

## Walter J. Scheirer

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### Education

**University of Colorado**, Colorado Springs, CO

Ph.D. in Engineering, Concentration in Computer Science, May 2009

Thesis Title: *Improving the Privacy, Security, and Performance of Biometric Systems*

Advisor: Prof. Terrance Boulton

**Lehigh University**, Bethlehem, PA

M.S. in Computer Science, January 2006

Thesis Title: *Syntax Versus Semantics: Two Competing Approaches to Dynamic Network Intrusion Detection Systems*

B.A., *cum laude*, in Computer Science and International Relations, June 2004

### Research Interests

Primary interests in Computer Vision, Machine Learning, Biometrics, and Digital Humanities. Specific areas of research include Open Set Recognition, Extreme Value Theory Models for Visual Recognition, Biologically-inspired Learning Algorithms, and Stylometry.

### Work Experience

Assistant Professor July 2015 – Present  
University of Notre Dame Notre Dame, IN  
Tenure-track appointment in the Department of Computer Science & Engineering. Affiliated with the Computer Vision Research Laboratory. Leading research connected to the fundamental problem of recognition in sensory processing and language understanding. Teaching courses related to computer vision, machine learning and security.

Research Associate July 2015 – Present  
Harvard University Cambridge, MA  
Appointment in the Department of Molecular & Cellular Biology. Affiliated with the CoxLab. Working with experimentalists to design wet lab experiments and process data from behavioral measurements and 2-photon microscopy in rodents to support the development of biologically-informed machine learning algorithms.

Postdoctoral Fellow October 2012 – July 2015  
Harvard University Cambridge, MA  
Appointments in the Department of Molecular & Cellular Biology, School of Engineering and Applied Sciences, and Center for Brain Science, working with Prof. David Cox. Research includes investigating the computational underpinnings of visual object recognition, biologically-inspired approaches to machine learning, and parallel processing techniques for large-scale vision applications.

Assistant Professor Adjunct September 2009 – July 2015  
University of Colorado, Colorado Springs Colorado Springs, CO  
Conducted computer vision and digital humanities related research at the Vision and Security Technology Lab in the College of Engineering & Applied Science. Additional responsibilities included advising students, as well as raising research money.

Director of Research & Development August 2007 – September 2012  
Securics, Inc. Colorado Springs, CO

Responsible for all research and development activities within Securics, Inc. Led advanced research in template protection systems for biometrics, multi-biometric fusion, and face recognition technology. Oversaw the design and implementation of commercial products utilizing the developed technology. Coordinated business development activities, which brought in over 4.1 million dollars in revenue.

Research Assistant August 2006 – January 2008  
Vision and Security Technology Lab University of Colorado, Colorado Springs

Worked on the construction of a large scale, distributed steganography detection framework as part of an AFRL research program. Other work included the design and implementation of template protection systems for biometrics, and low-cost spectrometer design.

Research Assistant August 2004 – May 2006  
Wireless Internet and Network Security Lab Lehigh University

Worked with Prof. Mooi Choo Chuah. Investigated dynamic approaches to network intrusion detection. As part of the DARPA DTN program, implemented security features to the bundle protocol for delay tolerant networks.

System Administrator June 2004 – August 2004  
Department of Computer Science and Engineering Lehigh University

Deployed hardware development tools (Cadence, Mentor Graphics, ISE Tools) on a research network. Maintained a heterogeneous (Unix/Microsoft) network environment.

Research Assistant May 2002 – June 2004  
Vision and Software Technology Lab Lehigh University

Worked with Prof. Terrance Boulton, CSE department chair. Carried out a large-scale biometric security experiment involving facial recognition under varying weather conditions. Implemented a network interface for an experimental vision tracking system. Created custom vision tracking security systems for a private vendor.

## Publications

### Journal Articles

J.1. N. Sünderhauf, O. Brock, W. Scheirer, R. Hadsell, D. Fox, J. Leitner, B. Upcroft, P. Abbeel, W. Burgard, M. Milford, and P. Corke, “The Limits and Potentials of Deep Learning for Robotics,” to appear in *International Journal of Robotics Research*, accepted for publication March 2018.

J.2. R. Fong\*, W. Scheirer\*, and D. D. Cox, “Using Human Brain Activity to Guide Machine Learning,” to appear in *Scientific Reports*, accepted for publication August 2017. \*Co-first authors.

J.3. E. Rudd, L. Jain, W. Scheirer, and T. Boulton, “The Extreme Value Machine,” appears in *IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)*, Vol. 40, No. 3, March 2018.

J.4. A. Rocha\*, W. Scheirer\*, C. Forstall, T. Cavalcante, A. Theophilo, B. Shen, A. Carvalho, and E. Stamatatos, “Authorship Attribution for Social Media Forensics,” appears in *IEEE Transactions on Information Forensics and Security (T-IFS)*, Vol. 12, No. 1, January 2017. \*Co-first authors.

J.5. M. Joesch, D. Mankus, M. Yamagata, A. Shahbazi, R. Schalek, A. Suissa-Peleg, M. Meister, J. Lichtman, W. Scheirer, and J. Sanes, “Reconstruction of Genetically Identified Neurons Imaged by Serial-Section Electron Microscopy,” *eLife*, Vol. 5, e15015, 2016.

- J.6. W. Scheirer, C. Forstall, and N. Coffee, “The Sense of a Connection: Automatic Tracing of Intertextuality by Meaning,” appears in *Digital Scholarship in the Humanities (DSH)*, Vol. 31, No. 1, April 2016.
- J.7. A. Rattani, W. Scheirer, and A. Ross, “Open Set Fingerprint Spoof Detection Across Novel Fabrication Materials,” appears in *IEEE Transactions on Information Forensics and Security (T-IFS)*, Vol. 10, No. 11, November 2015.
- J.8. W. Scheirer\*, L. Jain\*, and T. Boulton, “Probability Models for Open Set Recognition,” appears in *IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)*, Vol. 36, No. 11, November 2014. \*Co-first authors.
- J.9. M. Milford, E. Vig, W. Scheirer, and D. D. Cox, “Vision-based SLAM in Changing Outdoor Environments,” appears in the *Journal of Field Robotics (JFR)*, Vol. 31, No. 5, September / October 2014.
- J.10. W. Scheirer\*, S. Anthony\*, K. Nakayama, and D.D. Cox, “Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” appears in *IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)*, Vol. 36, No. 8, August 2014. \*Co-first authors.
- J.11. W. Scheirer, M. Wilber, M. Eckmann, and T. Boulton, “Good Recognition is Non-Metric,” appears in *Pattern Recognition*, Vol. 47, No. 8, August 2014.
- J.12. F. Costa, E. Silva, M. Eckmann, W. Scheirer, and A. Rocha, “Open Set Source Camera Attribution and Device Linking,” appears in *Pattern Recognition Letters (PRL)*, Vol. 39, April 2014.
- J.13. W. Scheirer, A. Rocha, A. Sapkota, and T. Boulton, “Towards Open Set Recognition,” appears in *IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)*, Vol. 35, No. 7, July 2013.
- J.14. W. Scheirer, A. Rocha, J. Parris, and T. Boulton, “Learning for Meta-Recognition,” appears in *IEEE Transactions on Information Forensics and Security (T-IFS)*, Vol. 7, No. 4, August 2012.
- J.15. A. Rocha, W. Scheirer, T. Boulton, and S. Goldenstein, “Vision of the Unseen: Current Trends and Challenges in Digital Image and Video Forensics,” appears in *ACM Computing Surveys*, Vol. 33, No. 4, October 2011.
- J.16. C. Forstall, S. Jacobson, and W. Scheirer, “Evidence of Intertextuality: Investigating Paul the Deacon’s *Angustae Vitae*,” appears in *Literary and Linguistic Computing (LLC)*, Vol. 26, No. 3, September 2011.
- J.17. W. Scheirer, A. Rocha, R. Micheals, and T. Boulton, “Meta-Recognition: The Theory and Practice of Recognition Score Analysis,” appears in *IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI)*, Vol. 33, No. 8, August 2011.
- J.18. W. Scheirer and M. Chuah, “Syntax vs. Semantics: Competing Approaches to Dynamic Network Intrusion Detection,” appears in the *International Journal of Security and Networks (IJSN)*, Vol. 3 No. 1, 2008.

