House Committee on Science, Space, and Technology
Subcommittee on Investigations and Oversight
Online Imposters and Disinformation, 09/26/2019

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Backgrounds

Deepfakes are the most recent twist to the disconcerting problem of online disinformation. The term *deepfake* first emerged in late 2017 as the name of a Reddit account that began posting synthetic pornographic videos generated using an AI-based face-swapping algorithm. The term has subsequently become synonymous with three types of AI-generated impersonation videos.

(1) Head puppetry entails synthesizing a video of a target person's head using a video of a source person's head, so the synthesized target appears to behave the same way as the source.

source (real)　　**target (fake)**　　**source (real)**　　**target (fake)**

(2) Face swapping involves generating a video of the target with the faces replaced by synthesized faces of the source while keeping the same facial expressions.

(3) Lip synching is to create a falsified video by only manipulating the lip region so that the target appears to speak something that s/he does not speak in reality.

[Source: Bill Posters and Daniel Howe, *The Spectre Project*]

Photos and videos have been doctored since their nascence. But there are three reasons why the current concerns over deepfakes and other AI-driven audio and visual media manipulations are justified. First, deepfakes can be made more easily, quickly, and with better quality — thanks to the rapid advancement of computer hardware and software technology, in particular those related to AI. Second, the capability to make deepfakes has been democratized through software tools that can be downloaded freely from online code sharing platforms.[1] Third, anyone with an online media presence is a potential target of a deepfake attack. A fake video showing a politician engaged in an inappropriate activity may be enough to sway an election if released close to voting day. A fake video of a falsified recording of a high-level executive commenting on his/her company's financial situation could potentially send the stock market awry. A fake video made by falsely implanting a woman's face in a pornographic video and shared on social-media platforms could tremendously traumatize the victim. The stakes are too high to ignore.

How are deepfakes made?

Deepfakes are created with a type of AI technology commonly known as deep neural networks.[2] A deep neural network model learns to synthesize realistic faces through *training*, which involves exposing the model to a large number of face images of different people with varying expression, head poses, and lighting conditions. Once the model is properly trained, it is ready to be used to generate deepfakes. Specifically, a face detection method is first run on the input video to locate the target's faces. Then facial landmarks corresponding to distinct locations such as the tips of eyes, eyebrows, nose, mouth, and contour of the face are extracted. Using these landmarks, the detected faces are warped to the same size and in a standard configuration. The standardized faces are fed to the deep neural network model to synthesize a new set of faces of different identity, which are then warped back to match the target's head orientations in the input.

Current computer hardware and AI technology has made it much easier to create deepfakes: a computer that is used to run the generation algorithm with a special computing hardware known as graphical computing unit (GPU) can be readily purchased for an affordable price on Amazon.[3] The training videos for the targets can be easily downloaded from social-media platforms such as YouTube, Instagram, and Facebook in large volume and high quality. Convenient software tools have made the whole process automated barring the choice of a few parameters. As a result, a few good-quality, minute-long videos, a commodity computer with a GPU, and several hours of training are sufficient to generate deepfakes with decent visual quality.

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[1] e.g., FakeAPP (used to be on Reddit but now defunct), DeepfaceLab (https://github.com/iperov/DeepFaceLab), faceswap-GAN (https://github.com/shaoanlu/faceswap-GA), faceswap (https://github.com/deepfakes/faceswa), and more recently ZAO (https://apkproz.com/app/zao).

[2] GANs are only one type of deep neural network model for creating deepfakes. For example, the deepfake created for today's hearing did not use a GAN, but instead a different model known as the variational auto-encoders. This is important because any legislative or rule making effort to address deepfakes should not rely on a single tool. Instead Congress should attempt to future-proof regulation to cover the act instead of the tool.

[3] An example of computer configuration for this purpose includes an HP-Z800 workstation (~$1,000) equipped with an Nvidia 2080Ti GPU (~$1,200) and other necessary peripherals. Cost effective and large-scale production can also be conducted using cloud platforms such as Amazon AWS or Google Cloud Platform.

How to combat deepfakes with technology development

While sophisticated deepfakes still take time and skill to produce, rough-and-ready fake videos may still cause harm. It is thus important to have effective technologies to identify, contain, and obstruct deepfakes before they can inflict damage. This should be done by focusing on improving forensic capabilities and making it harder to train deepfakes using online videos.

