ADITYA VEMPATY

avempat@us.ibm.com (315) 706-4548

CURRENT APPOINTMENT

IBM Thomas J. Watson Research Center *August 2015–present*
Postdoctoral Researcher
Services Research

SUMMARY

Researcher in the fields of decision making, crowdsourcing, network security, information and data fusion, and optimization. Expertise covers signal processing, information and coding theory, and communication theory. Around 25 papers (including 9 journal publications) published in various refereed journals and conferences.

RESEARCH INTERESTS

I am interested in understanding the theoretical and practical aspects of information processing and decision making in human-machine systems with potentially unreliable components. Tools from statistical signal processing, information theory, error correcting codes, and statistical learning are used in my research. I have also been actively involved in interdisciplinary collaboration with researchers from other fields such as psychology.

EDUCATION

Syracuse University, Syracuse, NY, USA *June 2015*
Ph.D. in Electrical Engineering
Thesis: *Reliable Inference from Unreliable Agents*
Advisors: Pramod K. Varshney and Lav R. Varshney (UIUC)
Graduating GPA 4.00/4.00

Indian Institute of Technology (IIT), Kanpur, India *May 2011*
B.Tech in Electrical Engineering
Project: *Location Estimation in Wireless Sensor Networks under Byzantine Attacks*
Advisor: Ajit K. Chaturvedi
Graduating CPI (Cumulative Performance Index) 9.4/10.0

SCHOLASTIC ACHIEVEMENTS

- Awarded the People's choice award at Syracuse University's inaugural 3-Minute Thesis competition for graduate students.
- Awarded the Syracuse University Graduate Fellowship Award by Syracuse University for the Academic years 2013-15.
- Awarded the Best EECS department poster at 2013 Nunan poster competition, Nunan Research Day, Syracuse University, NY.
- Phi Kappa Phi (honor society), inducted 2013.
- Golden Key International Honor Society, inducted 2012.
- Awarded the Academic Excellence Award by Indian Institute of Technology, Kanpur for the Academic years 2008-09 and 2009-10.
- Secured Indian Institute of Technology (IIT) Joint Entrance Examination (JEE) 2007 with 99.9 percentile (All India Rank 166) which is taken by about 200000 students in India.

- Secured All India Rank 171 in All India Engineering Entrance Examination 2007 given by more than 0.8 million students and awarded with scholarship for outstanding performance in the same.
- Shortlisted to participate in the INMO (Indian National Mathematics Olympiad) representing the state of Andhra Pradesh.

ACADEMIC EXPERIENCE

University of Illinois at Urbana-Champaign *June 2014–Aug. 2014*
Visiting Researcher
Coordinated Science Laboratory

Syracuse University *Aug. 2011–present*
Research Assistant
Sensor Fusion Laboratory

IIT Kanpur *Aug. 2010–May 2011*
B. Tech Project
Electrical Engineering Department

Syracuse University *May 2010–July 2010*
Undergraduate Research Intern
Sensor Fusion Laboratory

IIT Kanpur *May 2008–July 2008*
Undergraduate Researcher
Electrical Engineering Department

PAST INDUSTRIAL EXPERIENCE

Intel Corporation, Santa Clara *May 2013–Aug. 2013*
Graduate Research Intern
Data Systems Group

Bharat Heavy Electricals Limited, Hyderabad *May 2009–July 2009*
Undergraduate Researcher

RESEARCH MENTORING EXPERIENCE

- Research Mentor to Kaiqing Zhang from Tsinghua University for research on the use of data analytics for prioritizing human attention.

TEACHING EXPERIENCE

Teaching Assistant *Spring 2015*
ELE851: Detection and Estimation Theory
Duties: Guest lectures, and design of projects
Department of EECS, Syracuse University

PUBLICATIONS

JOURNAL ARTICLES

9. B. Kailkhura, **A. Vempaty**, and P. K. Varshney, "Distributed Inference in Tree Networks using Coding Theory," *IEEE Trans. Signal Process.*, vol. 63, no. 14, pp. 3715–3726, July 15, 2015.