## Refereed Conference Papers

- C.1. R. Metoyer, Q. Zhi, and B. Janczuk, and W. Scheirer, “Coupling Story to Visualization: Using Textual Analysis as a Bridge Between Data and Interpretation,” presented at the *ACM International Conference on Intelligent User Interfaces (IUI 2018)*, March 2018, Tokyo, Japan.
- C.2. J. Kinnison, N. Kremer-Herman, D. Thain, and W. Scheirer, “SHADHO: Massively Scalable Hardware-Aware Distributed Hyperparameter Optimization,” presented at the *IEEE Winter Conference on Applications of Computer Vision (WACV 2018)*, March 2018, Lake Tahoe, Nevada.
- C.3. R. Vidal Mata, S. Banerjee, K. Grm, V. Struč, and W. Scheirer, “UG<sup>2</sup>: a Video Benchmark for Assessing the Impact of Image Restoration and Enhancement on Automatic Visual Recognition,” presented at the *IEEE Winter Conference on Applications of Computer Vision (WACV 2018)*, March 2018, Lake Tahoe, Nevada.
- C.4. S. Banerjee, J. Brogan, A. Bharati, B. RichardWebster, V. Struč, P. Flynn, and W. Scheirer, “To Frontalize or Not to Frontalize: Do We Really Need Elaborate Pre-processing to Improve Face Recognition?,” presented at the *IEEE Winter Conference on Applications of Computer Vision (WACV 2018)*, March 2018, Lake Tahoe, Nevada.
- C.5. S. Banerjee, J. Bernhard, W. Scheirer, K. Bowyer, and P. Flynn, “SREFI: Synthesis of Realistic Example Face Images,” presented at the *IAPR/IEEE International Joint Conference on Biometrics (IJCB 2017)*, October 2017, Denver, Colorado.
- C.6. A. Jacobson, W. Scheirer, and M. Milford, “Deja vu: Scalable Place Recognition Using Mutually Supportive Feature Frequencies,” oral presentation at the *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2017)*, September 2017, Vancouver, Canada.
- C.7. J. Chen, S. Banerjee, A. Grama, W. Scheirer, and D. Z. Chen, “Neuron Segmentation Using Deep Complete Bipartite Networks,” presented at the *20th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI 2017)*, September 2017, Quebec City, Canada.
- C.8. J. Brogan, P. Bestagini, A. Bharati, A. Pinto, D. Moreira, K. Bowyer, P. Flynn, A. Rocha, and W. Scheirer, “Spotting the Difference: Context Retrieval and Analysis for Improved Forgery Detection and Localization,” presented at the *IEEE International Conference on Image Processing (ICIP 2017)*, September 2017, Beijing, China.
- C.9. A. Bharati, D. Moreira, A. Pinto, J. Brogan, K. Bowyer, P. Flynn, W. Scheirer, and A. Rocha, “U-Phylogeny: Undirected Provenance Graph Construction in the Wild,” oral presentation at the *IEEE International Conference on Image Processing (ICIP 2017)*, September 2017, Beijing, China.
- C.10. A. Pinto, D. Moreira, A. Bharati, J. Brogan, K. Bowyer, P. Flynn, W. Scheirer, and A. Rocha, “Provenance Filtering for Multimedia Phylogeny,” oral presentation at the *IEEE International Conference on Image Processing (ICIP 2017)*, September 2017, Beijing, China.
- C.11. M. McCurrie, F. Beletti, L. Parzianello, A. Westendorp, S. Anthony, and W. Scheirer, “Predicting First Impressions with Deep Learning,” oral presentation at the *12th IEEE International Conference on Automatic Face and Gesture Recognition (FG 2017)*, May 2017, Washington, D.C.
- C.12. V. Fragoso, W. Scheirer, J. Hespanha, and M. Turk, “One-Class Slab Support Vector Machine,” presented at the *23rd International Conference on Pattern Recognition*, December 2016, Cancun, Mexico.

- C.13. W. Scheirer, P. Flynn, C. Ding, G. Guo, V. Struc, M. Al Jazaery, K. Grm, S. Dobrisek, D. Tao, Y. Zhu, J. Brogan, S. Banerjee, A. Bharati, and B. RichardWebster, "Report on the BTAS 2016 Video Person Recognition Evaluation," oral presentation at the *Eighth IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2016)*, September 2016, Niagara, NY.
- C.14. L. Jain, W. Scheirer, and T. Bout, "Multi-Class Open Set Recognition Using Probability of Inclusion," presented at the *13th European Conference on Computer Vision (ECCV 2014)*, September 2014, Zurich, Switzerland.
- C.15. M. Milford, W. Scheirer, E. Vig, A. Glover, O. Baumann, J. Mattingley, and D.D. Cox, "Condition-Invariant, Top-Down Visual Place Recognition," oral presentation at the *IEEE International Conference on Robotics and Automation (ICRA 2014)*, June 2014, Hong Kong, China.
- C.16. M. Milford, E. Vig, W. Scheirer, and D. D. Cox, "Towards Condition-Invariant, Top-Down Visual Place Recognition," presented at the *Australasian Conference on Robotics and Automation (ACRA 2013)*, December 2013, Sydney, Australia. Best Paper Finalist.
- C.17. R. C. Johnson, T. Boulton, and W. Scheirer, "Voice Authentication Using Short Phrases: Examining Accuracy, Security and Privacy Issues," oral presentation at the *Sixth IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2013)*, September 2013, Washington D.C. Best Reviewed Paper.
- C.18. B. Heflin, W. Scheirer, and T. Boulton, "Detecting and Classifying Scars, Marks, and Tattoos Found in the Wild," oral presentation at the *Fifth IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2012)*, September 2012, Washington D.C.
- C.19. F. Costa, M. Eckmann, W. Scheirer, and A. Rocha, "Open-set Source Camera Attribution," presented at *Sibgrapi 2012 (XXV Conference on Graphics, Patterns and Images)*, August 2012, Ouro Preto, Brazil. Best Student Paper Award.
- C.20. W. Scheirer, N. Kumar, P. Belhumeur, and T. Boulton, "Multi-Attribute Spaces: Calibration for Attribute Fusion and Similarity Search," presented at the *IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2012)*, June 2012, Providence, RI.
- C.21. W. Scheirer, N. Kumar, K. Ricanek, P. Belhumeur, and T. Boulton, "Fusing with Context: a Bayesian Approach to Combining Descriptive Attributes," oral presentation at the *IAPR/IEEE International Joint Conference on Biometrics (IJCB 2011)*, October 2011, Washington D.C.
- C.22. B. Heflin, B. Parks, W. Scheirer, and T. Boulton, "Single Image Deblurring for a Real-Time Face Recognition System," oral presentation at the *36th Annual Conference of the IEEE Industrial Electronics Society (IECON 2010)*, November 2010, Phoenix, AZ.
- C.23. B. Heflin, W. Scheirer, and T. Boulton, "Correcting Rolling-Shutter Distortion of CMOS Sensors using Facial Feature Detection," oral presentation at the *Fourth IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2010)*, September 2010, Washington D.C. Best Student Paper Award Runner Up.
- C.24. V. Iyer, W. Scheirer, and T. Boulton, "Face System Evaluation Toolkit: Recognition is Harder Than it Seems," presented at the *Fourth IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2010)*, September 2010, Washington D.C.

