jose, CA, 2008.

2007

143. A. Thomas, A. Rusu, S. Mukund, and V. Govindaraju, “Non-writer specific synthetic handwriting generation for the CAPTCHA application”, IEEE WNY Image Processing Workshop, Rochester, NY, 2007.
144. F. Farooq and V. Govindaraju, “Language identification in historical Afghan manuscripts”, 9th International Symposium on Signal Processing and Its Applications (ISSPA), Sharjah, United Arab Emirates, 2007.
145. J. Li, S. Tulyakov, and V. Govindaraju, “Verifying fingerprint match by local correlation methods”, 1st IEEE Conference on Biometrics: Theory, Algorithms, and Systems, Washington, D.C., pp. 1-5, 2007. (Oral presentation acceptance rate = 25%).
146. S. Tulyakov, C. Wu, and V. Govindaraju, “Iterative methods for searching optimal classifier combination function”, IEEE Conference on Biometrics: Theory, Applications, and Systems, Washington, D.C., 2007. (Short oral presentation acceptance rate = 60%).
147. A. Rusu and V. Govindaraju, “Synthetic handwriting generator for cyber security”, 13th Conference of the International Graphonomics Society, Melbourne, Australia, 2007.
148. C. Wu, S. Tulyakov, and V. Govindaraju, “Robust point-based feature fingerprint segmentation algorithm”, 1st International Conference on Biometrics, Seoul, S. Korea, pp. 1095-1103, 2007.
149. I. Nwogu, Z. Shi, and V. Govindaraju, “PDE-based enhancement of low quality documents”, 9th International Conference on Document Analysis and Recognition, Curitiba, Brazil, 2007.
150. H. Cao, and V. Govindaraju, “Vector model based indexing and retrieval of handwritten medical forms”, 9th International Conference on Document Analysis and Recognition, Curitiba, Brazil, 2007.
151. S. Tulyakov, T. Slowe, Z. Zhang, and V. Govindaraju, “Facial expression biometrics using tracker displacement features”, 2nd IEEE CVPR Workshop on Biometrics (CVPRW), Minneapolis, MN, 2007.
152. A. Cartwright, A. Titus, F. Bright, and V. Govindaraju, “CMOS chemical and biochemical sensors using nanostructured materials”, 2007 IEEE/LEOS Summer Topical Meetings, Portland, OR, pp. 84-85, 2007.
153. Z. Zhang, V. Singh, T. Slowe, S. Tulyakov, and V. Govindaraju, “Real-time automatic deceit detection from involuntary facial expressions”, 2nd IEEE CVPR Workshop on Biometrics (CVPRW), Minneapolis, MN, pp. 1-6, 2007.
154. V. Govindaraju and H. Cao, “Indexing and retrieval of handwritten medical forms”, 8th Annual International Conference on Digital Government Research, Philadelphia, PA, pp. 280-281, 2007.
155. H. Cao and V. Govindaraju, “Handwritten carbon form preprocessing based on Markov random field”, IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR), Minneapolis, MN, 2007.
156. T. Slowe and V. Govindaraju, “Automatic deceit indication through reliable facial expressions”, 5th IEEE Workshop on Automatic Identification Advanced Technologies, Alghero, Italy, pp. 87-92, 2007.

157. R. Yampolskiy and V. Govindaraju "Similarity measure functions for strategy-based biometrics", 4th SPIE Symposium on Biometric Technology for Human Identification, Orlando, FL, pp. 4254-4259, 2007.
158. P. Mansukhani, S. Tulyakov, and V. Govindaraju, "Using support vector machines to eliminate false minutiae matches during fingerprint verification", SPIE Defense and Security Symposium, Orlando, FL, 2007.
159. L. Lorigo and V. Govindaraju, "Transcript mapping for handwritten Arabic documents", 14th SPIE Symposium on Document Recognition and Retrieval XIV, San Jose, CA, 2007.
160. H. Cao, F. Farooq, and V. Govindaraju, "Indexing and retrieval of degraded handwritten medical forms", IJCAI Workshop on Multimodal Information Retrieval, Hyderabad, India, 2007.
161. H. Cao and V. Govindaraju, "Template-free word spotting in low quality grayscale manuscripts", International Conference on Advances in Pattern Recognition, Kolkata, India, 2007.

2006

162. S. Tulyakov and V. Govindaraju, "Utilizing independence of multimodal biometric matchers", International Workshop on Multimedia Content Representation, Classification, and Security, Istanbul, Turkey, pp. 34-41, 2006.
163. A. Tulyakov and V. Govindaraju, "Identification model for classifier combinations", IEEE Biometric Consortium Conference, Special Session on Research, Washington, D.C., pp. 1-6, 2006.
164. C. Wu, S. Tulyakov and V. Govindaraju, "Image quality measures for fingerprint image enhancement", International Workshop on Multimedia Content Representation, Classification, and Security, Istanbul, Turkey, pp. 215-222, 2006.
165. A. Rusu and V. Govindaraju, "The influence of image complexity on handwriting recognition", 10th International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
166. R. Milewski and V. Govindaraju, "Automatic indexing of handwritten medical forms for search engines", 10th International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
167. F. Farooq, L. Lorigo and V. Govindaraju, "On the accent in handwriting of individuals", 10th International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
168. K. Sridharan, M. Beal, and V. Govindaraju, "Competitive mixtures of simple neurons'', 18th International Conference on Pattern Recognition, Hong Kong, China, pp. 494-497, 2006.
169. F. Farooq, K. Sridharan, and V. Govindaraju, "Identifying handwritten text in mixed documents", 18th International Conference on Pattern Recognition, Hong Kong, China, pp. 1142-1145, 2006.
170. S. Kompally, and V. Govindaraju, "Devanagari OCR", 13th World Sanskrit Conference, Edinburgh, UK, 2006.
171. C. Wu and V. Govindaraju, "Singularity preserving fingerprint image adaptive filtering'', 13th International Conference on Image Processing, Atlanta, GA, pp. 313-316, 2006.
172. S. Kompalli, S. Setlur, and V. Govindaraju, "Design and comparison of segmentation driven and recognition driven Devanagari OCR", 2nd International Workshop on Document Image Analysis for Libraries, Lyon, France, pp. 96-102, 2006.
173. R. Yampolsiky and V. Govindaraju, "Use of behavioral biometrics in intrusion detection and online gaming", 3rd SPIE Symposium on Biometric Technology for Human Identification, Orlando, FL, pp. 249-258, 2006.
174. R. Milewski and V. Govindaraju, "Extraction of handwritten text from carbon copy medical form images", International Workshop on Document Analysis Systems, Nelson, New Zealand, pp. 106-116, 2006.
175. S. Chikkerur and V. Govindaraju, "K-plet and coupled BFS: A graph based fingerprint representation and matching algorithm", 1st International Conference on Biometrics, Hong Kong, China, pp. 309-

315, 2006.

176. V. Govindaraju, “Indexing and searching handwritten medical forms”, International Conference on Digital Government Research, San Diego, CA, 2006.

2005

177. K. Sridharan and V. Govindaraju, “A sampling based approach to facial feature extraction”, 4th IEEE Workshop on Automatic Identification Advanced Technologies (AutoID), Buffalo, NY, pp. 51-56, 2005. (Won 2nd prize for Best Student Paper).
178. S. Deshpande, S. Chikkerur, and V. Govindaraju, “Accent classification in speech”, 4th IEEE Workshop on Automatic Identification Advanced Technologies (AutoID), Buffalo, NY, pp. 139-143, 2005.
179. K. Sridharan, F. Farooq, and V. Govindaraju, “Classification of machine print and handwriting in mixed Arabic documents’’, Symposium on Document Image Understanding Technology’’, College Park, MD, pp. 89-94, 2005.
180. T. Jea and V. Govindaraju, “Partial fingerprint recognition based on localized features and matching”, Biometrics Consortium Conference, Crystal City, VA, 2005.
181. S. Tulyakov and V. Govindaraju, “Identification model with independent matching scores”, Biometrics Consortium Conference, Crystal City, VA, 2005.
182. S. Chikkerur, A. Cartwright, and V. Govindaraju, “Fingerprint image enhancement using STFT analysis”, International Conference on Pattern Recognition and Image Analysis, Bath, UK, 2005.
183. S. Tulyakov, F. Farooq, and V. Govindaraju, “Symmetric hash functions for fingerprint minutiae”, International Conference on Pattern Recognition and Image Analysis, Bath, UK, pp. 30-38, 2005.
184. F. Farooq, V. Govindaraju, and M. Perrone, “Processing of handwritten Arabic document images”, Proceedings of the 12th Biennial Conference of the International Graphonomics Society, Salerno, Italy, pp. 183-186, 2005.
185. A. Rusu and V. Govindaraju, “Visual CAPTCHA with handwritten image analysis”, 2nd International Workshop on Human Interactive Proofs, Bethlehem, PA, pp. 42-52, 2005.
186. S. Tulyakov and V. Govindaraju, “Using independence assumption to improve multimodal biometric fusion”, 6th IAPR International Workshop on Multiple Classifier Systems, Monterrey, CA, pp. 147-155, 2005.
187. S. Tulyakov and V. Govindaraju, “Identification model with independent matching scores”, Biometric Consortium Conference, Washington, D.C., 2005.
188. H. Lei and V. Govindaraju, “Half-against-half multi-class support vector machines”, 6th IAPR International Workshop on Multiple Classifier Systems, Monterrey, CA, pp. 156-164, 2005.
189. H. Lei and V. Govindaraju, “Speeding up multi-class SVM evaluation by PCA and feature selection”, International Workshop on Feature Selection for Data Mining: Interfacing Machine Learning with Statistics, Newport Beach, CA, 2005.
190. S. Chikkerur, S. Pankanti, N. Ratha, R. Bolle, and V. Govindaraju, “Minutiae verification in fingerprint images using steerable wedge filters”, IEEE Workshop on Applications of Computer Vision, Breckenridge, CO, pp. 111-116, 2005.
191. Z. Shi and V. Govindaraju, “Historical document image segmentation using light intensity normalization”, 12th SPIE Symposium on Document Recognition and Retrieval, SPIE Proceedings Series, San Jose, CA, 2005.
192. H. Lei and V. Govindaraju, “Mouse based signature verification for internet based transactions”, 12th SPIE Symposium on Document Recognition and Retrieval, SPIE Proceedings Series, San Jose, CA, pp. 153-160, 2005.
193. A. Rusu and V. Govindaraju, “Challenges that handwritten text pose to computers and new practical applications”, 12th SPIE Symposium on Document Recognition and Retrieval, SPIE

Proceedings Series, San Jose, CA, pp. 84-91, 2005.