8. **A. Vempaty** and L. R. Varshney, "The Non-Regular CEO Problem," *IEEE Trans. Inf. Theory*, vol. 61, no. 5, pp. 2764–2775, May 2015.

7. S. Liu, **A. Vempaty**, M. Fardad, E. Masazade, and P. K. Varshney, "Energy-Aware Sensor Selection in Field Reconstruction," *IEEE Signal Process. Lett.*, vol. 21, no. 12, pp. 1476–1480, Dec. 2014.

6. **A. Vempaty**, H. He, B. Chen, and P. K. Varshney, "On Quantizer Design for Distributed Bayesian Estimation in Sensor Networks," *IEEE Trans. Signal Process.*, vol. 62, no. 20, 5359–5369, Oct. 15, 2014.

5. **A. Vempaty**, L. R. Varshney, and P. K. Varshney, "Reliable Crowdsourcing for Multi-Class Labeling using Coding Theory," *IEEE J. Sel. Topics Signal Process*, vol. 8, no. 4, pp. 667–679, Aug. 2014.

4. **A. Vempaty**, P. Ray, and P. K. Varshney, "False Discovery Rate based Distributed Detection in the Presence of Byzantines," *IEEE Trans. Aerosp. Electron. Syst*, vol. 50, no. 3, pp. 1826–1840, July 2014.

3. **A. Vempaty**, Y. S. Han, and P. K. Varshney, "Target Localization in Wireless Sensor Networks using Error Correcting Codes," *IEEE Trans. Inf. Theory*, vol. 60, no. 1, pp. 697–712, Jan. 2014.

2. **A. Vempaty**, L. Tong, and P. K. Varshney, "Distributed Inference with Byzantine Data: State-of-the-Art Review on Data Falsification Attacks," *IEEE Signal Process. Mag.*, vol. 20, no. 5, pp. 65–75, Sept. 2013.

1. **A. Vempaty**, O. Ozdemir, K. Agrawal, H. Chen, and P. K. Varshney, "Localization in Wireless Sensor Networks: Byzantines and Mitigation Techniques," *IEEE Trans. Signal Process.*, vol. 61, no. 6, pp. 1495–1508, Mar. 15, 2013.

CONFERENCE PAPERS

15. **A. Vempaty**, L. R. Varshney, G. J. Koop, A. H. Criss, and P. K. Varshney, "Decision Fusion by People: Experiments, Models, and Sociotechnical System Design," to appear in *Proc. 3rd IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, Orlando, Florida, Dec. 14-16, 2015.

14. S. Liu, F. Chen, **A. Vempaty**, M. Fardad, L. Shen, and P. K. Varshney, "Sparsity Promoting Sensor Management for Estimation: An Energy Balance Point of View," in *Proc. IEEE International Conference on Information Fusion (FUSION)*, Washington, D.C., July 2015.

13. **A. Vempaty** and L. R. Varshney, "CEO Problem for Belief Sharing," in *Proc. Information Theory Workshop (ITW 2015)*, Jerusalem, Israel, April - May 2015.

12. L. R. Varshney, **A. Vempaty**, and P. K. Varshney, "Assuring Privacy and Reliability in Crowdsourcing with Coding," in *Proc. 2014 Information Theory and its Applications Workshop (ITA 2014)*, San Diego, California, Feb. 2014.

11. **A. Vempaty**, Y. S. Han, L. R. Varshney, and P. K. Varshney, "Coding Theory for Reliable Signal Processing," in *Proc. International Conference on Computing, Networking and Communications (ICNC 2014)*, Honolulu, Hawaii, Feb. 2014, pp. 200–205.

10. **A. Vempaty**, Y. S. Han, and P. K. Varshney, "Byzantine Tolerant Target Localization in Wireless Sensor Networks Over Non-Ideal Channels," in *Proc. 13th International Symposium on Communications and Information Technologies (ISCIT 2013)*, Samui Island, Thailand, Sep. 2013, pp. 407–411.

