

# Venu Govindaraju

## CURRICULUM VITAE

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University Address UB Commons, Suite 202, Amherst, NY 14228  
Telephone Number 716 645 2356; 716 645 2377 (fax)  
Email venu@cubs.Buffalo.edu, govind@buffalo.edu  
Home Page <http://cubs.buffalo.edu/govind>

### Education

PhD University at Buffalo, State University of New York 1992  
Major: Computer Science  
Dissertation: A Computational Model for Locating Faces in Complex Scenes

MS University at Buffalo, State University of New York 1988  
Major: Computer Science

BTech Indian Institute of Technology (IIT), Kharagpur 1986  
Major: Computer Science & Engineering  
Thesis: Software System for Image Processing and Pattern Recognition

### Employment History

Director	Information and Computing Technology Strategic Strength-UB2020 Initiative	1/07 – on
Director	Center for Unified Biometrics and Sensors (CUBS) University at Buffalo, State University of New York	9/03 - on
Professor (tenured)	Dept. of Computer Science & Engineering University at Buffalo, State University of New York	8/02 - on
Associate Professor (tenured)	Dept. of Computer Science & Engineering University at Buffalo, State University of New York	9/00 - 8/02
Research Associate Professor	Dept. of Computer Science University at Buffalo, State University of New York	1/98 - 9/00
Member of Graduate Faculty	Dept. of Computer Science University at Buffalo, State University of New York	1/96 - on
Associate Director	Center for Document Analysis and Recognition (CEDAR) University at Buffalo, State University of New York	1/95 - on
Research Assistant Professor	Dept. of Computer Science University at Buffalo, State University of New York	1/92 - 12/97
Research Scientist	CEDAR University at Buffalo, State University of New York	6/91 - 9/00
Graduate Assistant	Dept. of Computer Science University at Buffalo, State University of New York	9/86 - 6/91

## Awards

- 2007 SUNY Chancellor's Award for Scholarship and Creative Activities
- Outstanding Service as an Associate Editor of the IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Computer Society
- MIT Global Indus Technovator Award 2004, MIT Indian Business Club, Cambridge, MA
- Visionary Innovator 2004, UB Office of Science, Technology Transfer and Economic Outreach
- IBM Faculty Award 2003-04, IBM TJ Watson Research Center, NY
- Exceptional Scholar Award, May 5, 2003, University at Buffalo, NY
- SUNY Research Foundation Research and Scholarship Award, 2002
- 40 Under Forty Honoree Business First, Nov. 7, 2002, Buffalo, NY
- Outstanding Young Investigator, Int. Conf. on Document Analysis and Recognition, 2001
- Outstanding Research Award Presented by UB President and Vice President of USPS, 1998

## Honors

- Elected **Fellow** - Institute of Electrical and Electronics Engineers (IEEE), 2006
- Elected **Fellow** – International Association of Pattern Recognition (IAPR), 2004
- Elected **Fellow** – Institute of Electrical and Telecommunications Engineers (IETE), 2002
- Nominated for ACM Best Doctoral Dissertation Award, Sep. 1992
- UB Presidential Fellowship, 1986 - 1988
- IIT Blue - for outstanding achievement in sports at IIT Kharagpur, 1986

## Impact

- The practical impact of Dr. Govindaraju's work has few parallels in academia. The team led by Govindaraju and his colleagues at the University at Buffalo delivered to the USPS a field-deployable real-time system yielding annual savings of several hundred million dollars. This has come about in part due to the seminal and widely cited paper—with 145 citations on 'Google Scholar'—by Govindaraju in the IEEE-Transactions on Pattern Analysis and Machine Intelligence, 19(4):366-379, 1997. This paper provided ground-breaking techniques to efficiently segment and process cursively written (often with illegible parts) words with the help of lexicons in real time.
- Licensed handwriting recognition technology to Xact Data, 2006
- Licensed handwriting recognition technology to Buffalo Graphics (via UB; \$50,000), 2006
- Licensed HWAI technology to UK Royal Mail (via Lockheed; \$300,000), 2004
- Licensed HWAI technology to Australia Post (via UB; \$180,000), 2000

# I Research

## A. Synopsis

Dr. Govindaraju’s research falls in the area of Pattern Recognition, which is a major branch in the field of Artificial Intelligence within Computer Science. This field is critical to diverse domains, from Homeland Security to Digital Libraries. Pattern recognition techniques are fundamental to automated handwriting, voice, and face recognition, as well as ‘biometrics’ that measure and analyze physical and behavioral traits for identifying a person, such as fingerprints, gait and gestures. Pattern recognition techniques also underlie automated analysis of images, video, and digital documents in multiple formats, modalities, scripts, and languages.

Much of Dr. Govindaraju’s early work focused on the automated recognition of written language, both machine-printed and hand-written text, and more recently on Digital Libraries and Biometrics. Text recognition is a very complex research problem, due to the variations in fonts and sizes of machine-printed text and the vagaries of individual handwriting. Dr. Govindaraju employs contextual knowledge, and both analytical and holistic approaches to solve this problem. The application of his research in the postal address recognition domain has resulted in the practical software that has been deployed in hundreds of post offices in the country. The U.S. Postal Service has reported savings of over 200 million dollars in the very first year of using this software. The software has also been adopted by the postal services of Australia and U.K.

Dr. Govindaraju has recently expanded his research beyond text recognition to investigate Digital Libraries and Biometrics. He is developing natural interfaces for accessing manuscripts in Indic scripts such as Arabic, Sanskrit, etc. In the area of Biometrics, Dr. Govindaraju investigates the strength of various biometric modalities (face, fingerprint, signature, etc.) to resist malicious attacks and provide solutions to mitigate some of the vulnerabilities.

## B. Grant Support (Total \$48.3M)

### I. PI, Venu Govindaraju; Total: \$8.06 M

Project	Federal and State Government	Co-PI	Amount	Period
1. Deceit Indication through Person Specific Behavioral Dynamics	National Science Foundation (NSF)	M. Frank T. Slowe	\$798,666	2007-10
2. Sanskrit Digital Library	NSF		\$205,000	2005-08
3. Advanced Biometrics for Large Scale Applications	Dept. of Defense	M.Moskal	\$1,560,884	2005-07
4. Multimodal Biometric Systems – PhaseII	Army Research Labs (ARL)	-	\$230,000	2005-06
5. Emergency Medicine, Disease Surveillance, Informatics	NSF	S. Setlur M.Moskal	\$450,000	2004-07
6. Multimodal Biometric Systems - PhaseI	ARL	-	\$40,000	2004

7. Arabic Handwritten OCR	Central Intelligence	-	\$240,000	2004-06
8. Smart Card Biometrics	NY Science and Tech (NYSTAR)	-	\$100,000	2004
9. Automated Reading of Medical Forms	NSF	-	\$50,000	2003-04
10. Cognitive Models for Recognition	NSF	-	\$99,000	2002-03
11. Devanagari Data and OCR Technology	NSF	-	\$487,319	2002-04
<b>Total Federal/State Funding</b>			<b>\$4,260,869</b>	
<b>Project</b>	<b>Industry</b>	<b>Co-PI</b>	<b>Amount</b>	<b>Period</b>
12. Student Doctoral Fellowship	IBM		\$30,000	2007-09
13. Remote Computer Reader, Image Truthing	Lockheed Martin (LM)	S. Setlur S. Srihari	\$498,000	2007-08
14. Deceit Indication by Behavioral Dynamics	CUBRC		\$31,000	2007
15. NY State Medical Survey Forms	Buffalo Graphics		\$60,000	2005-07
16. Information Retrieval from Handwritten Documents	Google, Inc.		\$50,000	2005-06
17. Biometric Fusion	CUBRC	-	\$25,000	2005
18. Quantitative Friction Ridge Analysis	CUBRC	-	\$25,000	2005-06
19. Face Recognition for Law Enforcement	CUBRC	-	\$25,000	2005
20. Multimodal Biometrics	CUBRC	-	\$25,000	2005
21. CAPTCHAS for Web Security	CUBRC	-	\$25,000	2004-05
22. Smart Card Biometrics	Ultra-Scan, Inc.	-	\$50,000	2004
23. Biometric Access Control System	IGI, Inc.	D. Bartnik	\$135,000	2003-04
24. Fingerprint Recognition (AFIS)	Ultra-Scan, Inc.	D. Bartnik S. Setlur	\$1,900,000	2002-05
25. Medical Forms Reading	CUBRC	-	\$25,000	2003-04
26. Forms Reading	CUBRC	-	\$25,000	2003-04
27. Biometrics	CUBRC	A. Cartwright	\$5,000	2003-04

28. HWAI Plus	Siemens Corp.	S. Srihari	\$317,000	2002-03
29. AAPS Parcel Address Recognition	Siemens Corp.	S. Srihari	\$90,000	2002
30. Student Support Fellowship	IBM	-	\$15,000	2001-02
31. Canadian Postcode Interpretation	Siemens Corp.	S. Srihari	\$50,000	2000-01
32. Handwritten Address Interpretation	Siemens Corp.	S. Srihari	\$300,000	2000-01
33. Canadian Postcode Recognition	Systems House Ltd		\$10,000	1994
34. Recognition of Handprinted Forms	Readers Digest, Inc.	S. Srihari	\$10,000	1994
35. Document Analysis and Recognition	Xerox Corp.	S. Srihari	\$70,000	1993-00
<b>Total Industry Funding</b>			<b>\$3.796M</b>	

**II. Co-PI, Venu Govindaraju; Total: \$1.71M** (1,711,565 dollars)

<b>Project</b>	<b>Sponsor</b>	<b>Other PIs</b>	<b>Amount</b>	<b>Period</b>
36. Odor Typing for Disease Detection	Oishei Foundation	F.Bright (PI) A.Titus A.Cartwright	\$400,000	2006-07
37. The LitGloss Project: Materials Development in Multiple Languages	National Endowment for Humanities (NEH)	M. Jameson (PI)	\$196,938	2003-05
38. Unobtrusive Biometrics Systems	NYSTAR/CUBRC	A.Titus (PI) A.Cartwright F. Bright	\$153,360	2003-04
39. Handwritten Text Recognition	National Security Agency (NSA)	S.Srihari (PI)	\$532,939	1994-96
40. Handwriting Individuality	National Institute of Justice (NIJ)	S.Srihari (PI) Y.C. Shin	\$428,328	1999-00

**III. Co-PI, Venu Govindaraju; Total Postal Funding: \$38.5M** (38,512,856 dollars)

PI: S. Srihari

<b>Project</b>	<b>Sponsor</b>	<b>Other Co-PIs</b>	<b>Amount</b>	<b>Period</b>
41. Digital Camera use in Barcode Imaging	USPS	S. Setlur	\$409,867	2003-07
42. Image Collection and Truthing	USPS	S. Setlur	\$3,906,541	2003-07
43. Flats Image Collection and Truthing	USPS	S. Setlur	\$1,499,471	2003-07

44. Alternate Keying Strategies	USPS	S. Setlur	\$165,000	2004-05
45. Reply Card Scanning	USPS	A. Shekhawat	\$210,000	2003-04
46. Personal Name Lookups	USPS	S. Setlur	\$166,000	2003
47. Comparison Study of Barcodes	USPS	S. Setlur	\$470,000	2003-05
48. UK Address Interpretation Project	LM	D. Bartnik	\$15,000	2003
49. Image Evaluation System- Flats	USPS	S. Setlur	\$340,000	2002-03
50. Micropayment Processing	USPS	A. Shekhawat	\$1,204,000	2001-03
51. Mailpiece Library	USPS	S. Setlur	\$190,000	2002
52. Evaluation of Identification Codes	USPS	A. Shekhawat	\$133,000	2001
53. Return Merchandise System	USPS	D. Bartnik	\$300,000	2001-02
54. Image Evaluation System Development	USPS	S. Setlur	\$1,850,583	1999-03
55. Information Based Indicia	USPS	A. Shekhawat	\$300,000	1999-01
56. UK Address Interpretation Project	LM	S. Setlur, D. Bartnik	\$1,245,000	2000-02
57. RCR/HWAI	LM		\$660,000	2000-01
58. SDMM Directory Generation and Validation	LM	S. Setlur	\$44,235	2000-01
59. Image Truthing	USPS	S. Setlur	\$1,102,000	2000-02
60. Address Interpretation Systems for UK Program	LM	S. Setlur	\$1,224,367	2000
61. HWAI Control Strategy	LM		\$129,190	1999-00
62. PROZE Character Recognition Improvements	LM		\$128,395	1999-00
63. VRR Word Recognizer Improvements	LM		\$42,590	1999-00
64. Last Line and Foreign Processing	LM	S. Setlur	\$101,417	1999-00
65. RCR/HWAI Improvements	LM		\$503,480	1999-00
66. UKAI Initial Tasks- Parsing and Resolution	LM	S. Setlur	\$152,442	1999-00
67. HWAI Australian Addresses, Release 4	LM		\$240,000	1999-00
68. Truthing for Recognition Improvement Plan	USPS	S. Setlur	\$75,000	1999-00