194. H. Lei, and V. Govindaraju, "Similarity-driven sequence classification based on support vector machines and its application in adaptive on-line handwriting recognition", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 252-256, 2005.
195. S. Kompalli, S. Setlur, and V. Govindaraju, "Challenges in OCR of Devanagari documents", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 327-331, 2005.
196. L. Lorigo, and V. Govindaraju, "Segmentation and pre-recognition of Arabic handwriting", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 605-609, 2005.
197. S. Kang, and V. Govindaraju, "A new feature ranking method in a HMM-Based handwriting recognition system", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 779-783, 2005.
198. Z. Shi, S. Setlur, and V. Govindaraju, "Text extraction from gray scale historical document images using adaptive local connectivity map", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 794-798, 2005.
199. A. Rusu, and V. Govindaraju, "A human interactive proof algorithm using handwriting recognition", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 967-971, 2005.
200. Z. Shi, and V. Govindaraju, "Multi-scale techniques for document page segmentation", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 1020-1024, 2005.
201. R. Milewski, S. Setlur, and V. Govindaraju, "A lexicon reduction strategy in the context of handwritten medical forms", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 1146-1150, 2005.
202. S. Tulyakov, and V. Govindaraju, "Combining matching scores in identification model", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 1151-1155, 2005.
203. F. Farooq and V. Govindaraju, and M. Perrone, "Pre-processing methods for handwritten Arabic documents", Proceedings of the 8th IAPR International Conference on Document Analysis and Recognition, Seoul, S. Korea, pp. 267-271, 2005.
204. V. Govindaraju, "Emergency medicine, disease surveillance, and informatics", Proceedings of the ACM 6th National Conference on Digital Government Research, Atlanta, GA, pp. 167-168, 2005.
205. V. Govindaraju, "Advances in fingerprint recognition at CUBS", Proceedings of the International Workshop on Document Analysis, Kolkata, India, pp. 149-174, 2005. (Invited).
206. P. Mansukhani and V. Govindaraju, "Exploring similarity measures for biometric databases", International Conference on Audio and Video Based Biometric Person Authentication, Tarrytown, NY, pp. 832-840, 2005.
207. K. Sridharan, S. Nayak, S. Chikkerur and V. Govindaraju, "A probabilistic approach to semantic face retrieval system", International Conference on Audio and Video Based Biometric Person Authentication, Tarrytown, NY, pp. 977-986, 2005.
208. A. Mhatre, S. Chikkerur, and V. Govindaraju, "Indexing biometric databases using pyramid technique", International Conference on Audio and Video Based Biometric Person Authentication, Tarrytown, NY, pp. 841-849, 2005.
209. A. Mhatre, S. Palla, S. Chikkerur, and V. Govindaraju, "Efficient search and retrieval in biometric databases", SPIE Conference on Defense and Security, Orlando, FL, pp. 265-273, 2005.

2004

210. J. Pei, F. Farooq, S. Upadhyaya, and V. Govindaraju, "Data mining for intrusion detection: Techniques, applications, and systems", 20th International Conference on Data Engineering, Boston, MA, 2004.
211. Z. Shi and V. Govindaraju, "Dynamic local connectivity and its application to page segmentation", ACM Hardcopy Document Processing Workshop Washington, D.C., pp. 47-51, 2004.
212. S. Palla, H. Lei, and V. Govindaraju, "Signature and lexicon pruning techniques", 9th IAPR International Workshop on Frontiers of Handwriting Recognition, Tokyo, Japan, pp. 474-478, 2004.
213. A. Rusu and V. Govindaraju, "Handwritten CAPTCHA: using the difference in the abilities of humans and machines in reading handwritten words", 9th IAPR International Workshop on Frontiers of Handwriting Recognition, Tokyo, Japan, pp. 226-231, 2004.
214. H. Lei, S. Palla, and V. Govindaraju, "ER^2: An intuitive similarity measure for on-line signature verification", 9th IAPR International Workshop on Frontiers of Handwriting Recognition, Tokyo, Japan, pp. 191- 195, 2004.
215. H. Baird, V. Govindaraju, and D. Lopresti, "Document analysis systems architectures for digital libraries: Challenges and opportunities", IAPR Workshop on Document Analysis Systems, Florence, Italy, pp. 1-16, 2004.
216. S. Kompalli, R. Setlur, and V. Govindaraju, "Architectures for Devanagari digital libraries" IAPR Workshop on Document Analysis Systems, Florence, Italy, pp. 28-37, 2004.
217. H. Lei and V. Govindaraju, "Direct image matching by dynamic warping", 1st IEEE Workshop on Face Processing in Video, Washington, D.C., 2004.
218. H. Lei and V. Govindaraju, "A comparative study on the consistency of features in on-line signature verification", Joint IAPR International Workshops on Syntactical and Structural Pattern Recognition and Statistical Pattern Recognition, Portugal, Lisbon, pp. 444-449, 2004.
219. V. Govindaraju and H. Xue, "Fast handwriting recognition for indexing historical documents", 1st Workshop on Document Image Analysis and Libraries, Palo Alto, CA, pp. 314-320, 2004.
220. Z. Shi and V. Govindaraju, "Line separation for complex document images using fuzzy runlength", 1st Workshop on Document Image Analysis and Libraries, Palo Alto, CA, pp. 306-313, 2004.
221. B. Zhang, C. Tomai, S. Srihari, and V. Govindaraju, "Construction of handwritten databases using transcript-based mapping", 1st International Workshop on Document Image Analysis and Libraries, Palo Alto, CA, pp. 288-298, 2004.
222. V. Govindaraju, S. Kompalli, F. Farooq, S. Khedekar, V. Ramanaprasad, and S. Setlur, "Tools for enabling digital access to multi-lingual indic documents", 1st Workshop on Document Image Analysis for Libraries, Palo Alto, CA, pp. 122-133, 2004.
223. Z. Shi, S. Setlur, and V. Govindaraju, "Digital enhancement of palm leaf manuscript images using normalization techniques", 5th International Conference on Knowledge Based Computer Systems, Hyderabad, India, pp. 69-78, 2004.
224. A. Rusu and V. Govindaraju, "Handwriting word recognition: A new CAPTCHA challenge", 5th International Conference on Knowledge Based Computer Systems, Hyderabad, India, pp. 357-367, 2004.
225. S. Chikkerur, S. Pankanthini, N. Ratha, R. Bolle, and V. Govindaraju, "Novel approaches for minutiae verification in fingerprint images", Indian Conference on Computer Vision and Image Processing, 2004.
226. H. Lei and V. Govindaraju, "Matching and retrieving sequential patterns under regression", IEEE/WIC/ACM International Joint Conference on Web Intelligence, Beijing, China, pp. 84-90, 2004.
227. H. Lei and V. Govindaraju, "Regression time warping for similarity measure of sequence", International Conference on Computer and Information Technology, Wuhan, China, pp. 826-830,

2004.

228. Z. Shi and V. Govindaraju, “Historical document image enhancement using background light intensity normalization”, 17th IAPR International Conference on Pattern Recognition, Cambridge, UK, pp. 473- 476, 2004.
229. H. Lei and V. Govindaraju, “GRM: A new model for clustering linear sequences”, SIAM Conference on Data Mining, Orlando, FL, pp. 23-32, 2004.
230. S. Chikkerur, C. Wu, and V. Govindaraju, “A systematic approach for feature extraction in fingerprint images”, 1st International Conference on Biometric Authentication, Hong Kong, China, pp. 344-350, 2004.
231. A. Teredesai and V. Govindaraju, “Issues in evolving GP based classifiers for a pattern recognition task”, IEEE Congress on Evolutionary Computation, pp. 509-515, Portland, OR, 2004.
232. C. Wu, Z. Shi, and V. Govindaraju, “Fingerprint image enhancement method using directional median filters”, SPIE Symposium on Biometric Technology for Human Identification, Orlando, FL, 2004.
233. T. Jea, V. Chavan, and V. Govindaraju, “Security and matching of partial fingerprint recognition systems”, SPIE Symposium on Biometric Technology for Human Identification, Orlando, FL, pp. 39-50, 2004.
234. R. Milewski and V. Govindaraju, “Automatic reading and mining of pre-hospital care reports”, 17th IEEE Symposium on Computer-Based Medical Systems, Bethesda, MD, pp. 428-433, 2004.
235. V. Chavan, S. Chikkerur, S. Tulyakov, and V. Govindaraju, “Securing pervasive networks using biometrics”, 1st NSF / NSA/ AFR Workshop on Secure Knowledge Management, Buffalo, NY, 2004.
236. S. Chikkerur, V. Chavan, and V. Govindaraju, “A study on the convergence of biometrics and cryptographic security”, 1st NSF / NSA/ AFR Workshop on Secure Knowledge Management, Buffalo, NY, 2004.
237. S. Palla, S. Chikkerur, and V. Govindaraju, “Classification and indexing in large biometric databases”, Biometrics Consortium Conference, Crystal City, VA, 2004.
238. S. Tulyakov, V. Chavan and V. Govindaraju, “Symmetric hash functions for fingerprint minutiae”, Biometrics Consortium Conference, Crystal City, VA, 2004.

2003

239. V. Govindaraju, Z. Shi, and J. Schneider, “Feature extraction using chaincoded contour representation of fingerprint images”, International Conference on Audio and Video Based Biometric Person Authentication, Surrey, UK, pp. 268-275, 2003.
240. J. Schneider, C. Richardson, F. Kiefer, L. Pratt, and V. Govindaraju, “On the correlation of image size to system accuracy in automatic fingerprint identification systems”, International Conference on Audio and Video Based Biometric Person Authentication, Surrey, UK, pp. 895-902, 2003.
241. Z. Shi and V. Govindaraju, “Skew detection for complex document images using fuzzy runlength”, IEEE International Conference on Document Analysis and Recognition, Edinburgh, UK, pp. 715-719, 2003.
242. S. Tulyakov and V. Govindaraju, “Postal address block location by contour clustering”, IEEE International Conference on Document Analysis and Recognition, Edinburgh, UK, pp. 421-432, 2003.
243. S. Khedekar, V. Ramanaprasad, S. Setlur, and V. Govindaraju, “Text - image separation in Devanagari documents”, 7th IAPR International Conference on Document Analysis and Recognition, Edinburgh, UK, pp. 1265-1269, 2003.
244. S. Setlur, V. Ramanaprasad, S. Kompalli, and V. Govindaraju, “A multi-lingual truthing platform for South Asian languages”, 7th IAPR International Conference on Data Engineering - Multilingual Information Management, Hyderabad, India, 2003.

245. S. Kompalli, S. Setlur, V. Govindaraju, and V. Ramanaprasad, “Creation of data resources and evaluation tool for multi-lingual OCR”, Symposium on Document Image Understanding Technology, MD, pp. 189-196, 2003.