C.25. W. Scheirer, A. Rocha, R. Micheals, and T. Boulton, “Robust Fusion: Extreme Value Theory for Recognition Score Normalization,” presented at the *11th European Conference on Computer Vision (ECCV 2010)*, September 2010, Crete, Greece.

C.26. C. Forstall and W. Scheirer “Features from Frequency: Authorship and Stylistic Analysis Using Repetitive Sound,” oral presentation at the *4th Annual Chicago Colloquium on Digital Humanities and Computer Science*, Chicago, IL, November 2009.

C.27. W. Scheirer, A. Rocha, B. Heflin, and T. Boulton, “Difficult Detection: A Comparison of Two Different Approaches to Eye Detection for Unconstrained Environments,” oral presentation at the *Third IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2009)*, September 2009, Washington, D.C.

C.28. W. Scheirer and T. Boulton, “Bipartite Biotokens: Definition, Implementation, and Analysis,” oral presentation at the *3rd IAPR/IEEE International Conference on Biometrics (ICB 2009)*, June 2009, Alghero, Italy.

C.29. W. Scheirer and T. Boulton, “A Fusion Based Approach to Enhancing Multi-Modal Biometric Recognition System Failure Prediction and Overall Performance,” presented at the *Second IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS 2008)*, September 2008, Washington, D.C.

C.30. W. Scheirer and T. Boulton, “Bio-Cryptographic Protocols with Bipartite Biotokens,” oral presentation at the *2008 Biometrics Symposium*, held in conjunction with the *Biometrics Consortium Conference (BCC 2008)*, September 2008, Tampa, FL.

C.31. W. Scheirer and T. Boulton, “Cracking Fuzzy Vaults and Biometric Encryption,” oral presentation at the *2007 Biometrics Symposium*, held in conjunction with the *Biometrics Consortium Conference (BCC 2007)*, September 2007, Baltimore, MD.

C.32. T. Boulton, W. Scheirer, and R. Woodworth, “Revocable Fingerprint Biotokens: Accuracy and Security Analysis,” presented at the *IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2007)*, June 2007, Minneapolis, MN.

C.33. D. Lopresti, S. Maas, D. Drake, R. Kaushal, S. Hookway, W. Scheirer, M. Strohmaier, and C. Wojciechowski, “A Bioinformatics Approach to Identify Recoding Events of A-to-I RNA Editing,” presented at the *Computational Systems Bioinformatics Conference*, August 2006, Palo Alto, CA.

### **Refereed Workshop Papers**

W.1. R. C. Johnson, W. Scheirer, and T. Boulton, “Secure Voice Based Authentication for Mobile Devices: Vaulted Voice Verification,” presented at the *SPIE Defense, Security and Sensing Symposium*, May 2013, Baltimore MD.

W.2. M. Wilber, W. Scheirer, P. Leitner, B. Heflin, J. Zott, D. Reinke, D. Delaney, and T. Boulton, “Animal Recognition in the Mojave Desert: Vision Tools for Field Biologists,” presented at the *IEEE Workshop on Applications of Computer Vision (WACV 2013)*, January 2013, Clearwater Beach, FL. Best Paper Award (selected by conference attendees).

W.3. M. Wilber, W. Scheirer, and T. Boulton, “PRIVV: Private Remote Iris-authentication with Vaulted Verification,” presented at the *IEEE Computer Society Workshop on Biometrics*, June 2012, Providence, RI.

W.4. B. Heflin, W. Scheirer, and T. Boulton, “For Your Eyes Only,” presented at the *IEEE Workshop on Applications of Computer Vision (WACV 2012)*, January 2012, Breckenridge, CO.

W.5. W. Scheirer, B. Bishop, and T. Boulton, “Beyond PKI: The Biocryptographic Key Infrastructure,” oral presentation at the *IEEE International Workshop on Information Forensics and Security (WIFS 2010)*, December 2010, Seattle, WA.

W.6. A. Sapkota, B. Parks, W. Scheirer, and T. Boulton, “FACE-GRAB: Face Recognition with General Region Assigned to Binary Operator,” oral presentation at the *IEEE Computer Society Workshop on Biometrics*, June 2010, San Francisco, CA.

W.7. V. Iyer, S. Kirkbride, B. Parks, W. Scheirer, and T. Boulton, “A Taxonomy of Face Models for System Evaluation,” presented at the *IEEE Workshop on Analysis and Modeling of Faces and Gestures (AMFG 2010)*, June, 2010, San Francisco, CA.

W.8. W. Scheirer, R. White, and T. Boulton, “Privacy Enhancement via Adaptive Cryptographic Embedding,” oral presentation at the *National Homeland Defense Foundation’s Emerging Technology Day*, October 2008, Colorado Springs, CO.

W.9. W. Scheirer, A. Bendale, and T. Boulton, “Predicting Biometric Facial Recognition Failure With Similarity Surfaces and Support Vector Machines,” oral presentation at the *IEEE Computer Society Workshop on Biometrics*, June 2008, Anchorage, AK.

W.10. T. Boulton, W. Scheirer, and R. Woodworth, “FAAD: Face at a Distance,” oral presentation at the *SPIE Defense and Security Symposium*, March 2008, Orlando FL.

W.11. W. Scheirer, S. Kirkbride, and T. Boulton, “INSPEC<sup>2</sup>T: Inexpensive Spectrometer Color Camera Technology,” presented at the *IEEE Workshop on Applications of Computer Vision (WACV 2008)*, January 2008, Copper Mountain, CO.

W.12. W. Scheirer and M. Chuah, “Network Intrusion Detection with Semantics-Aware Capability,” oral presentation at the *2nd International Workshop on Security in Systems and Networks (SSN 2006)*, April 2006, Rhodes, Greece.

### **Book Chapters**

B.1. G. Rosa, J. Papa, and W. Scheirer, “Person Identification Using Handwriting Dynamics and Convolutional Neural Networks,” forthcoming in R. Singh and M. Vatsa, editors, *Deep Learning in Biometrics*. CRC / Taylor & Francis Press, 2017.