69. Truthing and Analysis of Mailpiece Images	USPS	S. Setlur	\$290,636	1999-00
70. New Image Evaluation System	USPS	S. Setlur	\$395,257	1999-00
71. Implementation of Semi-automated Encoding	USPS	S. Setlur	\$185,261	1999-00
72. Sender Information Processing	USPS	S. Setlur	\$134,167	1999-00
73. Equipment Grant	USPS		\$46,200	1999-00
74. Travel Grant	USPS		\$34,103	1999-00
75. HWAI of Australian Addresses, Release 3	LM		\$218,333	1999
76. Last Line, Foreign Processing	LM		\$100,412	1999
77. Image Processing Functions	LM		\$69,156	1999
78. Control Strategy	LM		\$101,468	1999
79. Word Recognizer	LM		\$46,541	1999
80. New Character Recognition	LM		\$45,019	1999
81. HWAI of Australian Addresses, PIP -1 Release	LM		\$230,000	1999
82. HWAI of Australian Addresses, PIP	LM		\$89,959	1999
83. Gray Scale Image Processing Investigation	USPS	A. Shekhawat	\$790,000	1998-00
84. Address Truthing Analysis	USPS	S. Setlur	\$1,424,641	1998-00
85. HWAI Control Structures	LM		\$79,200	1998-99
86. Database Enhancement	LM		\$52,500	1998-99
87. New Parsing Technique	LM		\$77,500	1998-99
88. New Word Recognition Technique	LM		\$132,000	1998-99
89. New Character Recognition	LM		\$88,000	1998-99
90. RCR/HWAI Improvements	LM		\$400,000	1998-99
91. Firmname Recognition	LM		\$70,738	1998-99
92. RCR/ HWAI Improvements	LM		\$568,538	1998-99

93. Port HWAI to NT	LM		\$28,586	1998-99
94. HWAI Recognition Co-processor	USPS	A. Shekhawat	\$650,000	1998
95. HWAI of Australian Addresses	LM		\$1,144,418	1997-98
96. RCR/ HWAI Integration	LM		\$1,500,000	1997-98
97. HWAI PC Integration Task	USPS	A. Shekhawat	\$494,924	1997-98
98. HWAI/RCR Research	LM		\$550,860	1997
99. HWAI/RCR	LM		\$407,686	1997
100. Directory Compression	USPS		\$37,959	1997
101. Image Analysis	USPS		\$40,722	1997
102. Recognition through Evolutionary Computing	USPS		\$57,410	1997
103. HWAI PC Porting	USPS	A. Shekhawat	\$215,497	1997
104. HWAI/RCR Research	LM		\$585,924	1996-97
105. HWAI/RCR Integration	LM		\$596,474	1996-97
106. HWAI PC Integration, Task 1	USPS	A. Shekhawat	\$255,076	1996-97
107. HWAI Integration Testing	USPS		\$99,750	1996-97
108. Improvements in HWAI	USPS		\$2,510,681	1993-96
109. Reply Card Processing - Phase III	USPS		\$1,388,534	1995-96
110. Reply Card Processing PIMS	USPS		\$1,435,416	1993-95
111. Interactive Service Research Support	USPS		\$1,299,519	1993-96
112. CEDAR Supplemental Activities	USPS		\$750,000	1991-95
113. HWAI Research	USPS		\$3,256,837	1991-94

### C. Publications

1 Book, 5 edited volumes, 44 journal papers, 20 book chapters, 176 conference and workshop papers, 4 US patents.; Govindaraju's students are marked with an asterisk \*.

## Books

1. Advances in Biometrics: Sensors, Systems, and Algorithms. N. Ratha & V. Govindaraju (Editors). Springer (October 2007).

## Edited Volumes

2. Proceedings of the 4th IEEE Workshop on Automatic Identification Advanced Technologies, IEEE Computer Society Press, 2005. (Co-editor: V. Bhagavatula). ISBN 0-7695-2475-3.
3. Proceedings of the 8<sup>th</sup> International Conference on Document Analysis and Recognition, IEEE Computer Society Press, 2005. (Co-editors: M. Nakagawa and U. Miletzki).
4. Proceedings of the 1st International Workshop on Document Image Analysis for Libraries (DIAL 2004), IEEE Computer Society Press, 2004. (Co-editor: H. Baird). ISBN 0-7695-2088-X.
5. Proceedings of the Workshop on Document Image Analysis and Retrieval, IEEE Computer Society Press, 2003. (Co-editor: R. Manmatha).
6. Proceedings of the 8th International Workshop on Frontiers in Handwriting Recognition, IEEE Computer Society Press, 2002. (Co-editor: H. Fujisawa, G. Lorette, and M. Parizeau). ISBN 0-7695-1692-0.

## Edited Special Issues

1. “Special Issue on Advances in Biometrics”, IEEE Transactions on Systems, Man, and Cybernetics – B, J K. Bowyer, V. Govindaraju, and N. Ratha, Editors, October 2007.

## Journal Papers in Review

Copies of draft versions can be viewed at <http://cubs.buffalo.edu/govind/research.html>

1. H. Cao\*, and V. Govindaraju, “Preprocessing of Low Quality Handwritten Carbon Forms Using Markov Random Fields”, 2007.
2. S. Kompalli\*, S. Setlur, and V. Govindaraju, “Devanagari OCR Using a Recognition Driven Segmentation Framework and Stochastic Language Models”, 2007.
3. R. Milewski\* and V. Govindaraju, “Automatic Recognition of Handwritten Medical Forms for Search Engines”, 2007.
4. S. Tulyakov\* and V. Govindaraju, “Combining Biometric Scores in Identification Systems”, 2007.
5. H. Lei\*, V. Govindaraju, and M. Beal, “Speeding Up Multi-class SVM Evaluation via Principal Component Analysis and Recursive Feature Elimination”, 2007.

## Journal Papers

Copies of selected papers can be viewed at <http://cubs.buffalo.edu/govind/publications.html>

1. S. Tulyakov\*, F. Farooq\*, P. Mansukhani\*, and V. Govindaraju, “Symmetric Hash Functions for Securing Fingerprint Templates”, *Pattern Recognition Letters*, 2007 (in press).
2. K. Bowyer, V. Govindaraju, and N. Ratha, “Introduction to the Special Issue on Advances in Biometrics”, IEEE Transactions on Systems, Man, and Cybernetics – B, October 2007. (Editorial article).
3. R. Milewski\* and V. Govindaraju, “Binarization and Cleanup of Handwritten Text from Carbon Copy Medical Form Images”, *The Journal of Pattern Recognition*, Elsevier Publishers, 2007.
4. L. Lorigo and V. Govindaraju, “Arabic Handwritten Word Recognition: A Survey”, *IEEE Transaction on Pattern Analysis and Machine Intelligence*, Vol. 28, No. 5, pp. 712-724, IEEE Computer Society Press, 2006.

5. Z. Shi and V. Govindaraju, "A Chaincode Based Scheme for Fingerprint Feature Extraction", *Pattern Recognition Letters*, Vol. 27, pp. 462-468, Elsevier Press, 2006.
6. S. Chikkerur\*, A. Cartwright, and V. Govindaraju, "Fingerprint Image Enhancement Using STFT Analysis", *The Journal of Pattern Recognition*, Elsevier Publishers, 2006.
7. H. Lei\* and V. Govindaraju, "Generalized Regression Model for Sequence Matching and Clustering", *International Journal of Knowledge and Information Systems*, 2006.
8. S. Kompalli\*, S. Setlur, and V. Govindaraju, "Multi-Font Devanagari OCR Using Recognition Driven Segmentation", *Vivek (Special Issue on Document Analysis of Indian Scripts)*, Vol. 16, No. 3, pp. 18-25, 2006.
9. H. Xue\* and V. Govindaraju, "A Stochastic Model Combining Discrete Symbols and Continuous Attributes in Handwriting Recognition", *IEEE Transaction on Pattern Analysis and Machine Intelligence*, Vol. 28, No. 3, pp. 458-462, IEEE Computer Society Press, 2006.
10. H. Lei\* and V. Govindaraju, "Matching and Retrieving Sequential Patterns under Regression", *International Journal on Web Intelligence and Agent Systems*, Vol. 3, No. 4, pp. 361-370, IOS Press, 2005.
11. 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.
12. H. Lei\* and V. Govindaraju, "A Study on the Consistency of Features in On-line Signature Verification", *Pattern Recognition Letters*, 26(15): 2483-2489, Elsevier Press, 2005.
13. A. Terdesai\* and V. Govindaraju, "Improving Secondary Classification Using Genetic Programming Methods", *The Journal of Pattern Recognition*, Pergamon Publishers, Vol. 38, No. 4, pp. 505-512, 2005.
14. 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.
15. 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.
16. 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.
17. 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.
18. Y. Wu\*, K. Ianakiev\*, and V. Govindaraju, "Improvements to K-NN Classification", *The Journal of Pattern Recognition*, Pergamon Press, 2002.
19. R. Kasturi, L. O. Gorman, and V. Govindaraju, "Document Image Analysis: A Primer", *Saadhana*, Vol. 27, No. 1, pp. 3-22, 2002. *Invited Paper*.
20. 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.
21. 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.
22. 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.
23. V. Govindaraju and K. Ianakiev\*, "Improving Classifier Accuracy by Fuzzy Boundaries and Topology of Error-prone Sets", *IEEE Transactions on Fuzzy Systems*, IEEE Neural Networks Council, Vol. 8, No. 6, pp. 679-690, 2000.

24. X. Wang, V. Govindaraju, and S. Srihari, "Holistic Digit Pair Recognition", *Journal of Pattern Recognition*, Pergamon Publishers, Vol. 33, No. 12, pp 1967-1974, 2000.
25. 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.
26. 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.
27. 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.
28. 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.
29. 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.
30. 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.
31. 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.
32. 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.
33. G. Sheikoaslami, S. Srihari, V. Govindaraju, Computer-aided Graphology and Persian Handwriting, *Computer Magazine*, 9(61), 1998 (in Arabic).
34. 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.
35. 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.
36. 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.
37. 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.
38. V. Govindaraju, "Locating Human Faces in Photographs", *The International Journal of Computer Vision*, Kluwer Academic Publishers, Vol. 19, No. 2, pp. 129-146, 1996.
39. Z. Shi and V. Govindaraju, "Character Image Enhancement Using Selective Region Growing", *Pattern Recognition Letters*, Elsevier Science Publishers, Vol. 17, pp. 523-527, 1996.
40. 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.
41. 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.