2002

246. H. Xue and V. Govindaraju, “A stochastic model combining discrete symbols and continuous attributes and its application to handwriting recognition" 5th IAPR Workshop on Document Analysis Systems, Princeton, NJ, pp. 70-81, 2002.
247. H. Xue and V. Govindaraju, “Incorporating contextual character geometry in word recognition”, 8th International Workshop on Frontiers of Handwriting Recognition, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 123-127, 2002.
248. G. Leedham, S. Varma, A. Patankar, and V. Govindaraju, “Separating text and background in degraded document images - A comparison of global thresholding techniques for multi-stage thresholding”, 8th International Workshop on Frontiers of Handwriting Recognition, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 244-249, 2002.
249. R. Milewski and V. Govindaraju, “Medical word recognition using a computational semantic lexicon”, 8th International Workshop on Frontiers of Handwriting Recognition, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 401-406, 2002.
250. C. Tomai, B. Zhang, and V. Govindaraju, “Transcript mapping for historic handwritten document images”, 8th International Workshop on Frontiers of Handwriting Recognition, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 413-418, 2002.
251. A. Teredesai and V. Govindaraju, “On-line digit recognition using off-line features”, Indian Conference on Computer Vision, Graphics, and Image Processing, Ahmedabad, India, 2002.
252. A. Teredesai and V. Govindaraju, “Recurrent genetic programming”, IEEE International Conference on Systems, Man, and Cybernetics, IEEE Computer Society Press, Hammamet, Tunisia, 2002.
253. H. Xue and V. Govindaraju, “On the dependence of handwritten word recognizers on lexicons” 16th IAPR International Conference on Pattern Recognition, Quebec City, Canada, pp. 1553-1564, 2002.

2001

254. V. Govindaraju, “Automatic reading and mining of pre-hospital care reports”, 14th IEEE Symposium on Computer-Based Medical Systems, Bethesda, MD, pp. 152-157, 2001.
255. V. Govindaraju, Z. Shi, and A. Teredesai, “Secondary classification using key features”, SPIE Symposium on Document Recognition and Retrieval, Internet Imaging, SPIE Proceedings Series, San Jose, CA, pp. 272-278, 2001.
256. S. Setlur, V. Govindaraju, S. Srihari, and A. Lawson, “Large scale address recognition systems trothing, testing, tools and other evaluation issues”, Symposium on Document Image Understanding Technology, College Park, MD, 2001.
257. H. Xue and V. Govindaraju, “Building skeletal graphs for structural feature extraction on handwriting images”, 6th IAPR International Conference on Document Analysis and Recognition, Seattle, WA, pp. 96-105, 2001.
258. S. Tulyakov and V. Govindaraju, “Probabilistic models for segmentation based word recognizers with lexicon”, 6th IAPR International Conference on Document Analysis and Recognition, Seattle, WA, pp. 164-167, 2001.
259. A. Teredesai, and V. Govindaraju, “Active digit classifiers: A separability optimization approach to emulate cognition”, 6th IAPR International Conference on Document Analysis and Recognition, Seattle, WA, pp. 401-405, 2001.
260. S. Setlur, A. Lawson, V. Govindaraju, and S. Srihari, “A truthing and evaluation system for measuring address recognition performance”, 6th IAPR International Conference on Document Analysis and

Recognition, Seattle, WA, pp. 1205-1214, 2001.

261. A. Teredesai, J. Park, and V. Govindaraju, "Active handwritten character recognition using genetic programming", 4th European Conference, EuroGP, Lake Como, Italy, pp. 371-379, 2001.
262. W. Yang, V. Govindaraju, and S. Srihari, "Discovering redundant address components for automatic address interpretation", International Conference on Artificial Intelligence, Las Vegas, NV, pp. 308-312, 2001.
263. Y. Wu, K. Ianakiev and V. Govindaraju, "Improving K-NN classification", International Conference on Advances in Pattern Recognition, Rio De Janerio, Brazil, pp. 222-229, 2001. (Invited paper).

2000

264. Y. Wu, K. Ianakiev, and V. Govindaraju, "Confidence combination methods in multi-expert systems", IAPR International Workshop on Structural and Syntactic Pattern Recognition, , Alicante, Spain, pp. 641-649, 2000.
265. K. Ianakiev and V. Govindaraju, "Improvement of recognition accuracy using 2-stage classification", 7th International Workshop on Frontiers of Handwriting Recognition, Amsterdam, The Netherlands, pp. 153-165, 2000.
266. J. Park and V. Govindaraju, "Active handwritten word recognition", 7th International Workshop on Frontiers of Handwriting Recognition, Amsterdam, The Netherlands, pp. 403-412, 2000.
267. H. Xue and V. Govindaraju, "Character recognition by matching sequences of pseudo-stroke positions and directions", 7th International Workshop on Frontiers of Handwriting Recognition, Amsterdam, The Netherlands, pp. 589-594, 2000.
268. K. Ianakiev and V. Govindaraju, "Architecture for classifier combination using entropy measures", 3rd IAPR International Workshop on Multiple Classifier Systems, Cagliari, Italy, pp. 340-350, 2000.
269. P. Slavik, H. Xue, and V. Govindaraju, "Use of lexicon density in evaluating word recognizers", 3rd IAPR International Workshop on Multiple Classifier Systems, Cagliari, Italy, pp. 310-319, 2000.
270. S. Madhvanath and V. Govindaraju, "Score aggregation from multiple sources and training in the context of lexicon reduction using holistic features", 2nd Indian Conference on Computer Vision, Graphics, and Image Processing, Allied Publishers Limited, Bangalore, India, pp. 180- 187, 2000.
271. J. Park and V. Govindaraju, "Active character recognition using "A*-like" algorithm", 6th IEEE International Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, Hilton Head, S.C., pp. 82-87, 2000.
272. J. Park and V. Govindaraju, "Using lexical similarity in handwritten word recognition", 6th IEEE International Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, Hilton Head, S.C., pp. 290-295, 2000.

1999

273. S. Setlur and V. Govindaraju, "Translingual OCR by template correlations", 7th SPIE Symposium on Document Recognition and Retrieval, SPIE Proceedings Series, San Jose, CA, 1999.
274. D. Bouchaffra, V. Govindaraju, and S. Srihari, "Recognition of strings using non-stationary Markovian Models: An application in ZIP Code recognition", 5th IEEE Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, Fort Collins, CO, pp. 174-179, 1999.
275. V. Govindaraju, S. Srihari, and Y.C. Shin, "Use of handwriting recognition features in handwriting identification", International Graphonomics Society Conference, Singapore, pp. 73- 78, 1999.
276. K. Ianakiev and V. Govindaraju, "Fuzzy control structures in multiple parameter systems: An application in a handwritten address interpretation systems", 18th International Conference of the North American Fuzzy Information Processing Society, IEEE Computer Society Press, Manhattan, NY, pp. 918-922, 1999.
277. X. Wang, V. Govindaraju, and S. Srihari, "Multi-experts for touching digit string recognition", 5th

IAPR Conference on Document Analysis and Recognition, IEEE Computer Society Press, Bangalore, India, pp. 800-803, 1999.

278. J. Park, V. Govindaraju, and S. Srihari, "Efficient word segmentation driven by unconstrained handwritten phrase recognition", 5th IAPR Conference on Document Analysis and Recognition, IEEE Computer Society Press, Bangalore, India, pp. 605-608, 1999.
279. S. Srihari, W. Yang, and V. Govindaraju, "Information theoretic analysis of postal address fields for automatic address interpretation", 5th IAPR Conference on Document Analysis and Recognition, IEEE Computer Society Press, Bangalore, India, pp. 309-312, 1999.
280. S. Srihari, W. Yang, and V. Govindaraju, "Address interpretation", 5th International Conference on Mail Technology in Tomorrow's World, Stakis Brighton Metropole, Brighton, UK, 1999.
281. S. Srihari, W. Yang, and V. Govindaraju, "Graph-theoretic modeling and entropy analysis of postal address fields", HKK Conference and Symposium, Waterloo, ON, 1999.

1998

282. S. Madhvanath and V. Govindaraju, "Perceptual features for off-line handwritten word recognition: A framework for heuristic prediction, matching and representation", IAPR Workshop on Syntactic and Statistical Pattern Recognition, Sydney, Australia, pp. 524-531, 1998.
283. G. Kim, V. Govindaraju, and S. Srihari, "Architecture for handwritten text recognition systems", 6th International Workshop on Frontiers of Handwriting Recognition, Taejon, S. Korea, pp. 113-122, 1998.
284. X. Wang, V. Govindaraju, and S. Srihari, "Holistic recognition of handwritten character pairs", 6th International Workshop on Handwriting Recognition, Taejon, S. Korea, pp. 295-303, 1998.
285. D. Bouchaffra, V. Govindaraju, and S. Srihari, "A methodology for deriving probabilistic correctness measures from recognizers", 4th IEEE Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, Santa Barbara, CA, pp. 930-935, 1998.
286. D. Bartnik, V. Govindaraju, S. Srihari, and B. Phan, "Reply card mail processing", 12th International Conference on Pattern Recognition, IEEE Computer Society Press, Brisbane, Australia, pp. 633-636, 1998.
287. J. Park, V. Govindaraju, and S. Srihari, "OCR in hierarchical feature space", IEEE International Conference on Systems, Man, and Cybernetics, IEEE Computer Society Press, San Diego, pp. 324-329, 1998. (Invited paper).
288. V. Govindaraju, K. Ianakiev, and S. Srihari, "Improving classifier accuracy by simulating fuzzy boundaries between classes", North American Fuzzy Logic and Image Processing Conference, Pensacola, FL, pp. 161-164, 1998. (Invited paper).
289. S. Srihari, W. Yang, V. Govindaraju, X. Wang, and X. Song, "Information content in united states postal address fields", International Conference on Combinatorics, Statistics, Pattern Recognition, and Related Areas, Mysore, India, pp. 71-72, 1998.

1997

290. V. Govindaraju and M. Rajapakse, "Precise location of human faces in cluttered photographs", IEEE International Conference on Systems, Man and Cybernetics, IEEE Computer Society Press, Orlando, FL, pp. 28-33, October 1997. (Invited paper).
291. V. Govindaraju, G. Kim, and S. Srihari, "Paradigms in handwriting recognition", IEEE International Conference on Systems, Man and Cybernetics, IEEE Computer Society Press, Orlando, FL, pp. 1498-1503, 1997. (Invited paper).
292. S. Madhvanath, E. Kleinberg, and V. Govindaraju, "The HOVER system for rapid holistic verification of off-line handwritten phrases", 4th IAPR International Conference of Document Analysis and Recognition, IEEE Computer Society Press, Ulm, Germany, pp. 855-859, 1997.

293. S. Madhvanath and V. Govindaraju, “Contour-based image preprocessing for holistic handwritten word recognition”, 4th International Conference of Document Analysis and Recognition, IEEE Computer Society Press, Ulm, Germany, pp. 536-539, 1997.