Effective deepfake forensic detection methods look for traces of the synthesis process to differentiate deepfakes from real videos. For instance, synthesized faces are warped and processed to fit the target's head orientation, such operations leave traces that can be exploited to detect deepfakes. Another type of detection techniques involves examining physiological inconsistencies such as the lack of realistic eye blinking and heart beating. A third approach is to "use AI to fight AI", using another deep neural networks to detect deepfakes. State-of-the-art detection methods have shown promising accuracy on benchmark datasets, but their actual performance on real life deepfakes have yet to be tested.[4] Also, due to the complex nature of deepfakes, no single type of technology or specific method will be the *silver bullet*, and an effective solution may come as a combination of all these approaches.
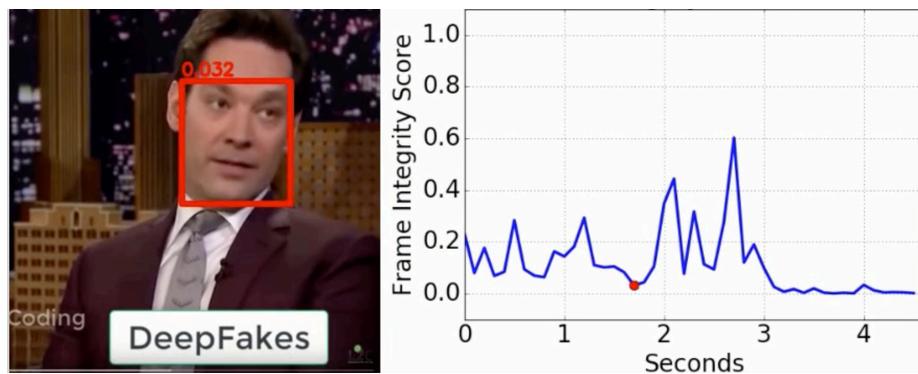
Detection results of a state-of-the-art deepfake detection method over a fake video on youtube.com. The lower integrity score (range in [0,1]) suggests a video frame more likely to be generated using deepfake algorithms.

In addition to deepfake forensics, there are also technologies to prevent the re-use of online images and videos as training data for the deep neural network generating deepfakes. This would involve inserting imperceptible "adversarial noise" into images and videos before they are uploaded to online social-media platforms. The adversarial noise correspond to subtle perturbations that human eyes cannot see nonetheless can disrupt a face detection algorithm and make it difficult to automate the training process. A dedicated adversary could overcome adversarial noise by painstakingly selecting the target's face in every frame of a training video, but that requires 1,500 hand-marked selections for each 60 second training video.[5]

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[4] One notable effort towards this goal is the upcoming *Deepfake Detection Challenge* (https://deepfakedetectionchallenge.ai) sponsored by Facebook, Microsoft and Partnership on AI, to advance the state-of-the-art deepfake detection capacities.

[5] This is calculated based on a target video quality of 25 frames per second, which is the lowest frame rate for uploaded YouTube videos. YouTube videos. The highest quality YouTube videos are uploaded at 60 frames per second, which would more than double the number of hand-marked selections for a 60 second video and the work to hand select faces.

Perspectives

As the underlying technology continues to develop, the current barriers to making deepfakes will fall and their quality will keep improving. What is also evolving is the quintessential cat-and-mouse game experienced by all attacker-defender relationships, and malicious attackers seem to have an upper-hand — they can adjust the generation algorithm whenever a new detection method is made public. Currently, the majority of research on combating deepfakes is sponsored under DARPA.[6] But it is important that the federal government also fund more civilian research through NSF. One reason this has not yet happened is because the grant-making capabilities of NSF are focused around existing directorates that are not well equipped to support research into cross-functional emerging technologies. It may be wise to fund the establishment of a new *Emerging Technologies Directorate* at NSF, which can function as a catchall until either an existing directorate's mission is expanded or a new directorate is created. This would create a research home not just for deepfake forensics but also other emerging technologies.

The open-source model of disseminating research code is an enabling factor of the current deepfake problem and requires more scrutiny. The availability of easy-to-use and easy-to-access software tools has significantly lowered the technical threshold for an ordinary user to create deepfakes. A nation state with more manpower and computing resources can build upon them refined and customized versions to make more crafted deepfakes with higher level of realism and use them in a disinformation campaign. It may thus be wise to consider requiring NSF to conduct an ethics review of proposed grants around dual-use technology like deepfakes with mandatory controls on the release of the underlying technology into the proverbial wild.