B.2. W. Scheirer, B. Bishop, and T. Boulton, “Beyond PKI: The Biocryptographic Key Infrastructure,” in P. Campisi editor, *Security and Privacy in Biometrics*. Springer-Verlag, 2013.

B.3. B. Heflin, W. Scheirer, A. Rocha, and T. Boulton, “A Look at Eye Detection for Unconstrained Environments,” in P. Wang editor, *Pattern Recognition, Machine Intelligence and Biometrics*. Higher Education Press & Springer-Verlag, 2011.

B.4. T. Boulton and W. Scheirer, “Long Range Facial Image Acquisition and Quality,” in M. Tistarelli, S. Li and R. Chellappa, editors, *Biometrics for Surveillance and Security*. Springer-Verlag, 2009.

### **Edited Volumes**

E.1. I. Kakadiaris, A. Kumar, and W. Scheirer (eds.), *Biometric and Surveillance Technology for Human and Activity Identification XII*, Proc. of SPIE Vol. 9457, 2015.

E.2. I. Kakadiaris, W. Scheirer, and C. Busch (eds.), *Biometric and Surveillance Technology for Human and Activity Identification XI*, Proc. of SPIE Vol. 9075, 2014.

E.3. I. Kakadiaris, W. Scheirer, and L. Hassebrook (eds.), *Biometric and Surveillance Technology for Human and Activity Identification X*, Proc. of SPIE Vol. 8712, 2013.

### Monographs

M.1. W. Scheirer, “Extreme Value Theory-based Methods for Visual Recognition,” Morgan & Claypool Publishers, 2017.

M.2. C. Forstall and W. Scheirer, “Quantitative Intertextuality,” forthcoming from Springer Nature in 2017.

### Non-Refereed Papers

N.1. A. Rocha and W. Scheirer, “Large-Scale Learning for Media Understanding,” Editorial introducing special issue of same name in *EURASIP Journal on Image and Video Processing*, Vol. 2015.

N.2. W. Scheirer, N. Kumar, V. Iyer, T. Boulton, and P. Belhumeur, “How Reliable are Your Visual Attributes?” Invited Paper at the *SPIE Defense and Security Symposium*, May 2013, Baltimore MD.

N.3. W. Scheirer, A. Rocha, T. Boulton, and S. Goldenstein, “The Unseen Challenge Data Sets,” Invited Paper at the *First IEEE Workitorial on Vision of the Unseen*, June 2008, Anchorage, AK.

N.4. W. Scheirer and M. Chuah, “The Strength of Syntax Based Approaches to Dynamic Network Intrusion Detection,” Invited Paper at the *40th Annual Conference on Information Sciences and Systems (CISS 2006)*, March 2006, Princeton, NJ.

### Patents

U.S. Patent Pending: Systems and Methods for Machine Learning Enhanced by Human Measurements, Application #US 61/840,871, Filed June 2013.

U.S. Patent Pending: Method and System for Authenticating Remote Users, Application #US 13/853,783, Filed March 2013.

U.S. Patent Pending: System and Apparatus for Failure Prediction and Fusion in Classification and Recognition, Application #US 12/766,283, Filed April 2010.

U.S. Patent Pending: Bio-Cryptography : Secure Cryptographic Protocols with Bipartite Biotokens, Application #PCT/US2008/013190, Filed November 2008.

### Current Research Support

PI, “Tesserae Intertext Service: Intertextual Search Access to Digital Collections in the Humanities,” NEH Digital Humanities Advancement Grant, \$279,609 for 2018 – 2019. Joint work between University at Buffalo and Notre Dame (lead institution).

PI, “*Verba Volant, Scripta Manent*: Automatic Manuscript Analysis for the Vatican Secret Archives,” Notre Dame Grant from Notre Dame Research, the College of Arts and Letters, the Medieval Institute, and the Office of Mission Engagement, and the Office of Digital Learning, \$32,000 for 2017 – 2018.



Co-PI (Notre Dame), “CI-New: Collaborative Research: COVE: Computer Vision Exchange for Data, Annotation and Tools,” NSF CISE Research Infrastructure Grant, \$200,686 for 2016 – 2019. Consortium project with University of Michigan (lead institution) and Boston University.

PI, “Restoration and Enhancement Techniques for Images Acquired by Small Unmanned Aerial Vehicles,” IARPA Office of Smart Collection, \$506,643.93 for 2016 – 2019.

Co-PI, “Infrastructure for Supporting Biomedical Application Algorithms, Runtime Development and Resource Management,” NSF CISE Research Infrastructure Grant, \$500,000 for 2016 – 2019.

Co-PI (with Patrick Flynn in the Dept. of Computer Science and Engineering and Kevin Enchelmeyer in the Dept. of Athletics), “Markerless Video Analytics for Athletic Performance Characterization,” Notre Dame FRSP Regular Grant, \$99,961 for 2016 – 2018.

Lead Co-PI (Notre Dame), “Media Forensics Integrity Analytics,” DARPA MediFor Program, \$1,163,391 for 2016 – 2020. Large consortium project with Purdue (lead institution), USC, NYU, University of Siena, and Politecnico di Milano.

Co-PI (Notre Dame), “Algorithms for Representation and Inference informed by the Acquisition of Data from Neuroscience Experiments (ARIADNE),” IARPA MICrONS Program, \$825,531 for 2016 – 2021. Large consortium project with Harvard (lead institution), MIT, University of Chicago, NYU, and the Rockefeller University.

NVIDIA Corporation, Hardware Grant, 2015, 2016, 2017 (Notre Dame).

### **Past Research Support**

Co-PI (with Lei Li in the Dept. of Biological Sciences at Notre Dame), “Melatonin Modulation of the Olfacto-Retinal Centrifugal Visual Pathway,” Department of Army, \$50,000 for 2016 – 2017.

Co-PI (UCCS), “Tesseract: A Search Engine for Allusion,” National Endowment for the Humanities Start-up Grant, \$49,835 for 2012–2014 (\$10,000 to UCCS). Joint work with the University at Buffalo.

PI, “AACTIONS: Automated Animal Classification and Tracking in Outdoor Niche Settings,” Air Force Phase II SBIR, \$749,961 for 2012 (project concluded in 2015).

PI, “Forensic Facial Image Analysis Providing 3D Mapping, Metatagging, Comparative Operation and Search System,” Army Phase II SBIR, \$729,800 for 2012 (project concluded in 2014). Joint work with InCadence Strategic Solutions and Intelligent Software Solutions.

PI, “Standoff-Biometric for Non-Cooperative Moving Subjects,” Army Phase II SBIR, \$730,000 for 2012 (project concluded in 2014). Joint work with Animetrics, Inc. and the CGI Group.

PI, “FaceTracer: Organization, Search and Manipulation of Large Databases of Face Images,” Office of Naval Research Phase II SBIR, \$750,000 for 2011–2012. Joint work with Automatic Face Systems, Inc.

PI, “Forensic Facial Image Analysis Providing 3D Mapping, Metatagging, Comparative Operation and Search System,” Army Phase I SBIR, \$120,000 for 2011–2012.

PI, “Standoff-Biometric for Non-Cooperative Moving Subjects,” Army Phase I SBIR, \$120,000 for 2011–2012. Joint work with Animetrics, Inc.