1996

294. G. Kim, V. Govindaraju and S. N. Srihari, “A segmentation and recognition approach of handwritten phrases as applied to street name images”, 2nd IEEE Conference on Pattern Recognition, IEEE Computer Society Press, Vienna, Austria, pp. 510-513, 1996.
295. G. Kim and V. Govindaraju, “Recognition of handwritten phrases as applied to street name images”, 2nd IEEE Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, San Francisco, CA, pp. 459-464, 1996.
296. G. Kim, V. Govindaraju, and S. Srihari, “Handwritten word recognition using dynamic matching with variable duration”, IEEE Conference on Acoustics, Speech, and Signal Processing, IEEE Signal Processing Society Press, Atlanta, GA, pp. 454-457, 1996.
297. J. Favata, V. Govindaraju, and S. Srihari, “Off-line handwritten sentence recognition” 5th International Workshop on Frontiers in Handwriting Recognition, Essex, UK, pp. 171-176, 1996.
298. G. Sheikholeslami, V. Govindaraju, and S. Srihari, “Computer aided graphology”, 5th International Workshop on Frontiers in Handwriting Recognition, Essex, UK, pp. 457-460, 1996.
299. G. Kim, V. Govindaraju, and S. Srihari, “Extension of handwritten word recognition to street name recognition”, 5th International Workshop on Frontiers in Handwriting Recognition, pp. Essex, UK, 221-226, 1996.
300. Z. Shi and V. Govindaraju, “Segmentation and recognition of connected handwritten numeral strings”, 5th International Workshop on Frontiers in Handwriting Recognition, Essex, UK, pp. 305-308, 1996.
301. G. Kim and V. Govindaraju, “Efficient chain code based image manipulation for handwritten word recognition”, SPIE Symposium on Document Recognition and Retrieval, SPIE Proceedings Series, San Jose, CA, pp. 262-272, 1996.
302. S. Madhvanath and V. Govindaraju, “Holistic lexicon reduction for handwritten word recognition”, SPIE Symposium on Document Recognition and Retrieval, SPIE Proceedings Series, San Jose, CA, pp. 224-234, 1996.

1995

303. M. Venkatraman and V. Govindaraju, “Zero crossings of a non-orthogonal wavelet transform for object location”, IEEE Conference on Image Processing, IEEE Signal Processing Society Press, Washington, D.C., Vol. 3, pp. 57-60, 1995.
304. V. Govindaraju and S. Srihari, “Image quality and human readability”, IEEE Conference on Image Processing, IEEE Signal Processing Society Press, Washington, D.C., Vol. 3, pp. 324-327, 1995.
305. G. Kim and V. Govindaraju, “Handwritten word recognition for real-time applications”, International Conference on Document Analysis and Recognition, IEEE Computer Society Press, Montreal, Canada, pp. 24-27, 1995.
306. S. Madhvanath, V. Govindaraju, V. Ramanaprasad, D. Lee, and S. Srihari, “Reading handwritten US census forms”, International Conference on Document Analysis and Recognition, IEEE Computer Society Press, Montreal, Canada, pp. 82-85, 1995.
307. S. Madhvanath and V. Govindaraju, “Serial classifier combination for handwritten word recognition”, International Conference on Document Analysis and Recognition, IEEE Computer Society Press, Montreal, Canada, pp. 911-914, 1995.
308. V. Govindaraju and S. Srihari, “System for reading handwritten documents”, IEEE International Conference on Systems, Man and Cybernetics, IEEE Computer Society Press, Vancouver, BC, pp.

347-352, 1995. (Invited paper).

309. J. Favata, V. Govindaraju, and S. Srihari, “Unconstrained handwritten text recognition”, Symposium on Document Image Understanding Technology, Bowie, MD, pp. 226-236, 1995.

1994

310. V. Govindaraju, R. Srihari, and S. Srihari, “Handwritten text recognition”, 4th International Workshop on Frontiers of Handwriting Recognition, Taipei, Taiwan, pp. 265-274, 1994.
311. R. Srihari, M. Venkatraman, R. Chopra, D. Burhans, and V. Govindaraju, “Use of collateral text in image interpretation”, ARPA Image Understanding Workshop, Monterey, CA, pp. 897-907, 1994.
312. V. Govindaraju, R. Srihari, and S. Srihari”, “Handwritten text recognition”, IAPR Workshop on Document Analysis Systems, Kaiserlautern, Germany, pp. 157-171, 1994.
313. S. Lam, V. Govindaraju, R. Srihari, J. Hull, and S. Srihari, “Intelligent data retrieval from raster images of documents”, The First Annual Conference on the Theory and Practice of Digital Libraries, College Station, TX, pp. 34-40, 1994.

1993

314. J. Zhou, V. Govindaraju, R. Acharya, and S. Srihari, “State name abbreviation recognition”, 3rd International Workshop on Frontiers in Handwriting Recognition, pp. 423-430, Buffalo, NY, 1993.
315. S. Madhvanath and V. Govindaraju, “Holistic word recognition”, 3rd International Workshop on Frontiers in Handwriting Recognition, Buffalo, NY, pp. 71-81, 1993.
316. V. Govindaraju, A. Shekhawat, and S. Srihari, “Interpretation of handwritten addresses in US mail stream”, 2nd IAPR International Conference on Document Analysis and Recognition, IEEE Computer Society Press, , Tsukuba Science City, Japan, pp. 291-294, 1993.
317. V. Govindaraju, A. Shekhawat, and S. Srihari, “Interpretation of handwritten addresses in US mail stream”, 1st European Conference Dedicated to Postal Technologies, Nantes, France, pp. 421-428, 1993.

1992

318. V. Govindaraju, E. Cohen, A. Shekhawat, and S. Srihari, “Determining the delivery point Code on handwritten addresses”, 5th Advanced Technology USPS Conference, Washington D.C., pp. 321-336, 1992.
319. V. Govindaraju, D. Wang, and S. Srihari, “Holistic approach to handwritten word recognition using temporal information extracted from static images”, 5th Advanced Technology USPS Conference, Washington D.C., pp. 529-546, 1992.
320. S. Madhavanath, V. Govindaraju, and S. Srihari, “Using holistic features in handwritten word recognition”, 5th Advanced Technology USPS Conference, Washington D.C., pp. 183-198, 1992.
321. V. Govindaraju, D. Sher, and S. Srihari, “A computational model for face location based on cognitive principles”, 10th National Conference of the American Association of Artificial Intelligence, AAAI Press / The MIT Press, San Jose, CA, pp. 350-355, 1992.
322. V. Govindaraju, D. Sher, and S. Srihari, “Caption-aided face location in newspaper photographs”, IAPR International Conference on Pattern Recognition, IEEE Computer Society Press, The Hague, Netherlands, pp. 474-477, 1992.

1991

323. V. Govindaraju, S. Lam, D. Niyogi, D. Sher, R. Srihari, S. Srihari, and D. Wang, “Newspaper image understanding”, International Conference on Knowledge Based Systems, Narosa Publishing House, Bombay, India, pp. 375-386, 1991.
324. V. Govindaraju and S. Srihari, “Separating handwritten text from overlapping non-textual contours”, 2nd International Workshop on Frontiers in Handwriting Recognition, Chateau de Bonas,

France, pp. 229-240, 1991.

325. J. Hull, T. Ho, V. Govindaraju, J. Favata, and S. Srihari, "Combination of segmentation based and holistic handwritten word recognition algorithms", International Workshop on Frontiers in Handwriting Recognition, Chateau de Bonas, France, pp. 229-240, 1991.

1990

326. V. Govindaraju, D. Sher, and S. Srihari, "A computational model for face location", 3rd International Conference on Computer Vision", IEEE Computer Society Press, Osaka, Japan, pp. 718-721, 1990.

1989

327. V. Govindaraju, R. Srihari, D. Sher, and S. Srihari, "Locating human faces in newspaper photographs", IEEE Conference on Computer Vision and Pattern Recognition, IEEE Computer Society Press, San Diego, CA, pp. 278-281, 1989.

B. Technical Impact

- **Architected an early AI success story** by making postal address recognition and deployment of engineered systems (via Lockheed, 1997-2001) a reality, saving the postal services of US, UK, and Australia, hundreds of millions of dollars[1] [2].
  - Govindaraju's seminal work in handwriting recognition[3] was at the core of the first handwritten address interpretation system used by the U.S. Postal Service. It uses an innovative dynamic matching algorithm to assign automatically segmented pieces of words to lexical entities. This simple but powerful idea enabled real-time handwriting recognition by overcoming the challenge of dealing with large lexicons.
  - Govindaraju developed the approach of "active recognition" which is modeled along the lines of the A* algorithm. It provides a multi-resolution framework for adapting to factors such as the quality of the input pattern, its intrinsic similarities with patterns of other classes, and the processing time available. This provides the knobs to engineered real-time systems to tradeoff accuracy and speed in a cost-benefit framework, which enabled postal services to gradually trim down the need for human data entry operators and thereby increase efficiencies and grow savings.

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[1] The Government Executive publication reported in 1999 that "USPS issued a contract to researchers at the State University of New York at Buffalo to develop the handwriting recognition technology. It was first launched in 1997 right before the Christmas holiday season. One year later, an estimated 400 million pieces of mail were automatically routed during the Christmas season alone using the handwriting recognition technology. The new technology has saved the Postal Service at least $90 million in its first year in the field."

[2] Computing Community Consortium (http://www.cra.org/ccc/) refers to the seminal work:

- March 25, 2009: **Computing Research that Changed the World: Reflections and Perspectives**, "… Automated handwriting analysis seems easy but there are many ways to write each number or letter. **Using a learning-based system developed at UB by Venu Govindaraju and colleagues, 25 billion letters a year are processed automatically by the US postal service -bar-coded for precise delivery- saving hundreds of millions of dollars**..." (Presentation by Daphne Koller).
- June 7, 2016: AI for public good: "**An early success story in the 90s widely considered the winter of AI**" (Presentation by Eric Horvitz).

[3] US 5,515,455: "System for recognizing handwritten words of cursive script", V. Govindaraju; D. Wang; and S. Srihari, 1996.

- **Pioneered automation of (multilingual) handwritten documents processing** by (i) improving efficiencies of document work-flow in large organizations using innovative handwriting recognition solutions (Emergency Medical Response 2004, NYS Department of Health 2007, Medical Management Research Network 2009); (ii) developing script and language-independent techniques for data-driven re-targetable recognition systems (DARPA MADCAT 2009-2013); and (iii) development of digital archives and transcription tools (International Sanskrit Digital Library, 2008; Marian Moore Digital Archive, 2016).
    - Departing from the myriad heuristic approaches, he introduced a principled statistical approach by modeling the degraded document as a Markov Random Field where the prior is learned from a training set of high quality images, and the probabilistic density is estimated on-the-fly. This approach proved to be critical in dealing with poor quality scanned forms and faxed prescriptions, thus contributing to improved health care due to decreased human error in medical transcription.
    - Through his landmark paper on Arabic script recognition, the first comprehensive book on OCR of Indic Scripts, and other publications, he demonstrated novel recognition driven methodologies that steer away from prior approaches that primarily used sequential rules to segment characters and lines. This paved the way for successful deployment of the DARPA Multilingual Automated Document Classification, Analysis, and Translation (MADCAT) system for generating real-time actionable intelligence using multilingual recognition capabilities. A direct consequence of this effort is the empowerment of people working and collaborating across language barriers.