Last but not least, education on responsible research should be an intrinsic part to the current AI research. Deepfakes add just one more item to the long list of various ethical issues of AI algorithms, such as built-in biases and prejudice, violations of individual privacy and safety, and the lack of accountability and transparency. As academic or industrial researchers working in these areas, we should recognize the potential impact of our research on society, and take them seriously as part of our due responsibilities. We should also provide training to students and post-docs on such issues. These practices could, again, be enforced through requirements from NSF on funded AI research that make such training and compliance mandatory.

Conclusions

It is not an exaggeration to say that we are on the cusp of deepfakes being cheap, easy to produce, indistinguishable from real videos, and ready to cause real damages. We therefore need a comprehensive and robust solution to this problem. The situation calls for continuous investment and perhaps an escalated funding level from the federal government to this strategically important research area. The situation surrounding deepfakes may not turn out to be as severe as we are predicting now. But it is better safe than sorry.

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[6] Most notably, the DARPA Media Forensics (MediFor) program (https://www.darpa.mil/program/media-forensics).

Biography

Siwei Lyu is a Professor of Computer Science and the Director of Computer Vision and Machine Learning Lab at University at Albany, State University of New York. Dr. Lyu received his Ph.D. degree in Computer Science in 2005 from Dartmouth College and under the supervision of Prof. Hany Farid, and his M.S. degree in Computer Science in 2000 and B.S. degree in Information Science in 1997, both from Peking University, China. Dr. Lyu's research interests include digital media forensics, computer vision, and machine learning. He is the recipient of the National Science Foundation CAREER Award in 2010, IEEE Signal Processing Best Paper Award, and the Google Faculty Research Award in 2019 for his work on digital media forensics. He has published one book on digital media forensics and over 120 refereed journal and conference papers in relevant research fields.

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EDUCATION

Ph.D.	Computer Science,	Dartmouth College, 2005
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PROFESSIONAL EMPLOYMENT

2019 – present	**Full Professor**	Computer Science Department
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2008 – 2014	**Assistant Professor**	Computer Science Department
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2005 – 2008	**Postdoc**	Howard Hughes Medical Institute
		Center for Neurosciences, New York University

PUBLICATIONS

Book & Book Chapters

1. [BookChap12] Siwei Lyu. Natural image statistics for digital image forensics. In H. T. Sencar and N. Memon, editors, *Digital Image Forensics: There is More to a Picture than Meets the Eye*. Springer, 2012.

2. [Book08] Siwei Lyu. *Natural Image Statistics in Digital Image Forensics*. VDM Verlag, 2008.

Refereed Journal Articles

1. [FRONTIER19] Michael Anthony Natole, Yiming Ying, and Siwei Lyu. Stochastic AUC optimization algorithms with linear convergence. *Frontiers in Applied Mathematics and Statistics, section Mathematics of Computation and Data Science*, 2019. (impact factor:).

2. [SPL19] Zhe Xue, Dawei Du, Qingming Huang, and siwei lyu. Deep constrained low-rank subspace learning for multi-view semi-supervised classification. In *IEEE Signal Processing Letters*, 2019. (impact factor:).

3. [INFOSCI19] Zhe Xue, Junping Du, Dawei Du, and Siwei Lyu. Deep low-rank subspace ensemble for multi-view clustering. *Information Science*, (to appear), 2019. (impact factor: 4.305).

4. [IJCV19] Longyin Wen, Zhen Lei, Siwei Lyu, and Stan Z. Li. Single-shot scale-aware network for real-time face detection. *International Journal of Computer Vision*, page to appear, 2019. (impact factor: 11.541).

5. [TCYB19] Lipeng Ke, Ming-Ching Chang, Longyin Wen, Honggang Qi, and Siwei Lyu. Fast online video pose estimation by dynamic Bayesian modeling of mode transitions. *IEEE Transactions on Cybernetics*, (to appear), 2019. (impact factor: 8.803).

6. [PR18] Xin Wang, Ming-Ching Chang, Lan Wang, and Siwei Lyu. Efficient algorithms for graph regularized PLSA for probabilistic topic modeling. *Pattern Recognition*, 86:236–247, Feburary 2018. (impact factor: 3.962).

7. [IJCV18] Baoyuan Wu, Bernard S. Ghanem, Wei Liu, and Siwei Lyu. Multi-label learning with missing labels using mixed dependency graphs. *International Journal of Computer Vision*, 126(8):875 – 896, 2018. (impact factor: 11.541).