PI (UCCS), “Group Travel Grant for the Doctoral Consortium at the IEEE Conference on Computer Vision and Pattern Recognition,” NSF Grant, \$14,525 for 2011–2012.

PI, “Improving Privacy and Security in Biometrics,” National Science Foundation Phase II STTR, \$656,692 for 2008–2011.

PI, “AACTIONS: Automated Animal Classification and Tracking in Outdoor Niche Settings,” Air Force Phase I SBIR, \$100,000 for 2010.

PI, “FaceTracer: Organization, Search and Manipulation of Large Databases of Face Images,” Office of Naval Research Phase I SBIR, \$70,000 for 2009–2010. Joint work with Automatic Face Systems, Inc.

PI, “Optimizing Remote Capture of Biometrics for Screening Processes,” Department of Homeland Security Phase I SBIR, \$100,000 for 2008.

PA Digital Greenhouse. Awarded \$8,000 for network intrusion detection research. (Fall 2004 - Spring 2005)

### **Technical Skills**

Programming Languages: Python, C/C++, Java, Matlab, R, perl, Assembly Language (x86, MIPS), Bash, SQL, HTML

Operating Systems: Linux, OS X, 4.BSD (OpenBSD, NetBSD, FreeBSD), Microsoft Windows

Software Development: gcc/g++, git, vagrant, virtual box, Java SE, Visual Studio

System Administration: Over 15 years of experience building and maintaining Unix networks.

Document Publishing: L<sup>A</sup>T<sub>E</sub>X, iWork, Microsoft Office

### **Professional Activities**

#### **Professional and Academic Membership:**

Senior Member of the IEEE, IEEE Computer Society, IEEE Signal Processing Society, and Society for Neuroscience

#### **Academic Service:**

Chair, SPIE Conference on Biometric and Surveillance Technology for Human and Activity Identification, 2013, 2014, 2015

Program Chair, SIBGRAPI 2014

Program Chair, IEEE WACV 2013, 2014

Program Chair, IEEE AMFG 2015

Program Chair, IAPR/IEEE IJCB 2017

General Chair, IEEE WACV 2012

Area Chair, IAPR/IEEE ICB 2015, 2016

Area Chair, IEEE ICIP 2016

Area Chair, IEEE FG 2018

Finance Chair, IEEE BTAS 2015

Finance Chair, IEEE CVPR 2011, 2012, 2013, 2017, 2018, 2019

Finance Chair, IEEE FG 2011, 2013, 2015, 2017

Finance Chair, IEEE ICCV 2017

Industry Chair, IEEE ICCV 2017

Corporate Relations Chair, Doctoral Consortium Chair, IEEE CVPR 2011

Computer Vision Foundation Liaison, IEEE CVPR 2015

Publications Chair, IEEE BTAS 2012

Publications Chair, IEEE WIFS 2011

Publications Chair, IEEE WACV 2008  
Publications Chair, IEEE ICCV 2007  
Competition Chair, IAPR/IEEE IJCB 2014  
Tutorial Chair, IEEE ISBA 2016  
Publicity Chair, IEEE BTAS 2016  
International Liaison, SIBGRAPI 2018  
Doctoral Consortium Mentor, IEEE BTAS 2015, 2016  
Doctoral Consortium Mentor, IEEE WACV 2018  
Organizer, Video Person Recognition Evaluation, BTAS 2016  
Communication Officer, IEEE PAMI-TC, 2010 - present  
IEEE Biometrics Council Conference Committee Member, 2011 - present  
Elected Member, IEEE IFS-TC, Term 2015 - 2017  
Chief Technical Officer, Computer Vision Foundation

**Conference/Workshop Reviewing:**

Reviewer, IEEE CVPR 2010–2016, 2018  
Reviewer, IEEE ICCV 2013, 2015  
Reviewer, ECCV 2012, 2014, 2016, 2018  
Reviewer, BMVC 2015, 2016  
Program Committee, ACCV 2012, 2014  
Program Committee, IEEE FG 2013, 2015, 2017  
Program Committee, IAPR/IEEE ICB 2013, 2015, 2016  
Program Committee, IEEE WACV 2009, 2011, 2012, 2015–2018  
Program Committee, IEEE BTAS 2012, 2013, 2015, 2016  
Reviewer, IAPR/IEEE International Joint Conference on Biometrics, 2011, 2014  
Program Committee, International Workshop on Biometrics in The Wild, 2015, 2017  
Reviewer, IEEE WBCV 2011  
Reviewer, IEEE ICIP 2015, 2016, 2017  
Reviewer, IEEE ICASSP 2016, 2017  
Reviewer, SIBGRAPI 2016  
Reviewer, NSF Data Science Workshop at UW, 2015  
Program Committee, Computer Vision Winter Workshop, 2016  
Program Committee, IEEE WIFS 2011, 2012, 2015, 2016  
Program Committee, IEEE ICME 2012 (Academic Track)  
Program Committee, IEEE ICME 2011 (Academic & Industrial Track)  
Program Committee, First IEEE Intl. Conference on Biometrics, Identity and Security, 2009  
Reviewer, Biometrics Symposium, 2008  
Program Committee, First IEEE Workitorial on *Vision of the Unseen*, 2008

**Journal Reviewing:**

Reviewer, IEEE Transactions on Pattern Analysis and Machine Intelligence  
Reviewer, IEEE Transactions on Information Forensics & Security  
Reviewer, IEEE Transactions on Image Processing  
Reviewer, IEEE Transactions on Multimedia  
Reviewer, IEEE Transactions on Systems, Man, and Cybernetics  
Reviewer, IEEE Transactions on Circuits and Systems for Video Technology  
Reviewer, IEEE Transactions on Neural Networks and Learning Systems  
Reviewer, IEEE Transactions on Aerospace and Electronic Systems  
Reviewer, IEEE Transactions on Human-Machine Systems  
Reviewer, IEEE Signal Processing Letters  
Reviewer, IEEE Multimedia Magazine  
Reviewer, IEEE Access  
Reviewer, PLOS Computational Biology  
Reviewer, International Journal of Computer Vision

Reviewer, Pattern Recognition  
Reviewer, Pattern Recognition Letters  
Reviewer, Image and Vision Computing  
Reviewer, Computer Vision and Image Understanding  
Reviewer, EURASIP Journal on Advances in Signal Processing  
Reviewer, International Journal of Remote Sensing  
Reviewer, Journal of Visual Communication and Image Representation  
Reviewer, Neurocomputing  
Reviewer, Information Fusion  
Reviewer, Machine Learning  
Reviewer, Digital Humanities Quarterly  
Reviewer, Digital Scholarship in the Humanities  
Reviewer, Psychological Science

**Editorships:**

Editorial Board Member, IEEE Biometrics Compendium

Guest Editor, EURASIP International Journal of Image and Video Processing, Special Issue on Large Scale Learning for Media Understanding (<http://jivp.urasipjournals.com/series/LSLMU>), Vol. 2015.