- **Major impact on the human language interface** to websites and hand-held devices, engaging with users on their terms (i.e., language), contributing to the ease of use and ubiquity of today's technologies.
    - Govindaraju developed a new stochastic framework that combined discrete symbols and continuous attributes and incorporated the theories of reading and perception developed in psychology literature in analyzing handwritten words. This led to the innovative spambot-fighting strategy using simulation of human-like handwriting for designing *captchas* to exploit the differential in handwriting reading proficiency between humans and machines.
    - Govindaraju proposed that, although handwriting is unique to writers, writer style represents a shared component of individual handwriting. He explicitly models this conceptualization via a three-level hierarchical Bayesian framework for the purposes of writer identification and verification. In this text-independent model, each writer's handwriting is modeled as a distribution over a limited set of writing styles that are shared amongst writers. Analogous to speech, accents in writing are treated as distinctive quirks unique to a group of people belonging to a common family of scripts, which have roots in cultural and genetic factors. This paved the way to personalization of handwriting stylus input as a viable alternative to keyboard and speech in mobile devices.

- **Key early consulting role in the world's largest biometric ID system, Aadhar** (over 1 billion enrolled participants in India) used extensively for the delivery of government services, empowering residents of India with a unique identity and digital platform to authenticate anytime, anywhere.
    - Govindaraju's highly innovative work in securing biometric templates using symmetric hash functions and convolving multiple biometric modalities where one biometric provides the

encrypting basis for another was proposed for integration to Aadhar. He has also shown theoretically, why random projections are an essential step in cancelable biometrics by defining the notion of an Independent Subspace Structure for datasets, and demonstrating that random projection preserves the subspace structure of data vectors generated from a union of independent linear subspaces.

- Govindaraju proved that the optimal combination (fusion) algorithm for identification systems is difficult to express analytically because of the difficulty presented by the dependencies between matching scores assigned to different classes by the same classifier. He developed the first taxonomy of the complexity of classification combination methodologies and a guideline for choosing a particular type of fusion technique. Thus, rival vendors reluctant to share the inner workings of individual classifiers are able to join forces on a common platform for improved performance.

❖ *Scholarship Impact*

- Research reported in prestigious technical media outlets
  - Scientific American- March'12
  - ACM Tech News- October'10, September'07, January'05
  - MIT Tech Review, January'09, October'09.

- **450 refereed publications**
- **13,500+ citations**
- **h-index: 58**

- 44 PhD students supervised as Major adviser
- 17 MS students supervised with thesis option
- Over 200 graduate students advised on various projects

❖ *Patents*

1. US 8,005,277: "Secure fingerprint matching by hashing localized information", S. Tulyakov; F. Farooq; S. Chikkerur; and V. Govindaraju, 2011.
2. US 7,689,006: "Biometric convolution using multiple biometrics", V. Govindaraju; V. Chavan; and S. Chikkerur, 2010.
3. US 7,580,551. "Method and apparatus for analyzing and/or comparing handwritten and/or biometric samples", S. Srihari; V. Govindaraju; et. al. 2009.
4. US 5,515,455: "System for recognizing handwritten words of cursive script", V. Govindaraju; D. Wang; and S. Srihari, 1996.

C. Grants & Research Projects Support

Total Funding: $68.2M

Projects	Government	PI : V. Govindaraju	Awards	Period
Center for Identification Technology Research (CITeR)	National Science Foundation (NSF)	Setlur, Nwogu	$400,000	2018-22
CITeR	Dept. of Homeland Security (DHS)	Setlur	$96,650	2019-20
Data Laboratory for Materials Engineering	NSF	Setlur, Rajan, Furlani	$2,909,772	2016-20
Janus - Face Recognition	Intelligence Advanced Project Activity (IARPA)	Setlur	$1,300,000	2014-18
Long term active authentication using multi- modal user profiles	NSF	Setlur, Upadhyaya, Inwogu,	$1,200,000	2013-16
Center for Identification Technology Research (CITeR)	NSF	Setlur, Nwogu	$300,000	2013-18
CITeR	DHS	Tulyakov	$207,476	2013-15
CITeR	National Security Agency (NSA)	Rudra	$80,000	2013-15
Planning I/UCRC Grant	NSF	Setlur	$12,997	2012
Privacy Preserving Biometric Templates & Efficient Indexing	NSF	Rudra	$514,788	2011-14
Identifying Accents in Handwritten Scripts	NSF		$150,000	2010-12
Transcript Mapping in Indic Scripts	NSF		$94,234	2008-10
Health Card Biometrics	NYSTAR: NY Science & Technology Advanced Research		$25,000	2008
Multilingual Document Classification	Defense Advanced Project Agency (DARPA)	Setlur	$3,277,393	2007-13
Person Specific Behavioral Dynamics	NSF	Frank	$852,649	2007-10
Sanskrit Digital Library	NSF		$202,888	2005-08
Advanced Biometrics	Dept. of Defense (DoD)	Moskal	$1,585,884	2005-07
Multimodal Biometric Systems	Army Research Labs (ARL)		$265,714	2004-06

Disease Surveillance Informatics	NSF	Setlur	$450,000	2004-08
Arabic Handwritten OCR	Directorate of Central Intelligence		$240,000	2004-06
Smart Card Biometrics	NYSTAR		$100,000	2004-05
Automation of Medical Forms	NSF		$50,000	2003-04
Cognitive Recog Models	NSF		$99,731	2002-03
Devanagari OCR	NSF		$487,319	2002-04
Total Federal/State Funding			**$14,902,495**	
CITeR	Zoloz	Setlur	$80,000	2017-19
Preparation of Data Sets	Lockheed	Setlur	$130,000	2014-15
Automated Package Processing System (APPS)	Lockheed	Setlur	$54,571	2013-14
CITeR	Qualcomm	Setlur	$270,000	2013-19
CITeR	Raytheon BBN	Setlur	$80,000	2013-15
CITeR	CUBRC	Setlur	$40,000	2013-14
ML in NLP	Digiliant		$30,000	2012-13
Scene Text OCR	eBay		$50,000	2012-13
Handwriting Datasets	Google		$50,000	2012-13
Soft Biometrics	CUBRC		$200,000	2011-12
Machine Learning	Fujitsu		$55,000	2011
Pen, Touch, and Hand Gestures	HP Labs	Corso	$150,000	2008-10
Processing Hand-Annotated Documents	HP Labs	Setlur	$185,000	2008-11
Smart Card Biometrics	Health Networks		$75,000	2008
GUI for DAQ	ACIS	Setlur	$40,000	2008
Barcodes project	Matrix	Setlur	$161,663	2008-10
Arabic OCR	Aplied Media Analysis		$150,000	2008-10
Document Classification	Copanion		$20,000	2007-08
Student Doctoral Fellowship	IBM		$55,314	2007-09
RCR Truthing	Lockheed	Setlur	$1,094,900	2007-14
Behavioral Dynamics	CUBRC		$31,000	2007
NY State Medical Forms	Buffalo Graphics		$60,000	2005-07
Information Retrieval for HW Documents	Google		$50,000	2005-06
Biometric Fusion	CUBRC		$25,000	2005
Friction Ridge Analysis	CUBRC		$25,000	2005-06
Face Recognition	CUBRC		$25,000	2005
Multimodal Biometrics	CUBRC		$25,000	2005

CAPTCHAS for Web Security	CUBRC		$25,000	2004-05
Smart Card Biometrics	U-Scan		$50,000	2004
Biometric Access Control System	International Graphics Inc.		$235,000	2003-04
Automatic Fingerprint Identification Systems	Ultra-Scan	Bartnik, Setlur	$1,246,333	2002-05
Medical Forms Reading	CUBRC		$25,000	2003-04
Forms Reading	CUBRC		$25,000	2003-04
Biometrics	CUBRC		$5,000	2003-04
HWAI Plus	Siemens	Srihari	$317,000	2002-03
Parcel Recognition	Siemens	Srihari	$90,000	2002
Student Support Fellowship	IBM		$21,000	2001-02
Canadian Postcode Interpretation	Siemens	Srihari	$50,000	2000-01
Handwritten Address Interpretation	Siemens	Srihari	$300,000	2000-01
Canadian Postcode Recognition	Systems House Ltd.	Srihari	$10,000	1994
Recognition of Hand Printed Forms	Readers Digest	Srihari	$10,000	1994
Document Analysis and Recognition	Xerox	Srihari	$70,000	1993-00
Total Industry Funding			**$5,691,781**	
Total Funding as PI			**$20,594,276**	
Non-Postal Funding as Co-PI				
Odor Typing for Disease Detection	Oishei Foundation	Bright, Cartwright	$400,000	2006-07
The LitGloss Project	National Endowments for Humanities (NEH)	Jameson	$196,938	2003-05
Unobtrusive Biometrics Systems	NYSTAR	Bright, Titus,	$153,360	2003-04
Handwritten Text Recognition	NSA	Chin,	$532,939	1994-96
Handwriting Individuality	National Institute of Justice (NIJ)	Shin, Srihari	$428,328	1999-00
Total Funding as Co-PI (Non- Postal)			**$1,711,565**	

Govindaraju Co-PI	Postal	PI		
IES Enhancements, Test Decks, Truthing	USPS	Setlur	$398,000	2015-16
Image Scoring Perf Eval APBS Program	USPS	Setlur	$31,697	2014-15
Flats RECO 2	USPS	Setlur	$40,081	2014-15
Prep of TD14 Test Deck for Comp Eval DQI Recognition Program	USPS	Setlur	$254,368	2014-15
Perf Eval for DQI Recognition Program	USPS	Setlur	$309,701	2014-15
Cancellation Mark Readability Support	USPS	Setlur	$26,974	2013-14
DQI TD13 Test Deck Creation Support	USPS	Setlur	$249,283	2013-14
Evaluation of Flat Mail Recognition Improvements	USPS	Setlur	$42,987	2013-14
Image Scoring and Evaluation Support (APPS)	USPS	Setlur	$77,897	2012-13
Test Deck Truthing, RCR Support	USPS	Setlur	$349,971	2012-13
Performance Evaluation DQI	USPS	Setlur	$1,170,215	2009-11
APBS Parcel Projects	USPS	Setlur	$96,373	2010-11
FRIP and FSS Recognition	USPS	Setlur	$354,000	2009-10
Comparative Evaluation DQI	USPS	Setlur	$46,051	2009-10
IES and Truthing	USPS	Setlur, Srihari	$401,511	2008-09
Flats Image Collection and Truthing	USPS	Setlur, Srihari	$810,664	2008-09
Image Evaluation	USPS	Setlur, Srihari	$273,116	2008
Flats Image Collection and Truthing	USPS	Setlur, Srihari	$1,950,533	2003-08
Digital Camera use in Barcode Imaging	USPS	Setlur, Srihari	$409,867	2003-07
Image Collection and Truthing	USPS	Setlur, Srihari	$4,368,541	2003-08
Alternate Keying Strategies	USPS	Srihari	$165,000	2004-05
Reply Card Scanning	USPS	Srihari	$210,000	2003-04
Personal Name Lookups	USPS	Setlur,	$166,000	2003
Comparison Study of Barcodes	USPS	Setlur,	$470,000	2003-05
UK Address Interpretation Project	Lockheed	Setlur, Srihari	$15,000	2003
Image Evaluation System-Flats	USPS	Setlur, Srihari	$340,000	2002-03
Micropayment Processing	USPS	Srihari	$1,204,000	2001-03
Mailpiece Library	USPS	Setlur,	$190,000	2002