9. **A. Vempaty**, O. Ozdemir, and P. K. Varshney, "Target tracking in wireless sensor networks in the presence of Byzantines," in *Proc. International Conference on Information Fusion (FUSION)*, Istanbul, Turkey, Jul. 2013, pp. 968–973.

8. **A. Vempaty**, V. S. S. Nadendla, and P. K. Varshney, "Further results on noise-enhanced distributed inference in the presence of Byzantines," in *Proc. Global Wireless Summit (GWS'13)*, Atlantic City, New Jersey, June 2013.

7. **A. Vempaty**, L. R. Varshney, and P. K. Varshney, "Reliable Classification by Unreliable Crowds," in *Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013, pp. 5558–5562.

6. **A. Vempaty**, Y. S. Han, and P. K. Varshney, "Target Localization in Wireless Sensor Networks using Error Correcting Codes in the Presence of Byzantines," in *Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013, pp. 5195–5199.

5. **A. Vempaty**, B. Chen, and P. K. Varshney, "Optimal Quantizers for Distributed Bayesian Estimation," in *Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013, pp. 4893–4897.

4. **A. Vempaty**, O. Ozdemir, and P. K. Varshney, "Mitigation of Byzantine attacks for target location estimation in wireless sensor networks," in *Proc. 46th Annual Conf. on Information Sciences and Systems (CISS)*, Princeton, NJ, Mar. 2012.

3. K. Agrawal, **A. Vempaty**, H. Chen, and P. K. Varshney, "Target localization in sensor networks with quantized data in the presence of Byzantine attacks," in *Proc. Asilomar Conf. Signals, Systems and Computers*, Pacific Grove, CA, Nov. 2011, pp. 1669–1673.

2. M. Gagrani, P. Sharma, S. Iyengar, V. S. S. Nadendla, **A. Vempaty**, H. Chen, and P. K. Varshney, "On noise-enhanced distributed inference in the presence of Byzantines," in *Proc. 49th Annual Allerton Conf. Comm., Control, and Comp. (Allerton)*, Monticello, Illinois, Sept. 2011, pp. 1222–1229.

1. **A. Vempaty**, K. Agrawal, H. Chen, and P. K. Varshney, "Adaptive learning of Byzantines' behavior in cooperative spectrum sensing," in *Proc. IEEE Wireless Comm. and Networking Conf. (WCNC)*, Cancun, Mexico, Mar. 2011, pp. 1310–1315.

WORSKHOP/CONFERENCE PRESENTATIONS

4. **A. Vempaty**, "Reliable Inference from Unreliable Agents," presented at *2015 Information Theory and its Applications Workshop (ITA)*, La Jolla, California, Feb. 1-6, 2015 (**Graduation Day Poster–Invited**)

3. **A. Vempaty**, G. J. Koop, A. H. Criss, and P. K. Varshney, "How optimal are we at fusing decisions?," presented at *CODE@MIT*, MIT Sloan School of Management, Cambridge, Oct. 10-11, 2014

2. **A. Vempaty**, L. R. Varshney, and P. K. Varshney, "Error-Correcting Codes allow Privacy and Quality Assurance in Crowdsourcing," presented at *CrowdConf*, Mission Bay Conference Center, San Francisco, Oct. 22, 2013

1. **A. Vempaty** and P. K. Varshney, "Distributed Inference in the Presence of Byzantines," presented at *DIMACS Workshop on Information-Theoretic Network Security*, Rutgers, The State University of New Jersey, NJ, 2012

OTHER PRESENTATIONS

3. **A. Vempaty**, L. R. Varshney, and P. K. Varshney, "Reliable Classification by Unreliable Crowds," presented at *Nunan Poster Competition*, Nunan Research Day, Syracuse University, Syracuse, NY, 2013 (**Declared Best Poster among EECS department posters**)