**Book Reviews:**

Reviewer, Edited Volume, Security and Privacy in Biometrics, Springer 2012

**Proposal Review Panels:**

Reviewer, Israel Science Foundation, 2016  
Reviewer, Maine Technology Institute, 2014  
Reviewer, King Abdulaziz City for Science and Technology, 2013  
Reviewer, National Science Foundation (Robust Intelligence, SBIR), 2012  
Reviewer, National Institute of Justice, 2011

**Other Review Panels:**

Washington Editorial Review Board Reader, National Institute of Standards and Technology, 2017

**University Service:**

Graduate Student Admissions Committee, Department of Computer Science and Engineering, University of Notre Dame, 2016, 2017

Undergraduate Curriculum Committee, Department of Computer Science and Engineering, University of Notre Dame, 2017

Research Experiences for Teachers (RET) in Engineering and Computer Science Mentor, Department of Computer Science and Engineering, University of Notre Dame, 2016

**Invited Talks**

“Computer Vision, Bodies and Brains,” invited talk at the Midwest Computer Vision Workshop, Ann Arbor, MI, March 2018.

“*Verba Volant, Scripta Manent*: Automatic Manuscript Analysis for the Vatican Secret Archives,” invited talk for the Digital Humanities Speaker Series, sponsored by the College of Arts and Letters, the Medieval Institute, the Hesburgh Libraries, Notre Dame Research, and the Office of Digital Learning, Notre Dame, IN, February 2018.

“Using Human Behavior and Brain Activity to Guide Machine Learning,” invited talk at the University of Kentucky, sponsored by the Computer Science Department, Lexington, KY, November 2017.

“Using Human Behavior and Brain Activity to Guide Machine Learning,” invited talk at Amazon, Seattle, WA, October 2017.

“Using Human Behavior and Brain Activity to Guide Machine Learning,” invited talk at the University of Colorado Colorado Springs, sponsored by the Department of Computer Science, Colorado Springs, CO, September 2017.

“Bipartisan Briefing on Brain Mapping,” briefing to the Congressional Neuroscience Caucus and the Congressional R&D Caucus, Washington D.C., June 2017.

“Visual Psychophysics for Facial Analysis,” keynote talk at Biometrics in the Wild 2017, held in conjunction with IEEE FG 2017, Washington D.C., June 2017.

“Quantitative Intertextuality: Analyzing the Markers of Information Reuse,” with C. Forstall, invited talk at Cultural Analytics 2017, Notre Dame, IN, May 2017.

“Scalable Strategies for Image Analysis in Neuroscience,” invited talk at West Virginia University, sponsored by the Lane Department of Computer Science and Electrical Engineering, Morgantown, WV, April 2017.

Panelist, Notre Dame Data Security Conference, sponsored by the John J. Reilly Center for Science, Technology and Values, University of Notre Dame Law School, Notre Dame, IN, February 2017.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at the University of Michigan, sponsored by the Department of Electrical Engineering and Computer Science, Ann Arbor, MI, December 2016.

“The Lannisters Send Their Regards: Intertextual Tools and Theory in the Age of Fandom,” with C. Forstall, talk based on extended abstract at the *11th Annual Chicago Colloquium on Digital Humanities and Computer Science*, Chicago, IL, November 2016.

“Quantitative Intertextuality for Texts Ancient and Modern,” with C. Forstall, invited talk at the College of the Holy Cross, Department of Classics, October 2016.

“The Impact of the Open Set Recognition Problem on Deep Learning,” invited talk at the DiCarlo Lab, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA, June 2016.

“The Impact of the Open Set Recognition Problem on Deep Learning,” invited talk at the Robotics: Science and Systems (RSS 2016) Workshop “Are the Sceptics Right? Limits and Potentials of Deep Learning in Robotics,” Ann Arbor, MI, June 2016.

“Scalable Strategies for Image Analysis in Neuroscience,” invited talk at Argonne National Laboratory, sponsored by the X-Ray Science Division, Lemont, IL, June 2016.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at Michigan State University, sponsored by the Department of Computer Science and Engineering, East Lansing, MI, April 2016.

“On the Automatic Tracing of Intertextuality by Meaning,” invited talk at the Faculté de Lettres, Unité de Latin, Université de Genève, Geneva, Switzerland, May 2015.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at the Centre Universitaire D’Informatique, Université de Genève, Geneva, Switzerland, May 2015.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at the University of South Florida, sponsored by the Department of Computer Science and Engineering, Tampa, FL, January 2015.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at the University of California, Santa Barbara, sponsored by the Department of Computer Science, Santa Barbara, CA, December 2014.

“Using Brain Function to Fuel Advances in Computer Vision,” invited talk at the Johns Hopkins University Applied Physics Laboratory, sponsored by the Applied Neuroscience team, Laurel, MD, December 2014.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at the University of Notre Dame, sponsored by the Department of Computer Science and Engineering, South Bend, IN, October 2014.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” invited talk at Xerox Research Centre Europe, Grenoble, September 2014.

“Emerging Work in Open Set Recognition for Vision and Language,” invited talk at Fundação Getulio Vargas, sponsored by the Escola de Matemática Aplicada, Rio de Janeiro, August 2014.

“Perceptual Annotation: Measuring Human Vision to Improve Computer Vision,” talk delivered at the Samsung Research Institute Brazil and the Universidade Estadual de Campinas as part of the Samsung Distinguished Speaker Program, Campinas, August 2014.

“Biocryptographic Authentication,” with T. Boulton and R.C. Johnson, talk based on extended abstract at the *Who are you?! Adventures in Authentication: WAY Workshop*, Menlo Park, CA, July 2014.

“Towards Open Set Recognition,” with A. Rocha, A. Sapkota, and T. Boulton, talk based on extended abstract at the *2nd Workshop on Web-scale Vision and Social Media (VSM)*, Columbus, OH, June 2014.

“The Open Set Recognition Problem,” invited talk at the Queensland University of Technology, sponsored by the School of Electrical Engineering and Computer Science, December 2013.

“An Extreme Value Theory Approach to Visual Attributes,” invited talk at Universidade Estadual de Campinas, sponsored by the Instituto de Computação, August 2013.

“Meta-Recognition: Score Analysis and Calibration for Recognition Problems,” invited talk at Boston University, hosted by the Department of Computer Science, April 2013.

“A Snapshot of Security and Privacy in Biometrics,” invited talk at *ICMedia: the International Conference on Multimedia Forensics, Surveillance, and Security*, sponsored by the Polícia Federal, Brasília, September 2012.

“Meta-Recognition: Score Analysis and Calibration for Recognition Problems,” invited talk at the University at Buffalo, hosted by the Computer Science and Engineering Department, May 2012.

“Meta-Recognition, Machine Learning and the Open Set Problem,” invited talk at Universidade Estadual de Campinas, sponsored by the Instituto de Computação, December 2011.

“Biometrics: New Solutions for Privacy and Security,” invited talk at Colorado State University, hosted by the Department of Computer Science, March 2011.

“Literary and Linguistic Computing: Motivation and a Prodigious Case Study,” invited talk at the University at Buffalo, sponsored by the Digital Humanities Initiative and Department of Classics, April 2010.

“Issues in Non-Cooperative Face Recognition,” invited talk at ROBUST 2008, Honolulu, HI, November 2008.

“The Integration of the Bundle Security Protocol Features into DTN2,” invited talk at the DTNRG meeting at IETF 65 in Dallas, TX, March 2006.