8. [TOMM18] Longyin Wen, Honggang Qi, and Siwei Lyu. Contrast enhancement estimation for digital image forensics. *ACM Transactions on Multimedia Computing, Communications and Applications*, 14(2):49:1–49:21, 2018. (impact factor: 2.019).

9. [SCIS18] Hui Zeng, Jingjing Yu, Xiangui Kang, and Siwei Lyu. Countering JPEG anti-forensics based on noise level estimation. *Science China Information Sciences*, 61:032103, 2018. (impact factor: 2.188).

10. [TIP18] Dawei Du, Longyin Wen, Honggang Qi, Qingming Huang, Tian Qi, and Siwei Lyu. Constrained graph seeking for object tracking. *IEEE Transactions on Image Processing*, 2018. (impact factor: 5.071).

11. [TCYB17] Dawei Du, Honggang Qi, Longyin Wen, Qingming Huang, Tian Qi, and Siwei Lyu. Geometric hypergraph learning for visual tracking. *IEEE Transactions on Cybernetics*, 47(12):4182–4195, 2017. (impact factor: 8.803).

12. [IJCV16] Longyin Wen, Zhen Lei, Ming-Ching Chang, Honggang Qi, and Siwei Lyu. Multi-camera multi-target tracking with space-time-view hyper-graph. *International Journal of Computer Vision*, 122(2):313–333, 2016. (impact factor: 11.541).

13. [TIP16] Dawei Du, Honggang Qi, Wenbo Li, Longyin Wen, Qingming Huang, and Siwei Lyu. Online deformable object tracking based on structure-aware hyper-graph. *IEEE Transactions on Image Processing*, 25(8):3572 – 3584, 2016. (impact factor: 5.071).

14. [TCVG16] Yan Kong, Weiming Dong, Xing Mei, Chongyang Ma, Tong-Yee Lee, Siwei Lyu, Feiyue Huang, and Xiaopeng Zhang. Measuring and predicting visual importance of similar objects. *IEEE Transactions on Visualization and Computer Graphics*, 22(12):2564 – 2578, 2016. (impact factor: 3.078).

15. [PAMI16] Longyin Wen, Zhen Lei, Siwei Lyu, Stan Z. Li, and Ming-Hsuan Yang. Exploiting hierarchical dense structures on hypergraphs for multi-object tracking. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 38(10):1983–1996, 2016. (impact factor: 9.455).

16. [PR15] Baoyuan Wu, Siwei Lyu, Baogang Hu, and Qiang Ji. Multi-label learning with missing labels for image annotation and facial action unit recognition. *Pattern Recognition*, 48(7):2279–2289, 2015. (impact factor: 3.962).

17. [IJCV14] Siwei Lyu, Xunyu Pan, and Xing Zhang. Exposing region splicing forgeries with blind local noise estimation. *International Journal of Computer Vision*, 110(2):202–221, November 2014. (impact factor: 11.541).

18. [NC11] Siwei Lyu. Divisive normalization as an efficient coding transform: Justification and effectiveness. *Neural Computation*, 23(11):2942–2973, November 2011. (impact factor: 1.651).

19. [TIFS10] Xunyu Pan and Siwei Lyu. Region duplication detection using image feature matching. *IEEE Transactions on Information Forensics and Security*, 5(4):857–867, December 2010. (impact factor: 5.824).

20. [NC09] Siwei Lyu and Eero P. Simoncelli. Nonlinear extraction of 'independent components' of natural images using radial Gaussianization. *Neural Computation*, 18(6):1–35, June 2009, **Featured on the cover page**. (impact factor: 1.651).

21. [PAMI08] Siwei Lyu and Eero P. Simoncelli. Modeling multiscale subbands of photographic images with fields of Gaussian scale mixtures. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 31(4):693–706, April 2009. (impact factor: 9.455).

22. [TIFS06] Siwei Lyu and Hany Farid. Steganalysis using higher-order image statistics. *IEEE Transactions on Information Forensics and Security*, 1(1):111–119, January 2006, **IEEE Signal Processing Society Best Paper Award.** (impact factor: 5.824).

23. [IFAR06] Dan Rockmore, Siwei Lyu, and Hany Farid. A digital technique for authentication in the arts. *International Foundation for Art Research (IFAR) Journal*, 8(2):21–29, 2006. (invited feature article).