2. **A. Vempaty**, O. Ozdemir, K. Agrawal, H. Chen, and P. K. Varshney, "Byzantines in Wireless Sensor Networks," presented at *North American School of Information Theory*, Cornell University, Ithaca, NY, 2012

1. **A. Vempaty**, O. Ozdemir, K. Agrawal, H. Chen, and P. K. Varshney, "Byzantines in Wireless Sensor Networks," presented at *Nunan Poster Competition*, Nunan Research Day, Syracuse University, Syracuse, NY, 2012

RESEARCH TALKS AND PRESENTATIONS

- "Reliable Inference from Unreliable Agents", at *IBM Thomas J. Watson Research Center,* Yorktown Heights, NY: 9 Mar. 2015.
- "Query Codes: Error Control for Reliable Human Computation", at Department of Electrical Communication Engineering, *Indian Institute of Sciences,* Bangalore, India: 1 Dec. 2014.
- "Query Codes: Error Control for Reliable Human Computation", at Coordinated Science Laboratory, *University of Illinois at Urbana-Champaign,* Urbana, IL: 24 Jun. 2014.
- "Reliable Classification by Unreliable Crowds", at Department of Psychology, *Syracuse University,* Syracuse, NY: 7 Mar. 2014.
- "Coding Theory for Reliable Signal Processing", at Electrical Engineering Department, *Indian Institute of Technology, Hyderabad,* India: 10 Jan. 2014.
- "Coding Theory for Reliable Signal Processing", at G. S. Sanyal School of Telecommunications, *Indian Institute of Technology, Kharagpur,* India: 3 Jan. 2014.

RESEARCH PROJECTS

Human-Machine Inference Networks

- Research on design and analysis of reliable human-machine inference systems consisting of humans and machines which complement each others' strengths.
- Presence of unskilled humans and/or malicious machines can deteriorate the system performance drastically.
- By understanding the behavior of humans in such systems, the machine parameters can be optimized for improved performance.

The Non-Regular CEO Problem

- Research on the non-regular (distributions that do not satisfy the regularity conditions) CEO problem where the CEO could be interested in estimating the belief that a particular event takes place, for which she uses multiple subordinates to send their observations.
- By modeling the noisy versions using copula, a $1/R^2$ convergence of the distortion is established, an intermediate regime between the exponential convergence of discrete case and $1/R$ convergence of Gaussian case.
- Achievability is proved by a layered architecture with quantization, entropy coding, and midrange estimator, and converse is proved using the Chazan-Zakai-Ziv bound.

Reliable Crowdsourcing

- Designed crowdsourcing systems to ensure reliable classification despite unreliable and unskilled crowd workers.
- Coding theory based techniques are used to pose easy-to-answer binary questions to the crowd workers.
- Three different crowdsourcing models are considered: systems with independent crowd workers, systems with peer-dependent reward schemes, and systems where workers have common sources of information.
- Showed that pairing among workers and diversification of the questions help in improving system performance.

Distributed Inference with Byzantine Data

- Research on the effect of and mitigation of malicious sensors (Byzantines) on distributed inference networks.
- Interactions between the honest and the malicious sensors are modeled using game theory and optimal attack strategies are determined to characterize the effect of such Byzantines in the network.
- Machine learning and statistical signal processing schemes are used to mitigate the effects of Byzantines by learning their behavior and identifying the malicious sensors.

Coding Theory for Reliable Signal Processing

- Research on design and analysis of systems to ensure reliable signal processing using coding-theoretic ideas.
- Effect of unreliable components in the network can be abstracted as errors in data.
- Error-correcting based schemes can be designed to correct these errors and ensure reliable performance.

Decision Fusion by Humans

- Developed psychology experiments to understand the phenomenon of decision fusion by humans.
- Compare the behavior of humans and sensors/machines while performing this task of decision fusion.
- Observed that a deterministic rule used by machines does not characterize the human behavior, which is not deterministic in nature.
- Developing randomized decision rule where the decision is first determined by a deterministic rule which then goes through a binary symmetric channel.