Evaluation of ID Codes	USPS	Srihari	$133,000	2001
Return Merchandise System	USPS	Bartnik, Srihari	$300,000	2001-02
Image Evaluation System	USPS	Setlur,	$1,850,583	1999-03
Information Based Indicia	USPS	Srihari	$300,000	1999-01
UK Address Interpretation Project	Lockheed	Setlur, Srihari	$1,245,000	2000-02
RCR/HWAI	Lockheed	Srihari	$660,000	2000-01
Directory Generation	Lockheed	Setlur,	$44,235	2000-01
Image Truthing	USPS	Setlur,	$1,102,000	2000-02
Address Interpretation for UK	Lockheed	Setlur,	$1,224,367	2000
HWAI Control Strategy	Lockheed	Srihari	$129,190	1999-00
PROZE Character Recognition	Lockheed	Srihari	$128,395	1999-00
VRR Word Recognizer	Lockheed	Srihari	$42,590	1999-00
Foreign Address Processing	Lockheed	Setlur,	$101,417	1999-00
RCR/HWAI Improvements	Lockheed	Srihari	$503,480	1999-00
UKAI Parsing and Resolution	Lockheed	Setlur,	$152,442	1999-00
HWAI Australian, Release 4	Lockheed	Srihari	$240,000	1999-00
Truthing for RIP	USPS	Setlur,	$75,000	1999-00
Truthing and Analysis	USPS	Setlur,	$290,636	1999-00
New Image Evaluation System	USPS	Setlur,	$395,257	1999-00
Semi-automated Encoding	USPS	Setlur,	$185,261	1999-00
Sender Information Processing	USPS	Setlur, Srihari	$134,167	1999-00
Equipment Grant	USPS	Srihari	$46,200	1999-00
Travel Grant	USPS	Srihari	$34,103	1999-00
HWAI of Australia, Release 3	Lockheed	Srihari	$218,333	1999
Last Line, Foreign Processing	Lockheed	Srihari	$100,412	1999
Image Processing Functions	Lockheed	Srihari	$69,156	1999
Control Strategy	Lockheed	Srihari	$101,468	1999
Word Recognizer	Lockheed	Srihari	$46,541	1999
New Character Recognition	Lockheed	Srihari	$45,019	1999
HWAI of Australia, PIP -1	Lockheed	Srihari	$230,000	1999
HWAI of Australia, PIP	Lockheed	Srihari	$89,959	1999
Gray Scale Investigation	USPS	Srihari	$790,000	1998-00
Address Truthing Analysis	USPS	Srihari	$1,424,641	1998-00
HWAI Control Structures	Lockheed	Srihari	$79,200	1998-99
Database Enhancement	Lockheed	Srihari	$52,500	1998-99
New Parsing Technique	Lockheed	Srihari	$77,500	1998-99
New Word Recognition	Lockheed	Srihari	$132,000	1998-99
New Character Recognition	Lockheed	Srihari	$88,000	1998-99
RCR/HWAI Improvements	Lockheed	Srihari	$400,000	1998-99
Firm name Recognition	Lockheed	Srihari	$70,738	1998-99
RCR/ HWAI Improvements	Lockheed	Srihari	$568,538	1998-99
Port HWAI to NT	Lockheed	Srihari	$28,586	1998-99

HWAI Recognition Co-	USPS	Srihari	$650,000	1998
HWAI of Australia	Lockheed	Srihari	$1,144,418	1997-98
RCR/ HWAI Integration	Lockheed	Srihari	$1,500,000	1997-98
HWAI PC Integration	USPS	Srihari	$494,924	1997-98
HWAI/RCR Research	Lockheed	Srihari	$550,860	1997
HWAI/RCR	Lockheed	Srihari	$407,686	1997
Directory Compression	USPS	Srihari	$37,959	1997
Image Analysis	USPS	Srihari	$40,722	1997
Evolutionary Computing	USPS	Srihari	$57,410	1997
HWAI PC Porting	USPS	Srihari	$215,497	1997
HWAI/RCR Research	Lockheed	Srihari	$585,924	1996-97
HWAI/RCR Integration	Lockheed	Srihari	$596,474	1996-97
HWAI PC Integration, Task 1	USPS	Srihari	$255,076	1996-97
HWAI Integration Testing	USPS	Srihari	$99,750	1996-97
Improvements in HWAI	USPS	Srihari	$2,510,680	1993-96
Reply Card Processing - Phase III	USPS	Srihari	$1,388,534	1995-96
Reply Card Processing PIMS	USPS	Srihari	$1,435,416	1993-95
Interactive Service Research	USPS	Srihari	$1,299,519	1993-96
Supplemental Activities	USPS	Srihari	$750,000	1991-95
HWAI Research	USPS	Srihari	$3,256,837	1991-94
Total Postal Funding Co-PI			**$45,909,105**	
TOTAL FUNDING (PI /Co-PI)			**$68,214,946**	
Postal funding at CUBS	USPS	Setlur	$1.471,794	2016-19

D. Mentorship

Post Doctoral Fellows (5)

2017-20	K. Davila (RIT PhD)	• Equations OCR and Understanding
2017-18	R. Subramanian (UB PhD)	• Materials Discovery and Machine Learning
2015-16	Y. Zhou (UB PhD)	• Deep Learning
2006-07	S. Tulyakov (UB PhD)	• Fusion of Classifiers
2004-06	L. Lorigo (MIT PhD)	• Arabic Handwriting Recognition

Major Adviser of Doctoral Students (44)

2021	Kyung Wong Lee	• Wardrobe model in biometric identification
2021	Deen Dayal. Mohan	• Deep learning applications in infographics
2021	Nagamani Lakshmi	• Facial expression analysis
2020	Nishant Shankaran	• Fusion of classifier templates
2020	Bhargav Urala	• Scene text OCR
2019	Neeti Pokhriyal *Dartmouth College, NH*	• Multiview learning via Gaussian processes with applications in biometrics and sustainability
2018	Neeti Narayanan *Yahoo Research, CA*	• Re-identification for online person tracking using spatio-temporal discrimination
2017	Rathin Radhakrishnan *Qualcomm, NY*	• An adaptive framework for metadata extraction and analysis from documents
2016	Rohit Pandey *Google, CA*	• Learning privacy preserving representations using deep neural networks
2016	Devansh Arpit *SalesForce, CA*	• Methodologies for learning data manifolds and robust feature representation
2015	Shounak Gore *Qualcomm, NY*	• Social networks analysis using game theory
2015	Yingbo Zhou *SalesForce, CA*	• Towards a globally optimal approach for learning deep unsupervised models
2015	Aarti Shivram *CUBRC, NY*	• Dynamic hierarchical relational models for handwriting recognition on mobile devices
2015	Gaurav Kumar *[24]7, CA*	• Bayesian approaches for word spotting
2014	Chetan Ramaiah *MetroMile, CA*	• Accents in handwriting: A hierarchical Bayesian approach to handwriting analysis

2014	Utkarsh Porwal *JLL, CA*	• A semi-supervised framework for handwriting analysis
2013	Manavender Malgireddy *Amazon, WA*	• Language motivated approaches for human action recognition and spotting
2012	Xi Cheng *Google, CA*	• A novel multi-sample fusion methodology for improving biometric verification
2012	Safwan Wshah *Univ. of Vermont, VT*	• Word spotting in multilingual handwritten documents using character recognition HMM models
2011	Ricardo Rodriguez *Universidade Federal do Rio Grande, Brazil*	• Transfer Learning for probability density estimation
2011	D. You *Univ. of Michiga, MI*	• Methods for content extraction towards improved biomedical multimodal retrieval
2010	Xijun Peng *ISI, Univ. of Southern California, CA*	• Probabilistic Random Field based text identification
2010	Anurag Bhardwaj *Apple, CA*	• Statistical techniques for efficient indexing and retrieval of document images
2010	Achint O. Thomas *Embibe Inc., India*	• Enhancing cyber security through synthetic handwritten CAPTCHAs
2009	Jiang Li *Quincy University, IL*	• Integrating minutiae based fingerprint matching with local correlation methods
2009	Ifeoma Nwogu *Rochester Institute of Technology, NY*	• Statistical modeling and inferencing techniques for medical image segmentation
2008	Zhi Zhang *J. P. Morgan Chase, NY*	• Integrating facial expressions and skin texture in face recognition
2008	Huaigu Cao *ISI, Univ. of Southern California, CA*	• Enhancement and retrieval of low quality handwritten documents
2008	Faisal Farooq *IBM Watson Research, NY*	• Use of language models and automatic topic categorization for indexing and retrieval of handwritten document images
2008	Praveer Mansukhani *Machinomatic Engineers, India*	• A framework for efficient fingerprint identification using a minutiae tree
2008	Roman Yampolisky *Univ. of Louisville, KY*	• Intrusion detection using spatial information and behavioral biometrics
2008	Amalia Rusu *Fairfield University, CT*	• Exploiting gap between human and machine in handwriting recognition
2007	Chaohong Wu *KLA-Tencor, CA*	• Framework for fingerprint enhancement and feature detection
2007	Suryaprakash Kompalli *INSOFE, India*	• Stochastic framework for font-independent Devanagari OCR
2007	Robert Milewski *@Hidden, Japan*	• Automatic search engines for handwritten medical forms
2006	Sergey Tulyakov Univ. at Buffalo, NY	• A complexity framework for combining classifiers in biometric systems