“Comparison of Three Sliding-Window Based Worm Signature Generation Schemes,” invited talk at the Lehigh University Network/Computer Security Workshop, August 2005.

#### Poster Presentations

“Fast Learning-free 2D Segmentation and 3D Reconstruction Software for Sparse Neuronal Circuit Tracing,” with A. Shahbazi, J. Kinnison, M. Joesch, and N. Kasthuri, poster presentation at the *47th Annual Meeting of the Society for Neuroscience*, Washington D.C., November 2017.

“Using Human Brain Activity to Guide Machine Learning,” with R. Fong and D. D. Cox, poster presentation at the *11th Annual Women in Machine Learning Workshop*, Barcelona, December 2016.

“Cross-modal Sensory Information Integration in Modulation of Vertebrate Visual System Functions,” with S. Banerjee and L. Li, poster presentation at the *46th Annual Meeting of the Society for Neuroscience*, San Diego, CA, November 2016.

“Use of Shallow, Non-invariant Representations in High-level Face Perception Tasks,” with S. Anthony, poster presentation at the *15th Annual Meeting of the Vision Sciences Society*, St. Pete Beach, FL, May 2015. Abstract appears in *Journal of Vision* 15(12):934.

“Euterpe’s Hidden Song: Patterns in Elegy,” with C. Forstall, poster presentation at *Digital Humanities 2014*, École Polytechnique Fédérale De Lausanne, July 2014.

“Real-World Computer Vision Applications Are Open, So Should Your Recognition,” with L. Jain and T. Boulton, poster presentation at *The International Workshop on Large Scale Visual Recognition and Retrieval (BigVision 2014)*, Columbus, OH, June 2014.

“Judgments of Personality Traits from Real-World Face Images,” with S. Anthony and K. Nakayama, poster presentation at the *14th Annual Meeting of the Vision Sciences Society*, St. Pete Beach, FL, May 2014. Abstract appears in *Journal of Vision* 14(10):1280.

“Using Brain Structure and Function to Fuel Advances in Machine Learning,” with D. D. Cox, C.-Y. Tsai and N. Kasthuri, *IARPA Machine Intelligence from Cortical Networks Workshop*, Arlington, VA, February 2014.

“Mind the Gap: Creating A Rosetta Stone for Unbiased Comparison of Cell Types and Connectivity between Primate and Mouse Brains,” with N. Kasthuri, D. D. Cox, C.-Y. Tsai, R. Schalek, D.-I. Lee, D. Berger and J. Lichtman, *IARPA Machine Intelligence from Cortical Networks Workshop*, Arlington, VA, February 2014.

“Modelling the Interpretation of Literary Allusion with Machine Learning Techniques,” with N. Coffee, J. Gawley, C. Forstall, D. Johnson, J. Corso and B. Parks, poster presentation at *Digital Humanities 2013*, University of Nebraska-Lincoln, July 2013. Presentation also appears in *The Journal of Digital Humanities*, Vol. 3, No. 1 Spring 2014.

“Human and Computer Face Detection Under Occlusion,” with S. Anthony, D.D. Cox and K. Nakayama, poster presentation at the *13th Annual Meeting of the Vision Sciences Society*, Naples, FL, May 2013. Student Poster Award.

“What makes an Allusion? A Digital Approach,” with C. Forstall, N. Coffee and J. Gawley, poster presentation at the *Digital Classics Association Conference*, Buffalo, NY, April 2013.

“Revealing Hidden Patterns in the Meter of Homer’s *Iliad*,” with C. Forstall, poster presentation at the *7th Annual Chicago Colloquium on Digital Humanities and Computer Science*, Chicago, IL, November 2012.

“Visualizing Sound as Functional n-grams in Homeric Greek Poetry,” with C. Forstall, poster presentation at *Digital Humanities 2011*, Stanford University, June 2011.

“Aspects of Digital Criticism,” with C. Forstall and N. Coffee, installation at E-Poetry [2011]: International Digital Language | Media | Arts Festival, University at Buffalo, May 2011.

“A Statistical Study of Latin Elegiac Couplets,” with C. Forstall, poster presentation at the *5th Annual Chicago Colloquium on Digital Humanities and Computer Science*, Chicago, IL, November 2010.

“Evidence of Intertextuality: Investigating Paul the Deacon’s *Angustae Vitae*,” with C. Forstall and S. Jacobson, poster presentation at *Digital Humanities 2010*, King’s College London, July 2010.

“A Bioinformatics Approach to Identify Recoding Events of A-to-I RNA Editing,” poster presentation at the Greater Philadelphia Bioinformatics Alliance 3rd Annual Retreat, Great Valley, PA, October 2005.

## **Tutorials and Seminars**

Tutorial Author, “The Open Set Recognition Problem and Its Implications and Opportunities in Visual Computing, Forensics and Security,” *IEEE International Conference on Image Processing*, Phoenix, AZ, September 2016.

Tutorial Speaker, “Statistical Methods for Open Set Recognition,” *IEEE Conference on Computer Vision and Pattern Recognition*, Las Vegas, NV, June 2016.

Tutorial Speaker, “The Open Set Recognition Problem in Information Forensics and Security,” *IEEE International Workshop on Information Forensics and Security*, Roma Tre University, Italy, November 2015.



Tutorial Speaker, “Biometrics: Practical Issues in Privacy and Security,” *IAPR/IEEE International Joint Conference on Biometrics*, Washington D.C., October 2011.

Tutorial Speaker, “Face Recognition: Long-Range and Surveillance,” *IEEE Conference on Automatic Face and Gesture Recognition*, Santa Barbara, CA, March 2011.

Tutorial Author, “Biometrics: Privacy and Social Acceptance,” IEEE Expert Now Series, online course material available in the IEEE eLearning Library, December 2010.

Tutorial Author, “Face Biometrics for Security: Long-Range and Surveillance,” IEEE Expert Now Series, online course material available in the IEEE eLearning Library, December 2010.

Tutorial Speaker, “Biometrics: Understanding Advances in Privacy and Security,” *IEEE Conference on Computer Vision and Pattern Recognition*, San Francisco, CA, June 2010.

Tutorial Speaker, “Template Protection,” *First IEEE International Conference on Biometrics, Identity and Security*, held in conjunction with the *Biometrics Consortium Conference*, Tampa, FL, September 2009.

Tutorial Speaker, “Biometrics: Ethics, Privacy, and Security,” *3rd IAPR/IEEE International Conference on Biometrics*, Alghero, Italy, June 2009.

Tutorial Speaker, First IEEE Workitorial on *Vision of the Unseen*, Anchorage, AK, June 2008.

Seminar Instructor, “Unix-based Forensics Training for Law Enforcement,” led a comprehensive seminar series for law enforcement encompassing several months of lectures and laboratory exercises, Fall 2004.

## **Student Advising**

### **Doctoral Committees**

Giovani Chiachia (UNICAMP, Ph.D. defended August 2013, now postdoc at UNICAMP)

Archana Sapkota (UCCS, Ph.D. defended November 2013, now at Aware, Inc.)

R.C. Johnson (UCCS, Ph.D. defended March 2014, now at Paypal)

Victor Fragoso (UCSB, Ph.D. defended December 2014, now assistant prof. at WVU)

Abdullah Albahdal (UCCS, Ph.D. defended February 2015, now at Salman Bin Abdulaziz U.)