42. S. Setlur and V. Govindaraju, "Generating Manifold Samples from Handwritten Words", *Pattern Recognition Letters*, Elsevier Science Publishers, Vol. 15, pp. 901-905, 1995.
43. V. Govindaraju and R.K. Srihari, "Automatic Face Recognition In News Photo Database", *Advanced Imaging*, Miller Freeman, Inc., Vol. 5, No. 11, 1989, pp. 22-26, 1991.
44. 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 Chapter Papers

1. S. Tulyakov\*, Stefan Jaegar, V. Govindaraju, and D. Doermann, "Classifier Combination Survey", *Combination of Multiple Classifiers in Document Analysis and Recognition*, Simone Marinai (editor), Springer, 2007, *Invited*.
2. S. Tulyakov\* and V. Govindaraju, "Learning Matching Score Dependencies for Classifier Combination", *Combination of Multiple Classifiers in Document Analysis and Recognition*, Simone Marinai (editor), Springer, 2007, *Invited*.
3. S. Kompalli\*, S. Setlur, and V. Govindaraju -"DL Architecture for Indic Scripts", in DAS 2004, LNCS 3163 S. Marinai and A. Dengel (editors), pp. 28-38, 2004.
4. R. Manmatha and V. Govindaraju, "Handwriting Recognition", *Encyclopedia on Human Computer Interaction*, W. Bainbridge (editor), Berkshire Publications, 2003, *Invited*.
5. K. Ianakiev\* and V. Govindaraju, "Deriving Pseudo-Probabilities of Correctness Given Scores", *Pattern Recognition and String Matching*, D. Chen & X. Cheng, (editors), Kluwer Publishers, 2002.
6. A. Teredesai\*, J. Park\*, and V. Govindaraju, "Active Handwritten Character Recognition Using Genetic Programming", *Lecture Notes in Computer Science*, J. Miller *et al.* (editors), Springer, pp. 371-379, 2001.
7. Y. Wu\*, K. Ianakiev\*, and V. Govindaraju, "Confidence Combination Methods in Multiple Expert Systems", *Advances in Pattern Recognition, Lecture Notes in Computer Science*, F. J. Ferri, J. M. Inesta, A. Amin, and P. Pudil (editors), Springer, pp. 641-649, 2000.
8. X. Wang, V. Govindaraju, and S. Srihari, "Holistic Recognition of Touching Digit Pairs", *Frontiers in Handwriting Recognition, Series in Machine Perception and Artificial Intelligence*, S.W. Lee (editor), World Scientific Publishing Company, Vol. 34, pp. 359-367, 1999.
9. G. Kim\*, V. Govindaraju, and S. Srihari, "Architecture for Handwritten Text Recognition Systems", *Frontiers in Handwriting Recognition, Series in Machine Perception and Artificial Intelligence*, S.W. Lee (editor), World Scientific Publishing Company, Vol. 34, pp. 359-367, 1999.
10. J. Favata, S. Srihari, and V. Govindaraju, "Off-line Handwritten Sentence Recognition", *Progress in Handwriting Recognition*, A. Downton, and S. Impedovo (editors), World Scientific Publishing Company, pp. 393-398, 1997.
11. G. Sheikoaslami\*, S. Srihari, and V. Govindaraju, "Computer Aided Graphology", *Progress in Handwriting Recognition*, A. Downton, and S. Impedovo (editors), World Scientific Publishing Company, pp. 503-510, 1997.
12. G. Kim\*, V. Govindaraju, and S. Srihari, "Extension of Handwritten Word Recognition Method to Street Name Images", *Progress in Handwriting Recognition*, A. Downton, and S. Impedovo (editors), World Scientific Publishing Company, pp. 533-540, 1997.
13. Z. Shi and V. Govindaraju, "Segmentation and Recognition of Connected Handwritten Numeral Strings", *Progress in Handwriting Recognition*, A. Downton, and S. Impedovo (editors), World Scientific Publishing Company, pp. 515-518, 1997.
14. G. Kim\* and V. Govindaraju, "Bank Check Recognition Using Cross Validation Between Legal and Courtesy Amounts", *Automatic Bank Check Processing*, S. Impedovo, P.S.P. Wang, and H.

- Bunke (editors), *Series in Machine Perception Artificial Intelligence*, World Scientific Publishing Company, Vol. 28, pp. 195-212, 1997.
15. D. Niyogi, S. Srihari, and V. Govindaraju, "Analysis of Printed Forms", Handbook on Optical Character Recognition and Document Image Analysis, P.S.P. Wang & H. Bunke (editors), World Scientific Publishing Company, pp. 485-502, 1996.
  16. V. Govindaraju, R. Srihari, and S. Srihari, "Handwritten Text Recognition", Document Analysis Systems, A.L. Spitz & A. Dengel (editors), World Scientific Publishing Company, pp. 288-306, 1995.
  17. V. Govindaraju and S. Srihari, "Separating Handwritten Text from Non-Textual Interference", From Pixels to Features: II, J. Simon & S. Impedovo (editors), Elsevier Science Publishers, North-Holland, pp. 17-28, 1992.
  18. J. Hull, T. Ho, V. Govindaraju, J. Favata, and S. Srihari, "Combination of Segmentation Based and Holistic Handwritten Word Recognition Algorithms", From Pixels to Features: II, J. Simon & S. Impedovo (editors), Elsevier Science Publishers, North-Holland, pp. 261-272, 1992.
  19. 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.
  20. V. Govindaraju, S. Lam, D. Niyogi, D. Sher, R. Srihari, and S. Srihari, "Newspaper Image Understanding", *Lecture Notes in Artificial Intelligence*, J. Siekmann (editor), Springer Verlag, Vol. 444, pp. 375-386, 1991.

## Conference and Workshop Papers

Acceptance rates are provided where available.

1. C. Wu\*, S. Tulyakov\*, and V. Govindaraju, "Robust Point-based Feature Fingerprint Segmentation Algorithm", 1<sup>st</sup> International Conference on Biometrics, Seoul, S. Korea, 2007.
2. I. Nwogu\*, Z. Shi, and V. Govindaraju, "PDE-based Enhancement of Low Quality Documents", 9<sup>th</sup> International Conference on Document Analysis and Recognition, Curitiba, Brazil, 2007.
3. H. Cao\*, and V. Govindaraju, "Vector Model Based Indexing and Retrieval of Handwritten Medical Forms", 9<sup>th</sup> International Conference on Document Analysis and Recognition, Curitiba, Brazil, 2007.
4. S. Tulyakov\*, T. Slowe, Z. Zhang\*, and V. Govindaraju, "Facial Expression Biometrics Using Tracker Displacement Features", 2<sup>nd</sup> CVPR Workshop on Biometrics, Minneapolis, MN, 2007.
5. 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, 2007.
6. Z. Zhang\*, V. Singh\*, T. Slowe, S. Tulyakov, and V. Govindaraju, "Real-time Automatic Deceit Detection from Involuntary Facial Expressions", 2<sup>nd</sup> CVPR Workshop on Biometrics, Minneapolis, MN, 2007.
7. V. Govindaraju and H. Cao\*, "Indexing and Retrieval of Handwritten Medical Forms", 8<sup>th</sup> Annual International Conference on Digital Government Research, Philadelphia, PA 2007.
8. 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-07), Minneapolis, MN, 2007.
9. T. Slowe and V. Govindaraju, "Automatic Deceit Indication Through Reliable Facial Expressions", 5<sup>th</sup> IEEE Workshop on Automatic Identification Technologies, Italy, 2007.
10. R. Yampolskiy\* and V. Govindaraju "Similarity Measure Functions for Strategy-based Biometrics", SPIE Defense and Security Symposium, Orlando, FL, 2007.
11. 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.

12. L. Lorigo and V. Govindaraju, "Transcript Mapping for Handwritten Arabic Documents", 14<sup>th</sup> SPIE Conference on Document Recognition and Retrieval, San Jose, CA, 2007.
13. H. Cao\*, F. Farooq\*, and V. Govindaraju, "Indexing and Retrieval of Degraded Handwritten Medical Forms", IJCAI Workshop on Multimodal Information Retrieval, Hyderabad, India, 2007.
14. H. Cao\* and V. Govindaraju, "Template-free Word Spotting in Low Quality Grayscale Document Images", International Conference on Advances in Pattern Recognition, Kolkata, India, 2007.
15. S. Tulyakov\* and V. Govindaraju, "Utilizing Independence of Multimodal Biometric Matchers", International Workshop on Multimedia Content Representation, Classification, and Security, Istanbul, Turkey, 2006.
16. 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, 2006.
17. A. Rusu\* and V. Govindaraju, "The Influence of Image Complexity on Handwriting Recognition", 10<sup>th</sup> International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
18. R. Milewski\* and V. Govindaraju, "Automatic Indexing of Handwritten Medical Forms for Search Engines", 10<sup>th</sup> International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
19. F. Farooq\*, L. Lorigo, and V. Govindaraju, "Separating Handwritten and Machineprinted Text in Arabic Documents", 10<sup>th</sup> International Workshop on the Frontiers of Handwriting Recognition, La Baule, France, 2006.
20. K. Sridharan\*, M. Beal, and V. Govindaraju, "Competitive Mixtures of Simple Neurons", 18<sup>th</sup> International Conference on Pattern Recognition, Hong Kong, 2006. Acceptance rate = 15%.
21. F. Farooq\*, K. Sridharan\*, and V. Govindaraju, "Identifying Handwritten Text in Mixed Documents", 18<sup>th</sup> International Conference on Pattern Recognition, Hong Kong, 2006. Acceptance rate = 42%.
22. S. Kompally\*, and V. Govindaraju, "Devanagari OCR", 13th World Sanskrit Conference, Edinburgh, UK, 2006.
23. C. Wu\* and V. Govindaraju, "Singularity Preserving Fingerprint Image Adaptive Filtering", 13<sup>th</sup> International Conference on Image Processing, Atlanta, GA, 2006.
24. S. Kompalli\*, S. Setlur, and V. Govindaraju, "Design and Comparison of Segmentation Driven and Recognition Driven Devanagari OCR", 2<sup>nd</sup> International Workshop on Document Image Analysis for Libraries, Lyon, France, April 2006.
25. R. Yampolsiky\* and V. Govindaraju, "Use of Behavioral Biometrics in Intrusion Detection and Online Gaming", *SPIE Conference on Defense and Security*, Orlando, FL, 2006.
26. R. Milewski\* and V. Govindaraju, "Extraction of Handwritten Text from Carbon Copy Medical Form Images", International Workshop on Document Analysis Systems, Nelson, NewZealand, 2006.
27. S. Chikkerur\* and V. Govindaraju, "K-plet and Coupled BFS: A Graph Based Fingerprint Representation and Matching Algorithm", *International Conference on Biometrics*, Hong Kong, 2006.
28. K. Sridharan\* and V. Govindaraju, "A Sampling Based Approach to Facial Feature Extraction", 4<sup>th</sup> *IEEE Workshop on Automatic Identification Advanced Technologies (AutoID)*, pp. 51-56, Buffalo, NY, 2005. (Won 2<sup>nd</sup> prize for Best Student Paper).
29. S. Deshpande\*, S. Chikkerur\*, and V. Govindaraju, "Accent Classification in Speech", 4<sup>th</sup> *IEEE Workshop on Automatic Identification Advanced Technologies (AutoID)*, pp. 139-143, Buffalo, NY, 2005.