2005	Tsai Yang Jea Bloomberg, NY	• Minutiae-based partial fingerprint recognition
2005	Hansheng Lei *Univ of Te.xas, Rio Grande Valley, TX*	• Sequential pattern classification without explicit feature extraction
2003	Ankur Teredesai *Univ. of Washington, Tacoma, WA*	• Use of genetic programming for advanced pattern recognition
2002	Hanhong Xue *Google, NY*	• Stochastic models for handwritten word recognition
2000	Ianiev Krassimir *Fair Isaac, Inc.*	• Organizing multiple experts for efficient pattern recognition
2000	Jaehwa Park (*Co-advised*) *Chung-Ang University, S. Korea*	• Hierarchical character recognition in handwritten phrase recognition
1997	Sriganesh Madhvanath (*Co-advised*) eBay, NY	• The holistic paradigm in handwritten word recognition and its applications
1996	Gyeonghwan Kim (*Co-advised*) *Sogang University, S. Korea*	• Handwritten word recognition for real-time applications

Major Adviser of graduated Masters students (17) with thesis option

2013	Nisha Bhaskaran *Time Inc., CA*	• Facial Expressions and Deception
2009	Omar Mukhtar *Amazon, WA*	• Language Modeling
2009	Bhaskar Purkayastha *Hughes Systems, MD*	• Gesture Recognition
2008	Daemien Jose *Microsoft, WA*	• Transcript Mapping
2006	Kartik Sridharan *Cornell University, NY*	• Sematic Face Recognition
2006	Sankalp Nayak *Morgan Stanley, NY*	• Devanagari OCR
2006	Shamalee Deshpande *Veritas Technologies, CA*	• Accent in Speech
2005	Amit Mahtre *Amazon, WA*	• Hand Geometry Biometrics
2005	Sharat Chikkerur *Microsoft, MA*	• Fingerprint Verification
2004	Pawan Rudravaram *Qualcom, CA*	• Palmprint Recognition
2004	Sumeet Manocha *Patni Computers, India*	• Security of Biometrics Systems
2004	Viraj Chavan *Nividea, CA*	• Biometrics and Barcode Representation

2004	Srinivas Palla *Amazon, CA*	• Multimodal Biometrics
2003	Swapnil Khadekar *Bloomberg, NY*	• Devanagari OCR
2000	David Bartnik *Qualcom, NY*	• Video Surveillance
2000	Gaurav Pal *BMC Software India*	• Music Index on the Web
2000	F. Zhou *Panasonic, NJ*	• Thinning Algorithms

2000-14 **McNair Scholars program (post baccalaureate)**

HON 101: Presidential Scholars Development Seminar (undergraduates)		
11/3/2016	Experiential Learning Activities	16 students
11/5/2015	Experiential Learning Activities	19 students

- 18 academic institution placements including tenure track faculty positions in Cornell University and University of Washington.
- 4 placements in top university research labs: Dartmouth, USC, UB, and University of Michigan.
- 2 MS students went to graduate with doctorate from MIT and University of Chicago.
- Students placed in USA, Brazil, India, Japan, China, and S. Korea.

E. Teaching

Undergraduate Lower Division		Class size
Fall 94	Introduction to Programming	90
Spring 95	Introduction to Programming	90
Undergraduate Upper Division		
Summer 89	Introduction to Artificial Intelligence	30
Fall 96	Computer Architecture and Organization	98
Spring 97	Algorithms and Data Structures	40
Spring 98	Computer Architecture and Organization	100
Fall 98	Computer Architecture and Organization	94
Spring 99	Computer Architecture and Organization	67
Graduate core classes		
Spring 00	Operating Systems	59
Fall 00	Operating Systems	76
Advanced graduate classes		
Fall 00	Topics in Artificial Intelligence	8
Fall 03	Document Analysis and Recognition	6
Spring 03	Topics in Artificial Intelligence	13
Spring 04	Topics in Artificial Intelligence	13
Fall 04	Image Analysis	12
Spring 05	Topics in Artificial Intelligence	11
Fall 05	Topics in Artificial Intelligence	7
Spring 06	Biometrics	6
Spring 07	Topics in Artificial Intelligence	8
Fall 07	Biometrics	10
Spring 08	Topics in Artificial Intelligence	6
Fall 08	Biometrics	7
Spring 09	Markov Models	7
Fall 09	Biometrics	11
Spring 10	Machine Learning	9
Fall 10	Biometrics	10
Spring 11	Machine Learning	13
Fall 11	Machine Learning	17
Spring 12	Biometrics	9
Fall 13	Biometrics	13
Spring 14	Topics in Artificial Intelligence	16
Fall 15	Topics in Artificial Intelligence	7
Fall 16	Topics in Artificial Intelligence	7
Fall 17	Deep Learning	10
Fall 19	Biometrics and Machine Learning	13

F. Professional Service

External Leadership & Service		
• SUNY-IBM Artificial Intelligence Research Alliance	Advisory Council	2019- current
• Empire Discovery Institute, NY	Board of Directors	2018- current
• Hauptman Woodward Institute, NY	Board of Directors	2015- current
• Buffalo Niagara Enterprise, NY	Board of Directors	2014 - 2016
• Asian Indian Community Foundation of WNY	Vice President	2008 - 2012
• Girl Scouts of Buffalo, NY	Board of Directors	2004 - 2006

Professional Societies Activities		
• IEEE Biometrics Council	President	2015 - 16
• IEEE Biometrics Council Nominations Committee	Chair	2009 - 11, 17-19
• IEEE Biometrics Council (Education)	Member	2007 - 08
• IEEE Education Activities Board	SME	2007 - 08
• International Graphonomics Society (IGS)	Secretary	2007- 09

Editorial Boards	
• IEEE Access	2015 - on
• IDRBT Journal of Banking Technologies	2017 - on
• IEEE Transactions on Information Security and Forensics	2014 - 2016
• IEEE Biometrics Compendium (Editor-in-Chief)	2012 - 2016
• IET Biometrics Identification	2011 - on
• Journal of Technology Management for Growing Economies	2010 - on
• International Journal on Document Analysis and Recognition	2003 - on
• International Journal of Pattern Analysis and Applications	2004 - 2008
• IEEE Transactions on Systems, Man, and Cybernetics (B)	2000 - 2008
• IEEE Transactions on Pattern Analysis and Machine Intelligence	2001 - 2005
• The Journal of Pattern Recognition	1997 - 2005

Conference Leadership		
• Honorary Chair	IEEE International Conference on Document Analysis and Recognition, San Jose, CA	Aug. 2023
• General Chair	IEEE International Conference on Identity, Security, and Behavioral Analysis (ISBA), Hyderabad, India	Jan. 2019
• General Chair	IAPR International Conference on Frontiers of Handwriting Recognition, Niagara Falls, NY	Aug. 2018
• Honorary Chair	IEEE International Conference on Identity, Security, and Behavioral Analysis (ISBA), Singapore	Jan. 2018
• General Chair	IEEE International Conference on Identity, Security, and Behavioral Analysis (ISBA), New Delhi, India	Feb. 2017
• General Chair	IAPR Summer School on Document Analysis: Document Informatics, Jaipur, India	Jan. 2017

• General Chair	IEEE Biometrics, Theory, Algorithms, and Systems (BTAS), Niagara Falls, NY	Sept. 2016
• General Co-Chair	International Conference on Information and Systems Security (ICISS), Hyderabad, India	Dec. 2014
• Sponsorship Chair	International Joint Conference on Biometrics, Tampa, FL	Sept. 2014
• Area Co-Chair	International Conference on Pattern Recognition (ICPR), Stockholm, Sweden	Aug. 2014
• General Co-Chair	Int. Conf. on Document Analysis and Recognition, Washington, D.C.	Sept. 2013
• General Co-Chair	ICDAR Multilingual OCR Workshop (MOCR), Washington D.C.	Aug. 2013
• General Co-Chair	Int. Conf. on Information Assurance and Management, Buffalo, NY	Aug. 2013
• Industry Chair	IAPR International Conference on Biometrics (ICB), Madrid, Spain	Jun. 2013
• Program Co-Chair	CVPR Biometrics Workshop, Portland, OR	Jun. 2013
• Tutorials Co-chair	IAPR International Conference on Biometrics (ICB), Spain	Jun. 2013
• Track Chair	Int. Conf. on Pattern Recognition, Tsukuba City, Japan	Nov. 2012
• Program Chair	CVPR Biometrics Workshop, Providence, RI	Jun. 2012
• Advisory Board	International Conference on Information Systems for Indian Languages, Patiala, India	Dec. 2011
• Area Chair	Indian Conference on Computer Vision and Image Processing, Chennai, India	Dec. 2011
• General Co-chair	Multilingual OCR Workshop, Beijing, China	Sept. 2011
• Program Chair	CVPR Workshop, Colorado Springs, CO	Jun. 2011
• Advisory Board	Multimedia Signal Processing	Apr. 2011
• Tutorials Chair	Int. Conf. on Handwriting Recognition, Kolkata, India	Oct. 2010
• General Co-Chair	1st International Workshop on Emerging Techniques and Challenges for Hand-based Biometrics , Istanbul, Turkey	Aug. 2010
• General Co-Chair	International Workshop. Document Analysis Systems, Boston, MA	Jun. 2010
• Program Chair	CVPR Biometrics Workshop., San Francisco, CA	Jun. 2010
• Steering Committee	Computational Modeling of Objects Presented in Images: Fundamentals, Methods, and Applications, NY	May. 2010
• General Co-Chair	Multilingual OCR Workshop., Barcelona, Spain	Jul. 2009
• Program Chair	CVPR Biometrics Workshop., Miami, FL	Jun. 2009
• Program Co-Chair	Document Analysis Track (ICPR) Tampa, FL	Dec. 2008
• Awards Committee	IEEE Biometrics Symposium, Tampa FL	Sept. 2008
• Program Co-Chair	2nd IEEE Conf. on Biometrics: (BTAS), DC	Sept. 2008
• Program Chair	CVPR Biometrics Workshop., Anchorage, AL	Jun. 2008
• Program Co-Chair	International Conference on Cognition and Recognition, India	Apr. 2008
• Steering Committee	Indo-US Symposium on Data Info Knowledge Spectrum	Dec. 2007
• Program Co-Chair	1st IEEE Conf. on Biometrics (BTAS), DC	Sept. 2007
• Program Chair	CVPR Biometrics Workshop., Minneapolis, MN	Jun. 2007

• Program Chair	CVPR Multi-biometric Workshop., NY, NY	Jun. 2006
• General Co-Chair	Int. Conf. on Cognition and Recognition, India	Dec. 2005
• General Chair	4th IEEE Int. Workshop. on AutoID, NY	Oct. 2005
• Program Co-Chair	Int. Conf. Document Analysis and Recognition, Korea	Oct. 2005
• General Co-Chair	Int. Workshop. on DIAL, Palo Alto, CA	Jan. 2004
• General Co-Chair	Int. Workshop. on Document Analysis and Retrieval, WI	Jun. 2003
• Publicity Chair	New York State Cyber-Security Symposium, Utica	Feb. 2003
• Program Co-Chair	International Workshop. on Handwriting Recognition	Sept. 2002
• Technical Committee	IEEE SMC (B) for Pattern Recognition	1998- 02