24. [TSP05] Siwei Lyu and Hany Farid. How realistic is photorealistic? *IEEE Transactions on Signal Processing*, 53(2):845–850, Feburary 2005. (impact factor: 2.628).

25. [PNAS04] Siwei Lyu, Dan Rockmore, and Hany Farid. A digital technique for art authentication. *Proceedings of the National Academy of Sciences*, 101(49):17006–17010, November 2004. (impact factor: 9.504).

Prestigesous Conference Papers

26. [BMVC19] Yuezun Li, Ming-Ching Chang, Xiao Bian, and Siwei Lyu. Exploring the vulnerability of single shot module in object detectors via imperceptible background patches. In *British Machine Vision Conference (BMVC)*, Cadiff, UK, 2019.

27. [MM19] Congcong Li, Dawei Du, Libo Zhang, Tiejian Luo, Yanjun Wu, Qi Tian, Longyin Wen, and Siwei Lyu. Data priming network for automatic check-out. In *ACM Multimedia*, Nice, France, 2019. (Acceptance rate 248 out of 936 (26.5%) submissions).

28. [MICCAI19] Bin Kong, Xin Wang, Junping Du, Yi Lu, Kunlin Cao, Qi Song, Shaoting Zhang, Siwei Lyu, and Youbing Yin. A multi-modal network for cardiomyopathy death risk prediction with CMR images and clinical information. In *the 22nd International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, Shenzhen, China, 2019.

29. [IJCAI19] Zhe Xue, Junping Du, Dawei Du, Wenqi Ren, and Siwei Lyu. Deep correlated predictive subspace learning for incomplete multi-view semi-supervised classification. In *International Joint Conference on Artificial Intelligence (IJCAI)*, Macau, China, 2019. (Acceptance rate 850 out of 4350 (19.5%) submissions).

30. [CVPR19] Wenbo Li, Pengchuan Zhang, Lei Zhang, Qiuyuan Huang, Siwei Lyu, and Jianfeng Gao. Object-driven text-to-image synthesis via adversarial training. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Long Beach, CA, United States, 2019. (Acceptance rate 25.2% of 5165 submissions).

31. [AAAI19a] Longyin Wen, Dawei Du, Shengkun Li, Xiao Bian, and Siwei Lyu. Learning Non-Uniform Hypergraph for Multi-Object Tracking. In *33rd AAAI Conference on Artificial Intelligence (AAAI-19)*, Honolulu, HI, United States, 2019. (Acceptance rate 16% of 7,500 submissions).

32. [AAAI19b] Dan Liu, Dawei Du, Libo Zhang, Tiejian Luo, Yanjun Wu, Feiyue Huang, and Siwei Lyu. Scale Invariant Fully Convolutional Network: Detecting Hands Efficiently. In *33rd AAAI Conference on Artificial Intelligence (AAAI-19)*, Honolulu, HI, United States, 2019. (Acceptance rate 16% of 7,500 submissions).

33. [ACCV18] Wenbo Li, Longyin Wen, Xiao Bian, and Siwei Lyu. Evolvement constrained adversarial learning for video style transfer. In *Asian Conference on Computer Vision (ACCV)*, Perth, Australia, 2018. (Acceptance rate 31% of 600).

34. [ECCV18] Lipeng Ke, Ming-Ching Chang, Honggang Qi, and Siwei Lyu. Multi-scale structure-aware network for human pose estimation. In *European Conference on Computer Vision (ECCV)*, Munich, Germany, 2018. (Acceptance rate 31% of 3,700).

35. [BMVC18] Yuezun Li, Daniel Tian, Ming-Ching Chang, Xiao Bian, and Siwei Lyu. Universal adversarial perturbation on deep proposal-based models. In *British Machine Vision Conference (BMVC)*, Bristol, United Kingdom, 2018. (Acceptance rate 23% of 1,120).

36. [IROS18] Shuai Li, Siwei Lyu, and Jeff Trinkle. Efficient state estimation with constrained Rao-Blackwellized particle filter. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Madrid, Spain, 2018. (Acceptance rate 47% of 2,693 submissions).

37. [UAI18] Siwei Lyu and Yiming Ying. A univariate bound of area under ROC. In *The International Conference on Uncertainty in Artificial Intelligence (UAI)*, Monterey, CA, United States, 2018. (Acceptance rate 30% of 337 submissions).

38. [ICML18] Yiming Ying, Micheal Natole, and Siwei Lyu. Stochastic proximal algorithms for AUC maximization. In *International Conference on Machine Learning (ICML)*, Stockholm, Sweden, 2018. (Acceptance rate 25% of 2473 submissions).