30. K. Sridharan\*, F. Farooq\*, and V. Govindaraju, "Classification of Machineprint and Handwriting in Mixed Arabic Documents", Symposium on Document Image Understanding Technology' College Park, MD, 2005
31. T. Jea\* and V. Govindaraju, "Partial Fingerprint Recognition Based on Localized Features and Matching", *Biometrics Consortium Conference*, Crystal City, VA, September 2005.
32. S. Tulyakov\* and V. Govindaraju, "Identification Model with Independent Matching Scores", *Biometrics Consortium Conference*, Crystal City, VA, September 2005.
33. S. Chikkerur\*, A., Cartwright, and V. Govindaraju, "Fingerprint Image Enhancement using STFT Analysis", *International Workshop on Pattern Recognition for Crime Prevention, Security and Surveillance, Bath, UK, 2005*. Acceptance rate  $75/200 = 38\%$ .
34. S. Tulyakov\*, F. Farooq\*, and V. Govindaraju, "Symmetric Hash Functions for Fingerprint Minutiae", *International Workshop on Pattern Recognition for Crime Prevention, Security and Surveillance, Bath, UK, 2005*. Acceptance rate  $75/200 = 38\%$ .
35. F. Farooq\* and V. Govindaraju, and M. Perrone, "Processing of Handwritten Arabic Document Images", Proceedings of the 12<sup>th</sup> Biennial Conference of the International Graphonomics Society, pp. 183-186, Salerno, Italy, 2005.
36. A. Rusu\* and V. Govindaraju, "Visual CAPTCHA with Handwritten Image Analysis", *Second International Workshop on Human Interactive Proofs*, pp. 42-52, Bethelam, PA, 2005.
37. S. Tulyakov\* and V. Govindaraju, "Optimal Combination of Independent Classifiers", *IAPR International Workshop on Multiple Classifier Systems*, pp. 147-155, Monterrey, CA, June 2005.
38. H. Lei\* and V. Govindaraju, "Half-Against-Half Multi-class Support Vector Machines", *IAPR International Workshop on Multiple Classifier Systems*, pp. 156-164, Monterrey, CA, June 2005.
39. 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.
40. S. Chikkerur\*, S. Pankanti, N. Ratha, R. Bolle, and V. Govindaraju, "Minutiae Verification in Fingerprint Images using Steerable Wedge Filters", *Workshop on Applications of Computer Vision*, pp. 111-116, CO 2005.
41. Z. Shi and V. Govindaraju, "Historical Document Image Segmentation Using Light Intensity Normalization", *SPIE Symposium on Electronic Imaging Science and Technology Electronic Imaging Vision*, SPIE Proceedings Series, San Jose, CA, January 2005.
42. H. Lei\* and V. Govindaraju, "Mouse based Signature Verification for Internet based Transactions", *SPIE Symposium on Electronic Imaging Science and Technology Electronic Imaging Vision*, SPIE Proceedings Series, Vol. 5673, pp. 153-160, San Jose, CA, January 2005.
43. A. Rusu\* and V. Govindaraju, "Challenges that Handwritten Text Pose to Computers and New Practical Applications", *SPIE Symposium on Electronic Imaging Science and Technology Electronic Imaging Vision*, Conference on Document Recognition and Retrieval XII, SPIE Proceedings Series, Vol. 5676, pp. 84-91, San Jose, CA, January 2005.
44. Z. Shi and V. Govindaraju, "Historical Documents Image Enhancement", *ACM Hardcopy Document Processing Workshop* Washington, D.C., 2004.
45. 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 International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 252-256, 2005.
46. S. Kompalli\*, S. Setlur, and V. Govindaraju, "Challenges in OCR of Devanagari Documents", *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 327-331, 2005.

47. L. Lorigo, and V. Govindaraju, “ Segmentation and Pre-Recognition of Arabic Handwriting”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 605-609, 2005.
48. S. Kang\*, and V. Govindaraju, “ A New Feature Ranking Method in a HMM-Based Handwriting Recognition System”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 779-783, 2005.
49. Z. Shi, S. Setlur, and V. Govindaraju, “Text Extraction from Gray Scale Historical Document Images Using Adaptive Local Connectivity Map”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 794-798, 2005.
50. A. Rusu\*, and V. Govindaraju, “A Human Interactive Proof Algorithm Using Handwriting Recognition”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 967-971, 2005.
51. Z. Shi, and V. Govindaraju, “Multi-scale Techniques for Document Page Segmentation”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 1020-1024, 2005.
52. R. Milewski\*, S. Setlur., and V. Govindaraju, “A Lexicon Reduction Strategy in the Context of Handwritten Medical Forms”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 1146-1150, 2005.
53. S. Tulyakov\*, and V. Govindaraju, “Combining Matching Scores in Identification Model”, *Proceedings of the International Conference on Document Analysis and Recognition*, Seoul, S. Korea, pp. 1151-1155, 2005.
54. F. Farooq\* and V. Govindaraju, and M. Perrone, “Pre-processing Methods for Handwritten Arabic Documents”, *Proceedings of the International Conference on Document Analysis and Recognition*, pp. 267-271, Seoul, S. Korea, 2005.
55. V. Govindaraju, “Emergency Medicine, Disease Surveillance, and Informatics”, *Proceedings of the ACM 6<sup>th</sup> National Conference on Digital Government Research*, pp. 167-168, Atlanta, GA, 2005.
56. V. Govindaraju, “Advances in Fingerprint Recognition at CUBS”, *Proceedings of the International Workshop on Document Analysis*, pp. 149-174, Kolkata, 2005. *Invited*.
57. P. Mansukhani\* and V. Govindaraju, “Similarity Measures for Biometric Databases”, *International Conference on Audio and Video Based Biometric Person Authentication*, Tarrytown, pp. 832-840, NY, 2005.
58. 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*, 977-986, Tarrytown, NY, 2005.
59. A. Mhatre\*, S. Chikkerur\*, and V. Govindaraju, “Indexing Biometric Databases using Pyramid Techniques”, *International Conference on Audio and Video Based Biometric Person Authentication*, Tarrytown, pp. 841-849, NY, 2005.
60. A. Mhatre\*, S. Palla\*, S. Chikkerur\*, and V. Govindaraju, “Efficient Search and Retrieval in Biometric Databases”, *SPIE Conference on Defense and Security*, Orlando, FL, 2005.
61. S. Palla\*, H. Lei\*, and V. Govindaraju, “Signature and Lexicon Pruning Techniques”, *Ninth IAPR International Workshop on Frontiers of Handwriting Recognition*, pp. 474-478, Tokyo, Japan, 2004.
62. A. Rusu\*, and V. Govindaraju, “Handwritten CAPTCHA: Using the difference in the abilities of humans and machines to read handwritten words”, *Ninth IAPR International Workshop on Frontiers of Handwriting Recognition*, pp. 226-231, Tokyo, Japan, 2004.
63. H. Lei\*, S. Palla\*, and V. Govindaraju, “An Intuitive Similarity Measure for Signature Verification”, *Ninth IAPR International Workshop on Frontiers of Handwriting Recognition*, pp. 191- 195, Tokyo, Japan, 2004.

64. H. Baird, V. Govindaraju, and D. Lopresti, "Document Analysis Systems Architectures for Digital Libraries" *IAPR Workshop on Document Analysis Systems*, pp. 1-16, Florence, Italy, 2004.
65. S. Kompalli\*, R. Setlur, and V. Govindaraju, "Architectures for Devanagari Digital Libraries" *IAPR Workshop on Document Analysis Systems*, pp. 28-37, Florence, Italy, 2004.
66. H. Lei\* and V. Govindaraju, "Direct Image Matching Using Dynamic Warping", *First IEEE Workshop on Face Processing in Video*, Washington D.C., 2004.
67. H. Lei\* and V. Govindaraju, "A 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*, pp. 444-449, Portugal, Lisbon, 2004.
68. V. Govindaraju and H. Xue\*, "Fast Handwriting Recognition for Indexing Historical Documents", *1<sup>st</sup> Workshop on Document Image Analysis and Libraries*, pp. 314-320, Palo Alto, CA, 2004.
69. Z. Shi and V. Govindaraju, "Line Separation for Complex Document Images Using Fuzzy Runlength", *1<sup>st</sup> Workshop on Document Image Analysis and Libraries*, pp. 306-313, Palo Alto, CA, 2004.
70. B. Zhang, C. Tomai, S. Srihari, and V. Govindaraju, "Construction of Handwritten Databases Using Transcript Based Mapping", *1<sup>st</sup> Workshop on Document Image Analysis and Libraries*, pp. 288-298, Palo Alto, CA, 2004.
71. V. Govindaraju, S. Kompalli, F. Farooq, S. Khedekar, V. Ramanaprasad, and S. Setlur, "Tools for Enabling Digital Access to Multilingual Digital Libraries", *1<sup>st</sup> Workshop on Document Image Analysis and Libraries*, pp. 122-133, Palo Alto, CA, 2004.
72. Z. Shi, S. Setlur, and V. Govindaraju, "Digital Enhancement of Palmscript Manuscript Images Using Normalization Techniques", *5<sup>th</sup> International Conference on Knowledge Based Computer Systems*, pp. 69-78, Hyderabad, India, 2004. Acceptance rate =  $50/200 = 25\%$ .
73. A. Rusu\* and V. Govindaraju, "Handwriting Word Recognition: A New CAPTCHA Challenge", *5<sup>th</sup> International Conference on Knowledge Based Computer Systems*, pp. 357-367, Hyderabad, India, 2004. Acceptance rate =  $50/200 = 25\%$ .
74. 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*, December 2004.
75. H. Lei\* and V. Govindaraju, "Matching and Retrieving Sequential Patterns Under Regression", *IEEE/WIC/ACM International Joint Conference on Web Intelligence*, pp. 84-90, Beijing, China, 2004. Regular paper acceptance rate =  $35/238 = 16\%$ .
76. H. Lei\* and V. Govindaraju, "Regression Time Warping for Similarity Measure of Sequences", *International Conference on Computer and Information Technology*, pp. 826-830, Wuhan, China, 2004.
77. Z. Shi and V. Govindaraju, "Historical Document Image Enhancement Using Background Light Intensity Normalization", *International Conference on Pattern Recognition*, pp. 473-476, Cambridge, UK, 2004. Oral Paper Acceptance rate = 18%.
78. H. Lei\* and V. Govindaraju, "GRM: A New Model for Clustering Linear Sequences", *SIAM Conference on Data Mining*, pp. 23-32, Orlando, FL, 2004.
79. S. Chikkerur\*, C. Wu, and V. Govindaraju, "Systematic approach for feature extraction in fingerprint images", *1st International Conference on Biometric Authentication*, pp. 344-350, Hong Kong 2004.
80. A. Teredesai\* and V. Govindaraju, "Issues in Evolving GP Based Classifiers for a Pattern Recognition Task", *IEEE Congress on Evolutionary Computation*, 2004.
81. C. Wu\*, Z. Shi, and V. Govindaraju, "Fingerprint Image Enhancement Using Directional Median Filters", *SPIE Conference on Defense and Security*, Orlando, FL, 2004.

82. T. Jea\*, V. Chavan, and V. Govindaraju, "Security and Matching of Partial Fingerprint Recognition Systems", *SPIE Conference on Defense and Security*, Orlando, FL, 2004.
83. R. Milewski\* and V. Govindaraju, "Automatic Reading and Mining of Pre-Hospital Care Reports", *17<sup>th</sup> IEEE Symposium on Computer-Based Medical Systems*, pp. 428-433, Bethesda, MD, June 2004.
84. V. Chavan\*, S. Chikkerur\*, S. Tulyakov\*, and V. Govindaraju, "Securing Pervasive Networks Using Biometrics", *1<sup>st</sup> NSF / NSA/ AFR Workshop on Secure Knowledge Management*, Buffalo, NY 2004.
85. S. Chikkerur\*, V. Chavan\*, and V. Govindaraju, "A Study on the Convergence of Biometrics and Cryptographic Security", *1<sup>st</sup> NSF / NSA/ AFR Workshop on Secure Knowledge Management*, Buffalo, NY 2004.
86. S. Palla\*, S. Chikkerur\*, and V. Govindaraju, "Classification and Indexing in Large Biometric Databases", *Biometrics Consortium Conference*, Crystal City, VA, September 2004.
87. S. Tulyakov\*, V. Chavan\* and V. Govindaraju, "Symmetric Hash Functions for Fingerprint Minutiae", *Biometrics Consortium Conference*, Crystal City, VA, September 2004.
88. V. Govindaraju, Z. Shi, and J. Schneider, "Feature Extraction Using Chaincoded Contours of Fingerprint Images", *International Conference on Audio and Video Based Biometric Person Authentication*, pp. 268-275, Surrey, UK, 2003. Acceptance rate =  $116/162 = 72\%$ .
89. J. Schneider, L. Pratt, and V. Govindaraju, "On the Correlation of Image Size to System Accuracy in Fingerprint Identification Systems", *International Conference on Audio and Video Based Biometric Person Authentication*, pp. 895-902, Surrey, UK, 2003. Acceptance rate =  $116/162 = 72\%$ .
90. Z. Shi and V. Govindaraju, "Skew Detection for Complex Document Images Using Fuzzy Runlengths", *IEEE International Conference on Document Analysis and Recognition*, pp. 715-719, Edinburgh, UK, 2003.
91. S. Tulyakov and V. Govindaraju, "Postal Address Block Location by Contour Clustering", *IEEE International Conference on Document Analysis and Recognition*, pp. 421-432, Edinburgh, UK, 2003.
92. S. Khedekar\*, V. Ramanaprasad\*, S. Setlur, and V. Govindaraju, "Text Image Separation in Devanagari Document Images", *IEEE International Conference on Document Analysis and Recognition*, pp. 1265-1269, Edinburgh, UK, 2003.
93. S. Setlur\*, V. Ramanaprasad\*, S. Kompalli\*, and V. Govindaraju, "A Multi-lingual Truthing Platform for South Asian Languages", *IEEE International Conference on Data Engineering - Multilingual Information Management*, Hyderabad, India, 2003.
94. 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*, pp. 189-196, MD, 2003
95. H. Xue\* and V. Govindaraju, "A Stochastic Model Combining Discrete Symbols and Continuous Attributes and Its Application to Handwriting Recognition" *IAPR Workshop on Document Analysis Systems*, Princeton, NJ, pp. 70-81, 2002.
96. H. Xue\* and V. Govindaraju, "Incorporating Contextual Character Geometry in Word Recognition", *Eighth International Workshop on Handwriting Recognition*, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 123-127, August 2002.
97. 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", *Eighth International Workshop on Handwriting Recognition*, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 244-249, August 2002.