G. Invited Talks

Keynotes, Plenary Talks, and Distinguished Lectures (41)	
09/29/18	International Conference on Computer Vision and Image Processing, Jabalpur, India
07/14/17	International Conference on Computational Intelligence & Data Engineering, Amaravati, India
03/28/17	Open Cloud Institute, University of Texas, San Antonio, TX
06/23/17	International Conference on Biometric and Forensic Engineering, Singapore
02/22/17	International Symposium on Biometric Authentication, Delhi, India
12/19/15	National Conf. on Computer Vision, Pattern Recognition, and Image Processing, Patna, India
08/24/15	IAPR/ ICDAR Outstanding Achievements Award Keynote, Nancy, France
12/14/14	ICVGIP Document Analysis and Recognition Workshop, Bengaluru, India
12/14/14	ICVGIP Workshop on Applications of Computer Vision, Graphics, and Image Processing, Bengaluru, India
12/30/13	Statistics 2013, Advanced Inst. of Mathematical, Statistics, and Comp. Sciences, Hyderabad, India
12/20/13	National Conf. on Computer Vision, Pattern Recognition, and Image Processing, Jodhpur, India
12/07/13	Large Scale Visual Commerce Workshop, at Int. Conf. Computer Vision, Sydney, Australia
02/22/13	International Conclave on Innovations in Engineering and Management, Patna, India
07/27/12	International Joint Conference on e-Business and Telecommunications, Rome, Italy
12/16/12	Distinguished Lecture Series, Adobe Inc., Bengaluru, India
02/03/12	TACTIC Smart Facilities, Hyderabad, India
12/17/11	IEEE India Conference (INDICON), Hyderabad, India
04/07/11	TACTIC Conference, Trivandrum, India
03/09/11	International Conference on Information Systems for Indian Languages, India
12/15/10	TACTIC Security Conference, Hyderabad, India
05/06/10	Computational Modeling of Objects Presented in Images, Niagara Falls, NY
02/01/10	Government of Jamaica Seminar on National Identification System, Jamaica.
12/21/09	International Conference on Recent Advances on Mathematical Sciences and Applications, Visakhapatnam, India
12/19/09	Workshop on Image and Speech Processing (WISP), Hyderabad, India
12/18/09	3rd International Conference on Pattern Recognition and Machine Intelligence, Kolkata, India

12/14/09	5th International Conference on Information Systems Security, Kolkata, India
09/11/09	HP Technology Summit, Bangalore, India
07/24/09	3rd Workshop on Analytics for Noisy Unstructured Text Data, Barcelona, Spain
03/15/09	11th International Conference on Technology, Policy, and Innovation, Delhi, India
12/30/08	International Conference on Business Data Mining, Hyderabad, India
12/16/08	Indian Conference on Vision and Image Processing, Bhubaneswar, India
07/21/08	Intensive Workshop on Indic Document Recognition, Delhi, India
07/09/08	Lockheed BEACON Center, Rockville, MD (broadcast to 8 remote centers)
02/12/08	IDGA's Military Biometrics Summit 2008, Washington, DC
01/02/08	Platinum Jubilee Conference, Indian Statistical Institute, Kolkata, India
09/29/06	IEEE Western New York Image Processing Workshop, Rochester, NY
12/23/05	International Conference on Cognition and Recognition, Mysore, India
12/15/05	13th International Conference on Advanced Computing and Communication, Coimbatore, India
01/03/05	Amrita University, Coimbatore, India
09/11/04	World Hindi Conference, Amherst, NY
05/09/03	Rochester Institute of Technology, Rochester, NY

Colloquium Talks (30)

10/25/17	National Cancer Institute, Center for Biomedical Informatics and Information Technology, Washington DC
12/22/14	Jawaharlal Nehru Technological University, Hyderabad, India
01/16/13	Acclerated Discovery Lab, IBM Almaden, CA
03/29/13	IBM Almaden, CA
03/01/13	SRC, Syracuse, NY
03/07/12	Syracuse University, Syracuse, NY*
12/23/11	HP, Bangalore, India
10/08/10	Fujitsu Inc, Sunnyvale, CA
10/04/10	Department of Computer Science and Engineering, Lehigh University, PA
07/10/09	Machine Learning Lab, Stanford University, Palo Alto, CA
12/15/08	IEEE Bangalore Chapter, India
05/20/08	École de Technologie Supérieure, Montréal, Québec (IEEE Chapter on CI)
01/28/08	University of California, Riverside, CA
11/09/07	University of New South Wales, Sydney, Australia
02/22/07	Carnegie Mellon University, Pittsburgh, PA
12/01/06	University of Maryland, College Park, MD
04/28/05	Korea Advanced Institute of Science and Technology, Seoul, S. Korea
01/16/05	Brown University, RI
10/10/03	Concordia University, Montreal, Canada
08/14/03	IBM TJ Watson Research Center, Yorktown Heights, NY
05/09/03	Rochester Institute of Technology, Rochester, NY
04/16/03	Wayne State University, Detroit, MI
10/13/02	University of Massachusetts, Amherst
10/09/00	IBM TJ Watson Research Center, Yorktown Heights, NY
06/15/00	Xerox Palo Alto Research Center (PARC)
12/03/99	Xerox, Webster Research Center, Rochester, NY
11/23/99	University of Maryland, College Park, MD
06/28/99	Kent Research Digital Labs, Singapore

03/27/97	Wayne State University, Detroit, MI
12/16/94	University of Michigan, Dearborn, MI

Invited Conferences Talks (22)

19/12/16	International Workshop on Pattern Recognition Applications, Kolkata, India
17/12/15	BB Chaudhuri Conference, Indian Statistical Institute, Kolkata, India
10/29/13	NRC Intelligence Committee Workshop on Science & Tech Investments, Washington DC
06/19/13	International Program on Information Assurance and Management, Buffalo, NY
08/22/12	CAPTCHAs for Remote Cyber Security in Banks, IPIAM, Buffalo, NY
12/20/12	Tutorial Lecture on Machine Learning, Amrita University, India
11/03/08	ROBUST Biometrics Conference, Hawaii
05/16/08	International Sanskrit Digital Library Workshop, Brown University
02/07/07	NYSTAR University Technology Showcase, Rochester, NY
11/17/06	NSF Workshop on International Sanskrit Digital Library Integration, Providence, RI
09/28/06	Summit on Arabic and Chinese Handwriting Recognition, College Park, MD
05/07/05	Workshop on Tools for Indian Digital Libraries, IIIT Hyderabad, India
11/14/03	Griffis Institute Cyber Security Conference, New Paltz, NY
02/25/03	New York State Cyber-Security Symposium, Utica, NY
01/24/03	International Workshop on Technology Development in Indian Languages, Kolkata, India
04/24/01	Symposium for Document Image Understanding Technology (SDIUT), Annapolis, MD
03/29/01	International Workshop. on Technology Development in Indian Languages, Kolkata, India
06/22/00	International Workshop on Multiple Classifier Systems, Cagliari, Italy
05/19/99	National Postal Forum, San Antonio, TX.
11/09/94	Digital Post Modernism, Nice, France
05/10/94	Digital Road Show, UK & France
02/15/94	2nd Census OCR Conference, National Institute of Standards, Bethesda, MD

Invited Talks at UB (16)

07/22/14	UB This Summer
03/14/13	Pi Day: Biometrics and Privacy
10/08/13	UB Insights (Biometrics: Is Privacy a Bygone Concept in the 21st century)
06/07/11	UB Postdoc Forum
03/31/11	UB Management School (Amrita)
07/25/09	UB Catholic Ministry, Newman Center
04/13/07	Guest Speaker, Information Assurance Class, School of Management
12/02/05	UB Friday Forum
09/30/05	IGERT Colloquium Series
07/21/05	UB This Summer
03/12/05	Engineering Seminar & Exhibition, University at Buffalo
07/23/03	UB This Summer
10/29/04	Guest Speaker, Information Assurance Class, School of Management
04/24/03	University at Buffalo, School of Engineering, Dean's Council, Buffalo, NY
11/19/99	Department of Computer Science & Engineering, University at Buffalo, NY
10/16/92	Department of Computer Science, University at Buffalo, NY

Other Seminars (43)

11/08/19	Barrett Womens Club, Buffalo, NY
03/25/19	Aditya Institute of Technology and Management, Tekkali, India
09/01/17	Microsoft Research, Redmond, WA
01/25/17	Maniphal Institute of Technology, Jaipur, India
01/27/17	Birla Institute of Technology Mesra Campus, Jaipur, India
01/19/17	Indian Statistical Institute, Kolkata, India
12/18/13	Prime Minister's Office Complex, Delhi, India
02/20/13	IDRBT, Hyderabad, India
01/02/13	IDRBT, Hyderabad, India
04/02/12	IDRBT, Hyderabad, India
04/12/11	IIT Hyderabad, India
06/08/10	Jawaharlal Nehru Technological University, Hyderabad, India
06/06/10	College of Engineering, Andhra University, Visakhapatnam, India
12/31/09	International Conference on Frontiers of Interface Between Statistics and Sciences, Hyderabad, India
03/16/09	Windows to the World Series, Tata Indicom, Delhi, India
01/05/09	Indian Institute of Technology Madras, Chennai, India
12/29/08	Computer Maintenance Corporation, Tata Group, Hyderabad, India
12/15/08	Hewlett Packard Research, Bengaluru, India
12/04/08	University of Hyderabad, India
08/07/08	Satyam Computers, Hyderabad, India
08/05/08	Siddhartha Engineering College, Vijayawada, India
07/22/08	TIFAC, Dept. of Science and Technology, Delhi, India
01/30/08	Google, Inc, Mountain View, CA
01/04/08	HP Research Laboratories, India
01/03/08	Google Research, Bangalore, India
06/04/07	Motorola Labs, Hyderabad, India
05/26/07	IEEE Chapter of Hyderabad and University of Hyderabad, India
01/04/07	Gayatri Vidya Parishad, Visakhapatnam, India
12/30/06	PES College of Engineering, Bangalore, India
11/07/06	Indian Institute of Technology, Delhi, India
11/04/06	IEEE Chapter of Birla Institute of Technology , Ranchi, India
11/04/06	Birla Institute of Technology, Ranchi, India
07/04/06	International Institute of Technology, Hyderabad, India
06/23/06	HP Research, Bangalore, India
05/06/05	Center for Development of Advanced Computing, Hyderabad, India
01/04/05	HP Research Labs, Bangalore, India
12/30/04	Indian Institute of Technology, Chennai, India
07/24/04	AP State Education Council, Hyderabad India
12/30/03	Jawaharlal Nehru Technological University, Hyderabad, India
06/02/03	Tata Consulting Services, Hyderabad, India
07/08/02	International Institute of Information Technology, Hyderabad, India
08/09/01	Institution of Electronics and Telecommunication Engineers, Hyderabad, India
12/24/99	Indian Statistical Institute, Calcutta, India