39. [CVPR18] Baoyuan Wu, Bernard S. Ghanem, Wei Liu, and Siwei Lyu. Tagging like humans: Diverse and distinct image annotation. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Salt Lake City, UT, United States, 2018. (Acceptance rate 24% of 5687 submissions).

40. [NIPS17] Yanbo Fan, Siwei Lyu, Yiming Ying, and Baogang Hu. Learning with average top-k loss. In *Advances in Neural Information Processing Systems (NIPS)*, Long Beach, CA, United States, 2017. (Acceptance rate 21% of 3240 submissions).

41. [ICCV17] Wenbo Li, Longyin Wen, Ming-Ching Chang, Ser nam Lim, and Siwei Lyu. Adaptive RNN tree for large-scale human action recognition. In *IEEE International Conference on Computer Vision (ICCV)*, Venice, Italy, 2017.

42. [AAAI17] Yang Yang, Longyin Wen, Siwei Lyu, and Stan Z. Li. Learning multi-level descriptors for person re-identification. In *31st AAAI Conference on Artificial Intelligence (AAAI-17)*, San Francisco, CA, United States, 2017. (Acceptance rate 26% of 2132 submissions).

43. [NIPS16] Yiming Ying, Longyin Wen, and Siwei Lyu. Stochastic online auc maximization. In *Advances in Neural Information Processing Systems (NIPS)*, Barcelona, Spain, December 2016. (**Oral**, Acceptance rate 1.8% of 2500 submissions).

44. [AISTATS16] Martin Boissier, Yiming Ying, Siwei Lyu, and Dingxuan Zhou. Fast convergence of online pairwise learning algorithms. In *The 19th International Conference on Artificial Intelligence and Statistics (AISTATS)*, Cadiz, Spain, 2016 (Acceptance rate 31% of 537 submissions).

45. [AAAI16a] Baoyuan Wu, Siwei Lyu, and Bernard S. Ghanem. Multi-label learning to missing labels and class imbalance. In *30th AAAI Conference on Artificial Intelligence (AAAI-16)*, Phoenix, AZ, United States, 2016 (Acceptance rate 26% of 2132 submissions).

46. [AAAI16b] Xin Wang, Yiming Ying, Ming-Ching Chang, and Siwei Lyu. Co-regularized PLSA for multi-modal learning. In *30th AAAI Conference on Artificial Intelligence (AAAI-16)*, Phoenix, AZ, United States, 2016 (Acceptance rate 26% of 2132 submissions).

47. [ICCV15a] Wenbo Li, Longyin Wen, Mooi Choo Chua, and Siwei Lyu. Category-blind human action recognition: A practical recognition system. In *IEEE International Conference on Computer Vision (ICCV)*, Santiago, Chile, 2015 (Acceptance rate 30% of 1698 submissions).

48. [ICCV15b] Baoyuan Wu, Siwei Lyu, and Bernard S. Ghanem. Machine Learning-MG: Multi-label learning with missing labels using a mixed graph. In *IEEE International Conference on Computer Vision (ICCV)*, Santiago, Chile, 2015 (Acceptance rate 30% of 1698 submissions).

49. [ICCV15c] Xing Mei, Honggang Qi, Baogang Hu, and Siwei Lyu. Improving image restoration with soft-rounding. In *IEEE International Conference on Computer Vision (ICCV)*, Santiago, Chile, 2015 (Acceptance rate 30% of 1698 submissions).

50. [CVPR15] Xing Mei, Weiming Dong, Baogang Hu, and Siwei Lyu. UniHIST: A unified framework for image restoration with histogram. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Boston, MA, United States, 2015. (Acceptance rate 30% of 2400 submissions).

51. [IROS15] Shuai Li, Siwei Lyu, Jeff Trinkle, and Wolfart Burgard. An evaluation of particle filters for contact-slam problems. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, 2015 (Acceptance rate 46% of 2134 submissions).

52. [BMVC15] Ming-Ching Chang, Honggang Qi, Xin Wang, Hong Cheng, and Siwei Lyu. Fast online upper body pose estimation from video. In *British Machine Vision Conference (BMVC)*, Swansea, United Kingdom, 2015 (Acceptance rate 33% of 553 submissions).