98. R. Milewski\* and V. Govindaraju, "Medical Word Recognition Using a Computational Semantic Lexicon", *Eighth International Workshop on Handwriting Recognition*, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 401-406, August 2002.
99. C. Tomai\*, B. Zhang\*, and V. Govindaraju, "Transcript Mapping for Historic Handwritten Documents", *Eighth International Workshop on Handwriting Recognition*, IEEE Computer Society Press, Niagara-on-the-Lake, Canada, pp. 413-418, August 2002.
100. A. Teredesai\* and V. Govindaraju. "On-Line Digit Recognition Using Off-Line Features", *Indian Conference on Computer Vision, Graphics, and Image Processing*, Ahmedabad, India, December 2002. *Invited paper*.
101. A. Teredesai\* and V. Govindaraju. "Recurrent Genetic Programming", *IEEE International Conference on Systems, Man, and Cybernetics*, IEEE Computer Society Press, Hammamet, Tunisia, October 2002. *Invited paper*.
102. H. Xue\* and V. Govindaraju, "On the Dependence of Handwritten Word Recognizers on Lexicons" *International Conference on Pattern Recognition*, pp. 241-244, Quebec City, Canada. 2002, *accepted*. Oral Paper Acceptance rate = 13%.
103. V. Govindaraju, "Automatic Reading and Mining of Pre-Hospital Care Reports", *14<sup>th</sup> IEEE Symposium on Computer-Based Medical Systems*, pp. 152-157, Bethesda, MD, July 2001.
104. V. Govindaraju, Z. Shi, and A. Teredesai\*, "Secondary Classification Using Key Features", *SPIE Symposium on Electronic Imaging Science and Technology*, Internet Imaging, SPIE Proceedings Series, San Jose, pp. 272-278, CA, January 2001.
105. S. Setlur, V. Govindaraju, S. Srihari, A. Lawson., "Large Scale Address Recognition Systems-Truthing and Tools", *Symposium on Document Image Understanding Technology*, MD, April 2001.
106. H. Xue\* and V. Govindaraju, "Building Skeletal Graphs for Structural Feature Extraction on Handwriting Images", *Sixth IAPR International Conference on Document Analysis and Recognition*, pp. 96-105, Seattle, WA, 2001. Oral paper presentation acceptance rate =  $143/297 = 48\%$ .
107. S. Tulyakov\* and V. Govindaraju, "Probabilistic Models for Segmentation Based Word Recognizers with a Lexicon", *Sixth IAPR International Conference on Document Analysis and Recognition*, pp. 164-167, Seattle, WA, 2001. Oral paper presentation acceptance rate =  $143/297 = 48\%$ .
108. A. Teredesai\* V. Govindaraju, "Active Digit Classifiers: A Separability Optimization Approach to Emulate Cognition", *Sixth IAPR International Conference on Document Analysis and Recognition* pp. 401-405, Seattle, WA, 2001. Oral paper presentation acceptance rate =  $143/297 = 48\%$ .
109. S. Setlur, A. Lawson, V. Govindaraju, and S. Srihari, "A Truthing and Evaluation System for Measuring Address Recognition Performance", *Sixth IAPR International Conference on Document Analysis and Recognition*, pp. 1205-1214, Seattle, WA, 2001. Oral paper presentation acceptance rate =  $143/297 = 48\%$ .
110. A. Teredesai\*, J. Park\*, and V. Govindaraju, "Active Handwritten Character Recognition Using Genetic Programming", *4<sup>th</sup> European Conference, EuroGP*, pp. 371-379, Lake Como, Italy, 2001.
111. W. Yang, V. Govindaraju, and S. Srihari, "Discovering Redundant Address Components for Automatic Address Interpretation", *International Conference on Artificial Intelligence*, pp. 308-312, Las Vegas, NV, June 2001.
112. Y. Wu\*, K. Ianakiev\* and V. Govindaraju., "Improving K-NN Classification", *International International Conference on Advances in Pattern Recognition*, pp. 222-229, Rio De Janerio, Brazil, March 2001. *Invited paper*.

113. Y. Wu\*, K. Ianakiev\*, and V. Govindaraju, "Confidence Combination Methods in Multiple Expert Systems", *IAPR International Workshop on Structural and Syntactic Pattern Recognition*, pp. 641-649, Alicante, Spain, August 2000.
114. K. Ianakiev\* and V. Govindaraju, "Improvement of Recognition Accuracy Using 2-stage Classification", *Seventh International Workshop on Handwriting Recognition*, Amsterdam, The Netherlands, pp. 153-165, August 2000. Ranked 7 out of 78 papers submitted.
115. J.Park\* and V. Govindaraju, "Active Word Recognition", *Seventh International Workshop on Handwriting Recognition*, Amsterdam, The Netherlands, pp. 403-412, August 2000. Ranked 19 out of 78 papers submitted.
116. H. Xue\* and V. Govindaraju, "Character Recognition by Matching Sequences of Pseudo-stroke Positions and Directions", *Seventh International Workshop on Handwriting Recognition*, Amsterdam, The Netherlands, pp. 589-594, August 2000. Ranked 3 out of 33 papers, accepted as poster.
117. K. Ianakiev and V. Govindaraju, "Architecture for Classifier Combination Using Entropy Measures", *IAPR International Workshop on Multiple Classifier Systems*, pp. 340-350, Cagliari, Italy, June 2000.
118. P. Slavik and V. Govindaraju, "Use of Lexicon Density in Evaluating Word Recognizers", *IAPR International Workshop on Multiple Classifier Systems*, pp. 310-319, Cagliari, Italy, June 2000.
119. S. Madhvanath\* and V. Govindaraju, "Score Aggregation from Multiple Sources and Training in the Context of Lexicon Reduction Using Holistic Features. *Indian Conference on Computer Vision, Graphics, and Image Processing*, Allied Publishers Limited, Bangalore, India, pp. 180-187, December 2000.
120. J. Park\* and V. Govindaraju, "Active Character Recognition Using A\*-like Algorithm", *IEEE International Conference on Computer Vision and Pattern Recognition*, IEEE Computer Society Press, Hilton Head, S.C., pp. 82-87, June 2000. Oral paper presentation acceptance rate =  $66/466 = 14\%$ .
121. J. Park\* and V. Govindaraju, "Using Lexical Entropy in Word Recognition", *IEEE International Conference on Computer Vision and Pattern Recognition*, IEEE Computer Society Press, pp. 290-295, Hilton Head, S.C., June 2000. Poster paper acceptance rate =  $154/400 = 39\%$ .
122. S. Setlur and V. Govindaraju, "Translingual OCR by Template Correlations", *SPIE Symposium on Electronic Imaging Science and Technology Internet Imaging*, SPIE Proceedings Series, San Jose, CA, January 2000.
123. D. Bouchaffra, V. Govindaraju, and S. Srihari, "Recognition of Strings Using Non-Stationary Markovian Models: An Application in ZIP Code Recognition", *IEEE Conference on Computer Vision and Pattern Recognition*, IEEE Computer Society Press, Fort Collins, pp. 174-179, June 1999.
124. 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.
125. K. Ianakiev\* and V. Govindaraju, "Fuzzy Control Structures in Multiple Parameter Systems: An Application in a Handwritten Address Interpretation System", *North American Fuzzy Information Processing Systems Conferences*, IEEE Computer Society Press, Manhattan, NY, pp. 918-922, 1999.
126. X. Wang, V. Govindaraju, and S. Srihari, "Multi-experts for Touching Digit String Recognition", *IAPR Conference on Document Analysis and Recognition*, IEEE Computer Society Press, Bangalore, India, pp. 800-803, 1999.
127. J. Park\*, V. Govindaraju, and S. Srihari, "Word Segmentation and Phrase Recognition", *IAPR Conference on Document Analysis and Recognition*, IEEE Computer Society Press, Bangalore, India, pp. 605-608, 1999.

128. S. Srihari, W. Yang, and V. Govindaraju, "Information Theoretic Analysis of Postal Address Fields for Automatic Address Interpretation", *IAPR Conference on Document Analysis and Recognition*, IEEE Computer Society Press, Bangalore, India, pp. 309-312, 1999.
129. S. Srihari, W. Yang, and V. Govindaraju, "Address Interpretation", *International Conference on Mail Technology in Tomorrow's World*, Stakis Brighton Metropole, Brighton, UK, June 1999.
130. S. Srihari, W. Yang, and V. Govindaraju, "Graph-Theoretic Modeling and Entropy Analysis of Postal Address Fields", *HKK Conference and Symposium*, Waterloo, ON, March 1999.
131. 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*, pp. 524-531, Sydney, Australia, August 1998.
132. G. Kim\*, V. Govindaraju, and S. Srihari, "Architecture for Handwritten Text Recognition Systems", *Sixth International Workshop on Handwriting Recognition*, pp. 113-122, Taejon, S. Korea, August 1998.
133. X. Wang, V. Govindaraju, and S. Srihari, "Holistic Recognition of Touching Digit Pairs", *Sixth International Workshop on Handwriting Recognition*, pp. 295-303, Taejon, S. Korea, August 1998.
134. D. Bouchaffra, V. Govindaraju, and S. Srihari, "A Methodology for Deriving Probabilistic Correctness Measures from Recognizers", *IEEE Conference on Computer Vision and Pattern Recognition*, IEEE Computer Society Press, pp. 930-935, Santa Barbara, CA, June 1998. Oral paper presentation acceptance rate =  $42/453 = 9\%$ .
135. D. Bartnik\*, V. Govindaraju, S. Srihari, and B. Phan, "Reply Card Mail Processing", *International Conference on Pattern Recognition*, IEEE Computer Society Press, pp. 633-636, Brisbane, Australia, 1998. Oral paper presentation acceptance rate =  $295/786 = 38\%$ .
136. J. Park\*, V. Govindaraju, and S. Srihari, "OCR in Hierarchical and Multi-resolution Feature Space", *IEEE International Conference on Systems, Man, and Cybernetics*, IEEE Computer Society Press, pp. (4)324-(4)329, San Diego, October 1998. *Invited paper*.
137. V. Govindaraju, K. Ianakiev\*, and S. Srihari, "Improving Classifier Accuracy by Simulating Fuzzy Boundaries Between Classes", *North American Fuzzy Logic and Image Processing Conference*, pp. 161-164, Pensacola, FL, August 1998. *Invited paper*.
138. 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*, pp. 71-72, Mysore, India, 1998.
139. 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. (2)028-(2)033, October 1997. *Invited paper*.
140. V. Govindaraju and S. Srihari, "Paradigms in Handwriting Recognition", *IEEE International Conference on Systems, Man and Cybernetics*, IEEE Computer Society Press, pp. 1498-1503, Orlando, FL, October 1997. *Invited paper*.
141. S. Madhvanath\*, E. Kleinberg, and V. Govindaraju, "The HOVER System for Rapid Holistic Verification of Off-line Handwritten Phrases", *International Conference of Document Analysis and Recognition*, IEEE Computer Society Press, Ulm, Germany, pp. 855-859, October 1997. Oral paper acceptance rate =  $295/786 = 38\%$ .
142. S. Madhvanath\* and V. Govindaraju, "Contour-based Image Preprocessing for Holistic Handwritten Word Recognition", *International Conference of Document Analysis and Recognition*, IEEE Computer Society Press, Ulm, Germany, pp. 536-539, October 1997. Oral paper acceptance rate =  $295/786 = 38\%$ .
143. G. Kim\*, V. Govindaraju and S. N. Srihari, "A Segmentation and Recognition Approach of Handwritten Phrases as Applied to Street Name Images", *IEEE Conference on Pattern*