Lalit Jain (UCCS, Ph.D. defended April 2015, now at VMware)

Hamdan Alzahrani (UCCS, Ph.D. defended April 2016)

Ethan Rudd (UCCS, Ph.D. defended April 2017, now at Sophos)

Fattaneh Bayatbabolghani (Notre Dame, Ph.D. defended May 2017, now postdoc at IU)

Jianxu Chen (Notre Dame, defended Summer 2017)

Lin Yang (Notre Dame, Ph.D. expected Spring 2018)

Sandipan Banerjee (Notre Dame, Ph.D. expected Spring 2018)

Andrey Kuelkamp (Notre Dame, Ph.D. expected Fall 2018)

Svati Dhamija Bendale (UCCS, Ph.D. expected Fall 2018)

Qiuwen Lou (Notre Dame, Ph.D. expected Fall 2018)

James Henrydoss (UCCS, Ph.D. expected Fall 2018)

James Gawley (UB, Ph.D. expected Fall 2018)

Antonios Anastasopoulos (Notre Dame, Ph.D. expected Spring 2019)

Kenton Murray (Notre Dame, Ph.D. expected Spring 2019)

### **Doctoral Proposal Reader**

Tariq Iqbal (Notre Dame, Ph.D. proposed April 2016 at Notre Dame, finished at UCSD)

### **Master's Committees**

Chris Eberle (UCCS, Master's defended March 2014, now at Facebook)

### **Graduate Advising**

Otávio Penatti (UNICAMP, Summer 2012, now at Samsung Research Institute Brazil)

Klemen Grm (University of Ljubljana, Fall 2016)

Brandon RichardWebster (Notre Dame, Summer 2015 - present, NSF GRFP winner)

Elia Shahbazi (Notre Dame, Summer 2015 - present)

Sreya Banerjee (Notre Dame, Spring 2016 - present)

Nathaniel Blanchard (Notre Dame, Summer 2016 - present)

Jeffery Kinnison (Notre Dame, Fall 2016 - present)

Bingyu Shen (Notre Dame, Fall 2016 - present)

Rosaura Vidal Mata (Notre Dame, Spring 2017 - present)

Samuel Grieggs (Notre Dame, Summer 2017 - present)

Jacob Dumford (Notre Dame, Master's Student, Fall 2017 - present)

### **Undergraduate Advising**

Michael Wilber (UCCS, Fall 2009 - Spring 2013, NSF GRFP winner, now grad. student at Cornell)

Jessica Tolbert (Oberlin, Summer 2013)

Shantanu Sinha (IIT Bombay, Summer 2013, now grad. student at MIT)

Vanessa Tan (Harvard, Summer 2013 - Fall 2013, now at Quora)

Chase Morrin (Harvard, Summer 2014)

Anupa Murali (Harvard, Fall 2014 - Spring 2015)

Amna Hashmi (Harvard, Spring 2015)

Ruth Fong (Harvard, Spring 2014 - Summer 2015, Rhodes Scholarship winner, now grad. student at Oxford)

James Bowyer (Notre Dame, Fall 2015, CSE 48901 Independent Study)

Kevin Shin (Notre Dame, Spring 2015)

Zachary Janicki (Notre Dame, Spring 2015)

Mel McMcCurrie (Notre Dame, Spring 2016, CSE 48901 Independent Study; Summer 2016, RA)

Fernando Beletti (Notre Dame, Summer 2016)

Lucas Parzianello (Notre Dame, Summer 2016)

Matthew Staffelbach (Notre Dame, Fall 2016, Spring 2017, CSE 48901 Independent Study)

Michael O'Malley (Notre Dame, Fall 2016 - Spring 2017)

Christopher Clarizio (Notre Dame, Spring 2017, CSE 48901 Independent Study)

So Yon Kwon (Notre Dame, Spring 2017)

Michael Parowski (Notre Dame, Fall 2017, CSE 48901 Independent Study)

Anthony DiFalco (Notre Dame, Fall 2017, CSE 48901 Independent Study)

Elisabetta Caldesi (Notre Dame, Fall 2017, CSE 48901 Independent Study)

Patricia Hale (Notre Dame, Spring 2018, CSE 48901 Independent Study)

William Badart (Notre Dame, Spring 2018, CSE 48901 Independent Study)

Antonio Minondo (Notre Dame, Spring 2018, CSE 48901 Independent Study)

Kelly Malecki (Notre Dame, Spring 2018, CSE 48901 Independent Study)

John Nolan (Notre Dame, Spring 2018, CSE 48901 Independent Study)

Luke Song (Notre Dame, Spring 2018, CSE 48901 Independent Study)

Thomas Marshall (Notre Dame, Spring 2018, CSE 48901 Independent Study)

### **High School Mentoring**

Michael Gohde (Harvard Intern, Spring 2015)

### **Postdoctoral Fellows Advised**

Christopher Forstall (Notre Dame, Fall 2016 - Summer 2017, now assistant professor at Mount Allison University)

Daniel Moreira (Notre Dame, Summer 2016 - present)

## Teaching (Notre Dame)

CSE 40537/60537 Biometrics, Fall 2015

CSE 40567/60567 Computer Security, Spring 2016, Spring 2017, Spring 2018

CSE 44567 Computer Security, Spring 2018

## Awards & Honors

Samsung Distinguished Speaker (2014)

IJCB Best Reviewer Award (2014)

CVPR Outstanding Reviewer Award (2013, 2015)

ICB Best Reviewer Award (2013)

ECCV Outstanding Reviewer Award (2012, 2014)

ACCV Best Reviewer Award (2012, 2014)

ICME Quality Reviewer Award (2011)

Outstanding Ph.D. Student of the Year, Department of Computer Science, University of Colorado, Colorado Springs (2009)

Chancellor's Scholarship, University of Colorado, Colorado Springs (2006)

Lehigh University Fellowship (2005)

## Press Coverage

1. "Computer IDs Culprits with Tattoo Recognition," *Innovation News Daily*, appeared in NBC News, Yahoo News, and Discovery News, Sept. 6 2012.
2. "The Rise of Voice Biometrics for Mobile Phones," *MIT Technology Review*, Dec. 5 2012.
3. "Smartphones Make Identifying Endangered Animals Easy," *New Scientist Magazine*, Issue 2899, Jan. 10 2013.
4. "Using Mobile Devices in Fieldwork," *National Wildlife*, May 28 2014.
5. "Machine-Vision Algorithm Learns to Judge People by Their Faces," *MIT Technology Review*, Nov. 1 2016.
6. "MRI Brain Scans Train Machines to See the World More Like Us," *New Scientist Magazine*, March 29 2017.
7. "Facing Facts: Artificial Intelligence and the Resurgence of Physiognomy," *Undark Magazine*, November 8 2017.

## Biographical Information

Citizenship: United States

Co-organizer and co-founder of the Dream Ride (<http://www.dream-ride.org>), a yearly bicycle ride for charity. Since 2007, the organization has raised over \$78,000 for humanitarian causes in the developing world including education for women, health care, and vaccine research.

Hobbies: Literature, Classical Music, Traveling, Cooking, Cycling, Hiking, Skiing, Golf