53. [FG15] Yelin Kim, Jixu Chen, Ming-Ching Chang, Xin Wang, Emily M. Provost, and Siwei Lyu. Joint event localization and classification of human action videos with event transitions. In *IEEE International Conference on Automatic Face and Gesture Recognition (FG)*, Ljubljana, Slovenia, 2015. (**Oral**, Acceptance rate 12% of 221 submissions)

54. [ICRA15] Shuai Li, Siwei Lyu, and Jeff Trinkle. State estimation for dynamic systems with intermittent contact. In *IEEE Conference on Robotics and Automation (ICRA)*, Seattle, WA, United States, 2015. (**Oral**, Acceptance rate 41% of 2275 submissions)

55. [ICANN14] Xing Zhang and Siwei Lyu. Variational EM learning of deep stack Boltzmann networks with deep boltzmann machines. In *International Conference on Artificial Neural Networks (ICANN)*, Hamburg, Germany, 2014.

56. [CVPR14] Xing Zhang and Siwei Lyu. Using projection kurtosis concentration of natural images for blind noise covariance matrix estimation. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Columbus, OH, United States, 2014. (Acceptance rate 30% of 1807 submissions)

57. [NIPS13] Siwei Lyu and Xin Wang. On algorithms of sparse multi-factor nonnegative matrix factorization. In *Advances in Neural Information Processing Systems (NIPS)*, South Lake Tahoe, CA, United States, 2013. (Acceptance rate 25% of 1420 submissions)

58. [ICCV13] Baoyuan Wu, Siwei Lyu, Baogang Hu, and Qiang Ji. Simultaneous clustering and tracklet linking for multi-face tracking in videos. In *IEEE International Conference on Computer Vision (ICCV)*, Sydney, Australia, 2013. (Acceptance rate 29% of 1505 submissions)

59. [IJCAI13] Zuoguan Wang, Siwei Lyu, and Qiang Ji. Deep feature learning using target priors with applications in ECoG signal decoding for BCI. In *International Joint Conference on Artificial Intelligence (IJCAI)*, Beijing, China, August 2013. (**Oral**, Acceptance rate 28% of 1473 submissions)

60. [ICRA13] Li Zhang, Siwei Lyu, and Jeff Trinkle. A dynamic Bayesian approach to simultaneous estimation and filtering in grasp acquisition. In *IEEE Conference on Robotics and Automation (ICRA)*, Karlsruhe, Germany, 2013. (**Oral**, Acceptance rate 39% of 2265 submissions)

61. [ACCV12] Jixu Chen, Xiaoming Liu, and Siwei Lyu. Boosting with side information. In *Asian Conference on Computer Vision (ACCV)*, Daegu, South Korea, 2012. (Acceptance rate 27%)

62. [NIPS12] Zuoguan Wang, Siwei Lyu, G. Schalk, K. Miller, and Qiang Ji. Learning with target priors. In *Advances in Neural Information Processing Systems (NIPS)*, South Lake Tahoe, CA, United States, 2012. (Acceptance rate 24% of 1467 submissions)

63. [ICCP12] Xunyu Pan, Xing Zhang, and Siwei Lyu. Exposing image splicing with inconsistent local noise variances. In *IEEE International Conference on Computational Photography*, Seattle, WA, United States, 2012. (Acceptance rate 20% of 120 submissions)

64. [NIPS11] Siwei Lyu. Unifying non-maximum likelihood learning objectives with minimum KL contraction. In *Advances in Neural Information Processing Systems (NIPS)*, Granada, Spain, 2011. (Acceptance rate 22% of 1400 submissions)

65. [NIPS10] Siwei Lyu. Divisive normalization: Justification and effectiveness as efficient coding transform. In *Advances in Neural Information Processing Systems (NIPS)*, Vancouver, Canada, 2010. (Acceptance rate 24% of 1219 submissions)

66. [UAI09] Siwei Lyu. Interpretation and generalization of score matching. In *The International Conference on Uncertainty in Artificial Intelligence (UAI)*, Montreal, QC, Canada, June 2009. (**Oral**, Acceptance rate 12%)

67. [CVPR09] Siwei Lyu. An implicit Markov random field model for natural images in multi-scale oriented representations. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Miami Beach, FL, United States, June 2009. (Acceptance rate 26% of 1464 submissions)

68. [NIPS08] Siwei Lyu and Eero P. Simoncelli. Reducing statistical dependencies in natural signals using radial Gaussianization. In *Advances in Neural Information Processing Systems (NIPS)*, Vancouver, Canada, 2008. (**Oral**, Acceptance rate 2.7% of 1022 submissions)