- Recognition*, IEEE Computer Society Press, pp. D-510-513, Vienna, Austria, August 1996. Oral paper acceptance rate =  $252/100 = 25\%$ .
144. G. Kim\* and V. Govindaraju, "Recognition of Handwritten Phrases as Applied to Street Name Images", *IEEE Conference on Computer Vision and Pattern Recognition*, IEEE Computer Society Press, pp. 459-464, San Francisco, CA, June 1996. Oral paper acceptance rate =  $73/551 = 13\%$ .
  145. 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, pp. (3)454-(3)457, Atlanta, GA, May 1996.
  146. J. Favata, V. Govindaraju, and S. Srihari, "Off-line Handwritten Sentence Recognition" *Fifth International Workshop on Frontiers in Handwriting Recognition*, pp. 171-176, Essex, UK, September 1996.
  147. S. Gholam\*, V. Govindaraju, and S. Srihari, "Computer Aided Graphology", *Fifth International Workshop on Frontiers in Handwriting Recognition*, pp. 457-460, Essex, UK, September 1996.
  148. G. Kim\*, V. Govindaraju, and S. Srihari, "Extension of Handwritten Word Recognition to Street Name Recognition", *Fifth International Workshop on Frontiers in Handwriting Recognition*, pp. 221-226, Essex, UK, September 1996.
  149. Z. Shi and V. Govindaraju, "Segmentation and Recognition of Connected Handwritten Numeral Strings", *Fifth International Workshop on Frontiers in Handwriting Recognition*, pp. 305-308, Essex, UK, September 1996.
  150. G. Kim\* and V. Govindaraju, "Efficient Chain Code Based Image Manipulation for Handwritten Word Recognition", *SPIE Symposium on Electronic Imaging Science and Technology*, SPIE Proceedings Series, pp. 262-272, San Jose, CA, February 1996.
  151. S. Madhvanath\* and V. Govindaraju, "Holistic Lexicon Reduction for Handwritten Word Recognition", *SPIE Symposium on Electronic Imaging Science and Technology*, SPIE Proceedings Series, pp. 224-234, San Jose, CA, February 1996.
  152. M. Venkatraman\* and V. Govindaraju, "Zero Crossings of a Non-orthogonal Wavelet Transform for Object Recognition", *IEEE Conference on Image Processing*, IEEE Signal Processing Society Press, Washington D.C., Vol. 3, pp. 57-60, August 1995.
  153. 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, August 1995. *Invited paper*.
  154. 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, August 1995. Oral paper acceptance rate =  $295/786 = 38\%$ .
  155. S. Madhvanath\*, V. Govindaraju, and S. Srihari, "Reading Handwritten US Census Forms", *International Conference on Document Analysis and Recognition*, IEEE Computer Society Press, Montreal, Canada, pp. 82-85, August 1995. Oral paper acceptance rate =  $295/786 = 38\%$ .
  156. S. Madhvanath\* and V. Govindaraju, "Lexicon Reduction for Handwritten Word Reduction", *International Conference on Document Analysis and Recognition*, IEEE Computer Society Press, Montreal, Canada, pp. 911-914, August 1995. Oral paper acceptance rate =  $295/786 = 38\%$ .
  157. V. Govindaraju and S. Srihari, "System for Reading Handwritten Documents", *IEEE International Conference on Systems, Man, and Cybernetics*, IEEE Computer Society Press, Vancouver, BC, October pp. 347-352, 1995. *Invited paper*.
  158. J. Favata, V. Govindaraju, and S. Srihari, "Unconstrained Handwritten Text Recognition", *Symposium on Document Image Understanding Technology*, pp. 226-236, Bowie, MD, October 1995.
  159. V. Govindaraju, R. Srihari, and S. Srihari, "Handwritten Text Recognition", *Fourth International Workshop on Handwriting Recognition*, pp. 265-274, Taipei, Taiwan, December 1994.

160. R. Srihari, M. Venkatraman\*, R. Chopra, and V. Govindaraju, "Use of Collateral Text in Image Interpretation", *ARPA Image Understanding Workshop*, pp. 897-907, Monterey, CA, November 1994.
161. V. Govindaraju, R. Srihari, and S. Srihari", "Handwritten Text Recognition", *IAPR Workshop on Document Analysis Systems*, pp. 157-171, Kaiserlautern, Germany, October 1994.
162. 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*, pp. 34-40, College Station, Texas, June 1994.
163. J. Zhou\*, V. Govindaraju, R. Acharya, and S. Srihari, "State Name Abbreviation Recognition", *Third International Workshop on Frontiers in Handwriting Recognition*, pp. 423-430, Buffalo, NY, May 1993.
164. S. Madhvanath\* and V. Govindaraju, "Holistic Word Recognition", *Third International Workshop on Frontiers in Handwriting Recognition*, pp. 71-81, Buffalo, NY, May 25-27, 1993.
165. V. Govindaraju, A. Shekhawat, and S. Srihari, "Interpretation of Handwritten Addresses in US Mail Stream", *International Conference on Document Analysis and Recognition*, IEEE Computer Society Press, pp. 291-294, Tsukuba Science City, Japan, October 1993. Oral paper acceptance rate =  $295/786 = 38\%$ .
166. V. Govindaraju, A. Shekhawat, and S. Srihari, "Interpretation of Handwritten Addresses in US Mail Stream", *First European Conference Dedicated to Postal Technologies*, pp. 421-428, Nantes, France, June 1993.
167. V. Govindaraju, E. Cohen, A. Shekhawat, and S. Srihari, "Determining the Delivery Point Code on Handwritten Addresses", *Fifth Advanced Technology USPS Conference*, pp. 321-336, Washington D.C., 1992.
168. V. Govindaraju, D. Wang, and S. Srihari, "Holistic Approach to Handwritten Word Recognition Using Temporal Information Extracted from Static Images", *Fifth Advanced Technology USPS Conference*, pp. 529-546, Washington D.C., 1992.
169. S. Madhavanath\*, V. Govindaraju, and S. Srihari, "Using n-gram Features in Handwritten Word Recognition", *Fifth Advanced Technology USPS Conference*, pp. 183-198, Washington D.C., 1992.
170. V. Govindaraju, D. Sher, and S. Srihari, "A Computational Model for Face Location Based on Cognitive Principles", *Tenth National Conference of the American Association of Artificial Intelligence*, AAAI Press / The MIT Press, pp. 350-355. San Jose, CA, 1992. Oral paper acceptance rate =  $133/636 = 21\%$ .
171. 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. Oral paper acceptance rate =  $295/786 = 38\%$ .
172. V. Govindaraju, S. Lam, D. Niyogi, D. Sher, R. Srihari, and S. Srihari, "Newspaper Image Understanding", *International Conference on Knowledge Based Systems*, Narosa Publishing House, pp. 375-386, Bombay, India, 1991.
173. V. Govindaraju and S. Srihari, "Separating Handwritten Text from Non-Textual Interference", *Second International Workshop on Frontiers in Handwriting Recognition*, pp. 229-240, Chateau de Bonas, France, September 1991.
174. 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*, pp. 229-240, Chateau de Bonas, France, September 1991.
175. V. Govindaraju, D. Sher, and S. Srihari, "A Computational Model for Face Location", *Third International Conference on Computer Vision*, IEEE Computer Society Press, pp. 718-721, Osaka, Japan, December 1990.

176. 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, pp. 278-281, San Diego, CA, June 1989. Oral paper acceptance rate =  $95/300 = 32\%$ .

## **D. Citations**

There are roughly 300 external citations to about 30 key papers by Dr. Govindaraju (source: Google Scholar). His seminal paper on real-time handwriting recognition (*IEEE Transaction on Pattern Analysis and Machine Intelligence*, 1997) has over 140 citations; the paper on Hough transform analysis of textual documents (*Journal of Machine Vision and Applications*, 1989) and an architecture for end-to-end handwriting recognition systems (*International Journal on Document Analysis and Recognition*, 1999) each have about 70 citations. Govindaraju's work on face detection is recognized as one of the first in the field (*IEEE Conference on Computer Vision and Pattern Recognition*, 1989), now an integral component of video surveillance technologies. Govindaraju has four important papers on the topic each with more than 50 citations.

## **E. Patents**

1. US 5,515,455: "System for Recognizing Handwritten Words of Cursive Script", V. Govindaraju, D. Wang, and S. Srihari. 1996.
2. US 20060078171: "Biometric Convolution Using Multiple Biometrics", V. Govindaraju, S. Chikkerur, and S. Chavan. 2006. (Provisional)
3. "Secure Fingerprint Matching by Hashing Localized Information", V. Govindaraju, S. Tulyakov, F. Farooq, and S. Chikkerur. 2007. (Pending)
4. "System for Indicating Deceit and Verity", T. Slowe, V. Govindaraju, P. Kilinskas, J. Delbert, and M. Moskal. 2007. (Pending)

## C. Invited Talks

(University and Industry Research Labs)

- 06/04/07 Motorola Labs, Hyderabad, India  
*Pattern Recognition for Mobile Devices*
- 05/26/07 IEEE Chapter of Hyderabad and University of Hyderabad, India  
*Fusion of Handwriting Classifiers*
- 02/22/07 Carnegie Mellon University, Pittsburgh, PA  
*Paradigms of Handwriting Recognition for Varying Degrees of Domain Constraints*
- 01/04/07 Gayatri Vidya Parishad, Visakhapatnam, India  
*Biometrics and Security*
- 12/30/06 PES College of Engineering, Bangalore, India  
*Combination of Classifiers*
- 12/01/06 University of Maryland, College Park, MD  
*Fusion of Biometric Matchers*
- 11/07/06 Indian Institute of Technology, Delhi, India  
*Fusion of Biometric Matchers*
- 11/04/06 IEEE Chapter of Birla Institute of Technology , Ranchi  
*Biometrics and Security*
- 11/04/06 Birla Institute of Technology, Ranchi, India  
*Fusion of Biometric Matchers*
- 07/04/06 International Institute of Technology, Hyderabad, India  
*Investigating the Vulnerabilities of Biometric Modalities*
- 06/23/06 HP Research, Bangalore, India  
*Investigating the Vulnerabilities of Biometric Modalities*
- 05/06/05 Center for Development of Advanced Computing, Hyderabad, India  
*Indexing and Searching Biometric Databases*
- 04/28/05 Korea Advanced Institute of Science and Technology, Seoul, S. Korea  
*Biometrics and Security*
- 01/04/05 HP Research Labs, Bangalore, India  
*Biometrics and Security*
- 01/03/05 **Distinguished Lecture Series**, Amrita University, Coimbatore, India  
*Biometrics and Security*
- 12/30/04 Indian Institute of Technology, Chennai, India  
*Biometrics and Security*
- 10/10/03 Concordia University, Montreal, Canada  
*From Fighting Bioterrorism to Reading ZIP Codes- the Handwriting is on the Wall*
- 08/14/03 IBM TJ Watson Research Center  
*From Fighting Bioterrorism to Reading ZIP Codes- the Handwriting is on the Wall*
- 06/02/03 Tata Consulting Services, Hyderabad, India  
*Unified Biometric Systems*
- 05/09/03 School of Engineering, Rochester Institute of Technology, Rochester, NY  
*From Anthrax to ZIP Codes- the Handwriting is on the Wall*
- 04/16/03 Department of Computer Science, Wayne State University, Detroit, MI  
*From Anthrax to ZIP Codes- the Handwriting is on the Wall*
- 10/13/02 Department of Computer Science, University of Massachusetts, Amherst  
*From Anthrax to ZIP Codes- the Handwriting is on the Wall*
- 07/08/02 International Institute of Information Technology, Hyderabad, India  
*Postal Automation*