Quantizer Design for Distributed Estimation

- Explored the design of optimal quantizers in distributed estimation under the Bayesian criterion.
- For a conditionally unbiased and efficient estimator at the fusion center, it is optimal to partition the local sensors into groups, with all sensors within a group using the same quantization rule.
- For capacity constrained wireless network, binary quantizers at the local sensors are optimal under certain conditions.
- Also derived the optimality conditions of quantizers for conditionally dependent observations.

Distributed Inference in Tree Networks

- Developed simple-to-implement coding theory based techniques to solve the distributed inference (classification and estimation) problems in tree structures.
- Studied the asymptotic inference performance of the proposed schemes for two different classes of tree networks: fixed height tree networks, and fixed degree tree networks.
- Showed that the proposed schemes are asymptotically optimal under certain conditions.

Sensor Selection in Field Reconstruction

- Introduced a new sparsity-promoting penalty function for sensor selection problems in field reconstruction.
- Using a reweighted ℓ_1 relaxation of the ℓ_0 norm, the sensor selection problem is reformulated as a convex quadratic program.
- Presented two fast algorithms: accelerated proximal gradient method and alternating direction method of multipliers, in order to handle large-scale problems.

KNOWLEDGE BASE

Programming & Software: MATLAB, C/C++, Java, Microcap, AimSpice, Verilog/VHDL
Academic: Information and coding theory; digital and statistical signal processing; graph theory; optimal control; digital and wireless communication; multi-camera systems; cognitive psychology.

RELEVANT GRADUATE COURSES

Detection & Estimation Theory	Statistical Signal Processing
Information and Coding Theory	Wireless Communications
Random Processes	Digital Communications
Optimal Control Systems	Graph Theory
Statistical Learning Theory	Matrix Completion Theory
Compressive Sensing	Time-Series Econometrics
Speech Signal Processing	Multi-Camera Systems
Cognitive Psychology	Mathematical Methods of Signal Processing
Wireless Communication in Competitive Environment	Wavelet Transforms in Image & Signal Processing

SERVICE & PROFESSIONAL ACTIVITIES

- **Student Member**, IEEE, IEEE Signal Processing Society, IEEE Communications Society
- **Reviewer**, IEEE Transactions on Signal Processing, IEEE Transactions on Information Theory, IEEE Journal on Selected Areas in Communication, IEEE Transactions on Wireless Communications, IEEE Journal on Selected Topics in Signal Processing, IEEE Signal Processing Letters, IEEE Communications Letters, IEEE Transactions on Vehicular Technology, IEEE Transactions on Industrial Informatics, Computer Networks, Computer Standards and Interfaces, IEEE International Symposium of Information Theory (ISIT 2013), National Communications Conference (NCC 2014), Military Communications Conference (MILCOM 2014), IEEE International Symposium of Information Theory (ISIT 2015)

REFERENCES

Prof. Pramod K. Varshney
Distinguished Professor — *Phone: (315) 443-1060*
Electrical Engineering and Computer Science — *email: varshney@syr.edu*
Syracuse University

Prof. Lav R. Varshney
Assistant Professor — *Phone: (217) 244-8042*
Electrical and Computer Engineering — *email: varshney@illinois.edu*
University of Illinois at Urbana-Champaign

Prof. Biao Chen
Professor — *Phone: (315) 443-3332*
Electrical Engineering and Computer Science — *email: bichen@syr.edu*
Syracuse University

Prof. Yunghsiang S. Han
Chair Professor — *Phone: 886-2-2737-6670*
Electrical Engineering — *email: yshan@mail.ntust.edu.tw*
National Taiwan University of Science and Technology

Prof. Yingbin Liang
Associate Professor — *Phone: (315) 443-2124*
Electrical Engineering and Computer Science — *email: yliang06@syr.edu*
Syracuse University