- 10/09/00 IBM TJ Watson Research Center, Yorktown Heights, NY  
*Issues in Classifier Combination*
- 06/15/00 Xerox Palo Alto Research Center (PARC)  
*Issues in Classifier Combination*
- 12/03/99 Xerox, Webster Research Center, Rochester, NY  
*Adaptive OCR*
- 12/24/99 Indian Statistical Institute, Calcutta, India  
*Active Pattern Recognition*
- 11/23/99 Linguistic and Multimedia Laboratory, University of Maryland, College Park, MD  
*Active Pattern Recognition*
- 06/28/99 Kent Research Digital Labs, Singapore  
*Non-Stationary Markov Models in ZIP Code Recognition*
- 03/27/97 Department of Electrical Engineering, Wayne State University, Detroit, MI  
*Paradigms in Recognition*
- 12/16/94 Department of Electrical Engineering, University of Michigan, Dearborn, MI  
*Handwritten Text Recognition*

### **Invited Talks at Conferences**

- 02/07/07 NYSTAR University Technology Showcase, Rochester, NY  
*Pattern Recognition in Biometrics and Digital Libraries*
- 11/17/06 NSF Workshop on International Sanskrit Digital Library Integration, Brown University  
*Devanagari Script OCR*
- 09/29/06 IEEE Western New York Image Processing Workshop, Rochester, NY  
**Plenary Talk:** *Improving the Security of Biometric Systems, Rochester, NY*
- 09/28/06 Summit on Arabic and Chinese Handwriting Recognition, College Park, MD  
*Paradigms in Handwriting Recognition*
- 12/23/05 International Conference on Cognition and Recognition, Mysore, India  
**Valedictory Address:** *Passwords on Your Fingertips*
- 12/15/05 Advanced Computing Conference, Amrita University, Coimbatore, India  
**Keynote Address:** *Passwords on Your Fingertips*
- 05/07/05 Workshop on Tools for Indian Digital Libraries, IIT Hyderabad, India  
*Enhancement of Historical Manuscript Images and State of Devanagari OCR*
- 01/16/05 Devanagari OCR Workshop, Brown University, RI  
*Digital Access of Indic Documents*
- 09/11/04 World Hindi Conference, Amherst, NY  
**Keynote Address:** *Digital Access of Indic Manuscripts*
- 11/14/03 Griffis Institute Cyber Security Conference, New Paltz, NY  
*Unified Biometrics and Sensors*
- 02/25/03 New York State Cyber-Security Symposium, Utica, NY  
*Biometric Acquisition and Recognition*
- 01/24/03 International Workshop on Technology Development in Indian Languages (IWTDIL)  
Indian Statistical Institute, Calcutta, India
- 04/24/01 Symposium for Document Image Understanding Technology (SDIUT), Annapolis, MD  
*Large Scale Truthing*
- 03/29/01 International Workshop on Technology Development in Indian Languages (IWTDIL)  
Indian Statistical Institute, Calcutta, India  
*Lexicon Modeling in Handwritten Phrase Recognition*
- 06/22/00 International Workshop on Multiple Classifier Systems, Cagliari, Italy.  
*Serial Combination of Word Recognizers*

02/15/94 2<sup>nd</sup> Census OCR Conference, National Institute of Standards, Bethesda, MD  
*Handwritten Phrase Recognition*

### **Talks at University at Buffalo**

04/13/07 Guest Speaker, Information Assurance Class, School of Management  
*Biometrics 101*

12/02/05 UB Friday Forum  
*Tailoring Unique Biometric Systems for Homeland Security and Public Health*

09/30/05 IGERT Colloquium Series  
*Overview of the Center for Unified Biometrics and Sensors*

07/21/05 UB This Summer, Buffalo, NY  
*Biometrics in Homeland Security*

03/12/05 Engineering Seminar & Exhibition, University at Buffalo  
*Biometrics and Handwriting Recognition for Security Applications*

07/23/03 UB This Summer, Buffalo, NY  
*From Fighting Bio-Terrorism to Reading ZIP Codes*

10/29/04 Guest Speaker, Information Assurance Class, School of Management  
*Biometrics and Sensors*

04/24/03 University at Buffalo, School of Engineering, Dean's Council, Buffalo, NY  
*Unified Biometric Systems*

11/19/99 Department of Computer Science & Engineering, University at Buffalo, NY  
*Active Pattern Recognition*

10/16/92 Department of Computer Science, University at Buffalo, NY  
*Face Location in Photographs*

### **Talks at Other Forums**

04/26/07 Copanion Inc., Boston, MA  
*Searching Degraded Handwritten Documents*

07/24/04 AP State Education Council, Hyderabad India  
*Biometrics Applications*

12/30/03 Jawaharlal Nehru Technological University, Hyderabad, India  
*Unified Biometrics and Sensors*

08/09/01 Institution of Electronics and Telecommunication Engineers, Hyderabad, India  
*Active Handwritten Character Recognition*

05/19/99 National Postal Forum, San Antonio, TX.  
*USPS is World Leader in Handwriting Recognition*

11/09/94 Digital Post Modernism, Nice, France  
*Mail Sorting Applications*

08/17/94 System House Limited, Ottawa, Canada  
*Remote Computer Reading*

05/10/94 Digital Road Show, UK & France  
*Mail Sorting Applications*

## II Service

### A. Professional Service

#### Professional Memberships

- |  |                    |                |
|--|--------------------|----------------|
| • Institute of Electrical and Electronics Engineers (IEEE) | Member<br>(Fellow) | 1998 - present |
| • International Graphonomics Society (IGS)                 | Board Member       | 1999 – present |
| • American Association of Computing Machinery (ACM)        | Member             | 1998 - present |

#### Editorial Boards

- |  |               |
|--|---------------|
| • International Journal of Pattern Analysis and Applications     | 2004- present |
| • International Journal on Document Analysis and Recognition     | 2003- present |
| • IEEE Transactions on Pattern Analysis and Machine Intelligence | 2001- 2005    |
| • IEEE Transactions on Systems, Man, and Cybernetics (B)         | 2000- present |
| • The Journal of Pattern Recognition                             | 1997- present |

#### Conference Organizations/ Leadership Positions

- |                         |  |            |
|-------------------------|--|------------|
| • Co-Chair              | Document Analysis Track, International Conference on Pattern Recognition, Tampa, FL                              | Dec. 2008  |
| • Co-Chair              | CVPR Biometrics Workshop   | Jun. 2007  |
| • General Program       | First IEEE Conference on Biometrics: Theory, Applications, and Systems, DC                                       | Sept. 2007 |
| • Co-Chair              | CVPR Multi-biometric Workshop, Minneapolis, MN   | Jun. 2006  |
| • General Program Chair | Int. Conference on Cognition and Recognition   | Dec. 2005  |
| • General Chair         | Fourth IEEE International Workshop on Automatic Identification Technologies, NY                                  | Oct. 2005  |
| • General Program       | Int. Conference on Document Analysis and Recognition, Seoul, S. Korea  | Oct. 2005  |
| • Co-Chair              |  |            |
| • General Co-Chair      | Int. Workshop on Document Image Analysis for Libraries, Palo Alto, CA  | Jan. 2004  |
| • Tutorial Co-Lead      | Data Mining for Intrusion Detection and Computer Security Techniques, Applications, and Systems, New Orleans, LA | 2003       |
| • General Co-Chair      | Int. Workshop on Document Analysis and Retrieval, Madison, WI  | Jun. 2003  |
| • Publicity Chair       | New York State Cyber-Security Symposium, Utica   | Feb. 2003  |
| • Program Co-Chair      | Int. Workshop on Handwriting Recognition Niagara-on-the-lake, OT   | Sep. 2002  |
| • Technical Committee   | IEEE SMC for Pattern Recognition   | 1998- 2002 |

#### Program Committee Memberships

1. Int. Workshop on Document Analysis Systems, Nara, Japan, 2008.
2. Int. Conference on Advanced Computing and Communication, Gauhati, India, Dec. 2007.

3. 11<sup>th</sup> Int. Conference on Computer Vision, Rio De Jnerio, Brazil, Oct. 2007
4. IEEE Systems, Man, and Cybernetics, Montreal, Canada, Oct. 2007.
5. IAPR Int. Conference on Document Analysis and Recognition, Curitiba, Brazil, Sep. 2007.
6. IEEE Int. Conference on Biometrics, Seoul, Korea, Sep. 2007.
7. Biometrics Symposium, Baltimore, Sep. 2007.
8. Int. Workshop on Pattern Recognition, Plymouth, UK, Jul. 2007.
9. Int. Conference on Computer Vision and Pattern Recognition, Minneapolis, MN, Jun. 2007.
10. Int. Symposium on Signal Processing and its Applications, Sharjah, UAE, Feb. 2007.
11. Int. Workshop on Multiple Classifier Systems, Prague, Czech, May 2007.
12. 3<sup>rd</sup> Int. Conference on Intelligent Computing, Qingdao, China, 2007.
13. IEEE Int. Symposium on Ubisafe Computing, Niagara Falls, Canada, May 2007.
14. ACM Annual Symposium on Applied Computing- Document Engineering, S. Korea, Mar. 2007.
15. Int. Conference on Computer Vision, Graphics, and Image Processing, India, Dec. 2006.
16. Int. Workshop on Frontiers of Handwriting Recognition, France, Oct. 2006.
17. Biometrics Symposium, Crystal City, Sep. 2006.
18. 1<sup>st</sup> IEEE Computer Society Workshop on Multi-biometrics, NY, NY Jun. 2006.
19. Int. Conference on Pattern Recognition, HongKong, Aug. 2006.
20. Int. Conference on Computer Vision and Pattern Recognition, NY, NY, Jun. 2006.
21. 21<sup>st</sup> Annual ACM Symposium on Applied Computing – Document Engineering, Dijon, France
22. 9<sup>th</sup> European Conference on Computer Vision, Graz, Austria, May 2006.
23. Int. Workshop on Document Analysis Systems, New Zealand, Feb. 2006.
24. Biometrics Symposium, Crystal City, Sep. 2005.
25. Int. Conference on Advances in Pattern Recognition, Beth, UK, Aug. 2005.
26. Int. Workshop on Multiple Classifier Systems, CA, Jun. 2005.
27. 20<sup>th</sup> Annual ACM Symposium on Document Engineering, Santa Fe, NM, Mar. 2005.
28. Biometrics Symposium, Crystal City, Sep. 2004.
29. Int. Conference on Computer Vision and Pattern Recognition, Washington D.C., Jun. 2004.
30. Int. Workshop on Frontiers of Handwriting Recognition, Tokyo, Japan, Aug. 2004
31. Int. Workshop on Multiple Classifier Systems, Cagliari, Italy, Jun. 2004.
32. 11th Int. Graphonomics Society Conference, Scottsdale, AZ, Nov. 2003.
33. IEEE Systems, Man, and Cybernetics, Washington D.C., Oct. 2003
34. EACL Workshop on “Computational Linguistics for South Asian Languages”, Budapest, Hungary, Apr. 2003.

35. New York State Cyber-Security Symposium, Utica, NY, Feb. 2003.
36. Int. Workshop on Handwriting Recognition, Niagara-on-the-Lake, Canada, Aug. 2002.
37. IEEE Systems, Man, and Cybernetics, Hammamet, Tunisia, Oct. 2002
38. Int. Conference on Document Analysis and Recognition, Seattle, WA, Oct. 2001.
39. IEEE Workshop on Computer Vision Applications, Palm Springs, CA, Dec. 2000.
40. Int. Workshop on Handwriting Recognition, Amsterdam, The Netherlands, Aug. 2000.
41. IEEE Systems, Man, and Cybernetics, Tokyo, Japan, Oct. 1999.
42. Int. Workshop on Frontiers of Handwriting Recognition, Buffalo, NY, May 1993.

### Session Chairs

• Fingerprint, Hand, and Palm	IEEE CVPR Workshop on Biometrics Minneapolis, MN, June 18, 2007
• Behavioral Biometrics	IEEE CVPR Workshop on Biometrics Minneapolis, MN June 18, 2007
• Multiple Classifier Applications	7 <sup>th</sup> International Workshop on Multiple Classifier Systems Prague, Czech Republic, May 23-25, 2007
• Face Recognition	SPIE Conference on Defense and Security, Biometric Technologies, April 9-11, 2007, Orlando, FL
• Detecting and Correcting Noisy Text	IJCAI 2007 Workshop on Analytics for Noisy Unstructured Text Data, Jan. 8, 2007, Hyderabad, India,
• Biometrics: Gait and Gesture	International Conference on Pattern Recognition, Aug. 21-25, 2006, Hong Kong
• Arabic OCR	Symposium on Document Image Understanding Nov. 2-4, 2005, Adelphi, MD
• Crime Prevention, Security, and Surveillance	Int. Conference on Advances in Pattern Recognition August 22, 2005, Bath, UK
• Performance Analysis of CAPTCHAs	Int. Workshop on Human Interactive Proofs, May 19-20, 2005, Lehigh, PA
• Performance and Evaluation	SPIE Conference on Defense and Security, Biometric Technologies, March 29-30, 2005, Orlando, FL
• Handwriting Analysis	Ninth International Workshop on Handwriting Recognition Oct. 24-27, 2004, Tokyo, Japan
• Oral Presentations	First International Conference on Biometrics and Authentication Jul. 15-17, 2004, Hong Kong
• Demos and Exhibits	Symposium on Document Image Understanding Apr. 9-11, 2003, Greenbelt, MD
• Handwriting Recognition	IEEE Conference on Pattern Recognition Aug. 12-16, 2002, Quebec City, Canada
• Digit Segmentation	IEEE Conference on Document Analysis and Recognition Sep. 10-12, 2001, Seattle, USA
• Information Retrieval & Word Spotting	IEEE Conference on Document Analysis and Recognition Sep. 10-12, 2001, Seattle, USA
• Handwriting Segmentation	IEEE Conference on Document Analysis and Recognition Sep. 10-12, 2001, Seattle, USA

• E-Learning Costs and Infrastructure	E-Learning & E-Learning Technologies Aug. 7-8, 2001, Hyderabad, India
• Image Segmentation	IEEE Systems, Man, and Cybernetics Conference Oct. 12-15, 1999, Tokyo, Japan
• Pattern Recognition	IEEE Systems, Man, and Cybernetics Conference Oct. 12-15, 1999, Tokyo, Japan
• Character Recognition	IEEE Systems, Man, and Cybernetics Conference Oct. 11-14, 1998, San Diego, CA
• Face Recognition	IEEE Systems, Man, and Cybernetics Conference Oct. 12-15, 1997, Orlando, FL
• Gesture Understanding	AAAI Symposium on Language and Vision Nov. 10-12, 1995, Cambridge, MA
• Document Analysis	Symposium on Document Image Understanding Oct. 24-25, 1995, Bowie, MD
• Document Analysis	DARPA Workshop on Document Image Understanding May 6-8, 1992, Palo Alto, CA

### Panel Moderator

- HIP R&D Methodologies Int. Workshop on Human Interactive Proofs, Lehigh, PA May 19, 2005
- Postal Technologies Int. Workshop on Tokyo, Japan Oct. 24, 2004
- Handwriting Recognition
- Digital Libraries DIAR Workshop, Madison, WI Jun. 21, 2003
- Tools of Multilingual OCR MLOCR Workshop, Bangalore, India Sep. 20, 1999
- Postal Address Interpretation International Conference on Document Analysis and Recognition, Bangalore, India Sep. 21, 1999
- Document Analysis DARPA Workshop on Document Image Understanding, Palo Alto, CA May 6-8, 1992

### Panelist

- Multimodal Information Retrieval IJCAI Workshop, Hyderabad, India Jan 6, 2007
- Linguistic Issues in Text Encoding of Sanskrit Joint Int. Conference of Assoc. of Computers and Humanities Assoc. for Literary and Linguistic Computing, University of Georgia, Athens May 29, 2003
- E-Learning Technologies Birla Science Center Hyderabad, India Aug. 8, 2001
- Computer Processing of Indian Languages Indian Statistical Institute, Calcutta, India Dec. 24, 1999

## **B. University Service (UB)**

2007-on	Director, Information and Computing Technology, UB 2020 Initiative
2005-07	Engineering School, Faculty Promotions Committee
2005-06	Engineering School, Dean Search Committee
Spring 2005	UB 2020 Computer and Information Technology, Leadership Committee
Spring 2005	Centers evaluation subcommittee
Spring 2005	UB 2020 Committee member for Computer Information Technology
Nov. 2004	CUBS Tour for Dean's Council
Oct. 2004	CUBS tour for SEAS Emeritus Faculty
Feb. 2004	Review committee member for internal grant proposals (IRCAF)
Apr. 2003	Sigma Xi Student Poster Judge
2002-03	Member of SUNY Cyber Security Task Committee
2002-03	Member of Dean's Research Advisory Committee
Feb. 2002	Review committee member for internal grant proposals (IRCAF)
2000-02	Engineering School, Faculty Promotions Committee
2000-01	Mentor for undergraduate students
May 2001	Marshall for the commencement ceremony
Feb. 4, 2001	Member of UB delegation to Albany on UB day
Apr. 24, 2001	Conducted CEDAR tour for parents of prospective students

## **C. Departmental Service (CSE)**

2005-06	Member of Faculty Recruiting Committee
2004-05	Chair of Faculty Recruitment Committee
2003-04	Member of Faculty Recruitment Committee
2003-04	Member of Publications Committee
2002-03	Chair of Faculty Recruitment Committee
2002-03	Member of Distinguished Speaker Series Committee
2002	Student Grievance Committee Member
2001-02	Chair of Publications Committee
2000-01	Chair of the Colloquium Committee
2000-01	Member of Faculty Recruitment Committee
1998-99	Chair of the Colloquium Committee
1999-00	Participated in the re-design of CSE 241 and CSE 341
1996-97	Member of Faculty Recruitment Committee

# III. Teaching

## A. Research Supervision

### Post Doctoral Fellows

1. 2004-06 L. Lorigo Arabic Handwriting Recognition,  
PhD, MIT Funded by the Directorate of Central Intelligence
2. 2006-07 S. Tulyakov Fusion of Classifiers  
PhD, UB

### Major Advisor of PhD Students Graduated

1. 2007 A. Rusu Exploiting the Gap Between Human and Machine Abilities in  
Handwriting Recognition for Web Security
2. 2007 C. Wu A Framework for Fingerprint Image Enhancement and Feature  
Detection
3. 2007 S. Kompalli A Stochastic Framework for Font Independent Devanagari OCR  
(Wayne State University)
4. 2006 R. Milewski Automatic Recognition of Handwritten Medical Forms for Search  
Engines  
(Become Japan, Inc.)
5. 2006 S. Tulyakov A Complexity Framework for Combination of Classifiers in  
Verification and Identification Systems  
(University at Buffalo)
6. 2005 T. Jea Minutiae-Based Partial Fingerprint Recognition  
(IBM)
7. 2005 H. Lei Sequential Pattern Classification Without Explicit Feature  
Extraction  
(University of North Texas)
8. 2003 A. Teredesai Use of Genetic Programming for Advanced Pattern Recognition  
(Rochester Institute of Technology)
9. 2002 H. Xue Handwritten Word Recognition Using Structural Features and  
Stochastic Models  
(IBM)
10. 2000 I. Krassimir Organizing Multiple Experts for Efficient  
Pattern Recognition  
(Fair Isaac, Inc.)

### Co-Advisor of PhD Students Graduated

1. 2000 J. Park Hierarchical Character Recognition and its Use in Handwritten  
Phrase Recognition  
(Chung-Ang University, S. Korea)
2. 1997 S. Madhvanath The Holistic Paradigm in Handwritten Word Recognition and its  
Applications to Large and Dynamic Lexicon Scenarios  
(HP Research Labs, India)
3. 1996 G. Kim Handwritten Word Recognition for Real-time Applications  
(Sogang University, S. Korea)

## Major Advisor of Current PhD Students

1.	2007	S. Kung	Handwriting Recognition with Digital Camera Images
2.	2008	F. Farooq	Language Models for Arabic Character Recognition
3.	2008	P. Mansukhani	Security of Fingerprint Biometrics
4.	2008	R. Yampolsiky	Behavioral Biometrics in Gaming
5.	2009	J. Li	Fingerprint Matching Using Correlation Filters
6.	2009	H. Cao	Handwritten Keyword Spotting
7.	2009	Z. Zhang	Face Retrieval from Distributed Databases
8.	2009	A. Thomas	Speaker Identification for Biometrics
9.	2009	I. Nwgou	Medical Image Processing
10.	2010	V. Singh	Face Expression Analysis
11.	2010	R. Ricardo	Biometrics and Cryptography
12.	2010	D. You	Unconstrained Handwriting Recognition
13.	2010	X. Peng	Offline Signature Recognition

## Committee Member of PhD Students Graduated

1.	2006	S. Karri	Toward an Analog Very Large Scale Integration System for Perceiving Depth
2.	2006	M. Cho	Novel techniques for Data Warehousing and Online Analytical processing in Emerging Applications
3.	2005	D. Jiang	Mining Coherent Patterns and Clusters from Genomic Data
4.	2004	Y. Wu	High-dimensional Pattern Analysis in Bioinformatics
5.	2004	Q. Lu	Model-based Active Object Recognition Using Foveal Vision
6.	2004	C. Tomai	Handwriting Identification
7.	2003	B. Zhang	Binary Feature Vectors in Handwriting Recognition
8.	2001	L. Zhu	Keyblock: An Approach for Content Based Image Retrieval
9.	2001	H. Luo	Knowledge Based Image Understanding and Classification System for Medical Image Databases
10.	2001	M. Jung	Font Classification and Character Segmentation in Postal Address Interpretation
11.	1999	E. Milun	Algorithms for Stylus Generated Images Inspired by the Human Visual System
12.	1999	M. Venkatraman	A Framework for Media-Streaming Over Packet-Switched Networks
13.	1999	H. Moon	Performance Evaluation Methodology for Face Recognition Algorithms
14.	1999	H. Kwon	Video Compression Using Vector Quantization for Multimedia Applications
15.	1997	J. Park	Address Block Location System Using State Space Search
16.	1998	U. Mahadevan	Parsing Techniques for Handwritten Address Interpretation
17.	1998	J. Soh	A Theory of Document Object Locator Combination
18.	1994	J. Zhou	A Hierarchical Fusion Neural Network for Character Recognition

## Major Advisor of MS Students Graduated (Thesis Option)

1.	2006	K. Sridharan	Semantic Face Recognition
2.	2006	S. Nayak	Devanagari OCR
3.	2005	A. Mhatre	Hand Geometry Biometrics
4.	2004	S. Manocha	Security of Biometric Systems
5.	2004	V. Chavan	Biometrics and Barcode Representation

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|----|------|------------|-------------------------------|
| 6. | 2004 | S. Palla   | Multimodal Biometrics         |
| 7. | 2000 | D. Bartnik | Video Surveillance            |
| 8. | 2000 | G. Pal     | Music Index on the Web        |
| 9. | 2000 | F. Zhou    | Comparing Thinning Algorithms |

### **Thesis Committee Member of MS Students Graduated**

- |    |      |                 |  |
|----|------|-----------------|--|
| 1. | 2005 | S. Chikkerur    | Online Fingerprint Verification System                       |
| 2. | 1997 | S. Chebolu      | Accurate Location of Human Faces in Photographs              |
| 3. | 1996 | B. Senaka       | A Skew Correction Technique for Handwritten Word Recognition |
| 4. | 1996 | G. Sheikoaslami | Computer-Aided Graphology                                    |
| 5. | 1995 | R. Setlur       | Generating Manifold Samples from Handwritten Words           |

### **B. Courses Taught at UB**

- |    |   |               |
|----|---|---------------|
| 1. | Introduction to Programming             | Undergraduate |
| 2. | Introduction to Artificial Intelligence | U             |
| 3. | Algorithms and Data Structures          | U             |
| 4. | Computer Architecture & Organization    | U             |
| 5. | Operating Systems                       | Graduate      |
| 6. | Biometrics (designed new course)        | Advanced      |
| 7. | Document Image Analysis                 | A             |
| 8. | Digital Libraries                       | A             |