69. [CVPR08] Siwei Lyu and Eero P. Simoncelli. Nonlinear image representation using divisive normalization. In *IEEE Conference on Computer Vision and Patten Recognition (CVPR)*, Anchorage, AK, United States, June 2008. (Acceptance rate 24% of 1593 submissions)

70. [NIPS06] Siwei Lyu and Eero P. Simoncelli. Statistical modeling of images with fields of Gaussian scale mixtures. In *Advances in Neural Information Processing Systems (NIPS)*, Vancouver, Canada, 2006. (Acceptance rate 26%)

71. [ECML05] Siwei Lyu. Kernels for unordered sets: the Gaussian mixture approach. In *European Conference on Machine Learning (ECML)*, Porto, Portugal, 2005. (**Oral**, Acceptance rate 10%)

72. [CVPR05a] Siwei Lyu. Mercer kernels for object recognition/detection with local features. In *IEEE International Conference on Computer Vision and Pattern Recognition (CVPR)*, San Diego, CA, United States, 2005. (Acceptance rate 26%)

73. [CVPR05b] Siwei Lyu. Infomax boosting. In *IEEE International Conference on Computer Vision and Pattern Recognition (CVPR)*, San Diego, CA, United States, 2005. (Acceptance rate 26%)

74. [MM05] Siwei Lyu. Automatic image orientation determination with natural image statistics. In *ACM Multimedia*, Singapore, 2005. (Acceptance rate 32%)

75. [IH02] Siwei Lyu and Hany Farid. Detecting hidden messages using higher-order statistics and support vector machines. In *International Workshop on Information Hiding*, Noordwijkerhout, Netherlands, 2002. (Acceptance rate 24%)

Other Refereed Conference/Workshop Papers

76. [AVSS19] Yuezun Li, Longyin Wen, Ming-Ching Chang, and Siwei Lyu. Graph-to-graph energy minimization for video object segmentation. In *International Conference on Advanced Video and Signal-Based Surveillance (AVSS)*, Taipei, Taiwan, 2019.

77. [CVPRW19a] Ehab AlBadawy, Siwei Lyu, and Hany Farid. Detecting ai-synthesized speech using bispectral analysis. In *Workshop on Media Forensics (in conjunction with CVPR)*, Long Beach, CA, United States, 2019.

78. [CVPRW19b] Yuezun Li and Siwei Lyu. Exposing deepfake videos by detecting face warping artifacts. In *Workshop on Media Forensics (in conjunction with CVPR)*, Long Beach, CA, United States, 2019.

79. [IHMMSec19a] Xin Yang, Yuezun Li, Honggang Qi, and Siwei Lyu. Exposing GAN-synthesized faces using landmark locations. In *International Workshop on Information Hiding and Multimedia Security*, Paris, France, 2019 (Acceptance rate 37% of 62 submissions).

80. [IHMMSec19b] Yuezun Li and Siwei Lyu. De-identification without losing faces. In *International Workshop on Information Hiding and Multimedia Security*, Paris, France, 2019 (Acceptance rate 37% of 62 submissions).

81. [ICASSP19b] Shuchen Weng, Wenbo Li, Yi Zhang, and Siwei Lyu. Dual-stream cnn for structured time series classification. In *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Bristol, United Kingdom, 2019 (Acceptance rate 46.5%).

82. [ICASSP19a] Xin Yang, Yuezun Li, and Siwei Lyu. Exposing deep fakes using inconsistent head poses. In *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Bristol, United Kingdom, 2019 (Acceptance rate 46.5%).

83. [ISBI19] Eric Wu, Bin Kong, Xin Wang, Junjie Bai, Yi Lu, Feng Gao, Shaoting Zhang, Kunlin Cao, Qi Song, siwei lyu, and Youbing Yin. Residual attention based network for hand bone age assessment. In *IEEE International Symposium on Biomedical Imaging (ISBI)*, Venice, Italy, 2019.

84. [AVSS18] Yuezun Li, Xiao Bian, Ming-Ching Chang, and Siwei Lyu. Pixel offset regression (POR) for single-shot instance segmentation. In *International Conference on Advanced Video and Signal-Based Surveillance (AVSS)*, Auckland, New Zealand, November 2018.

85. [WIFS18] Yuezun Li, Ming-Ching Chang, and Siwei Lyu. In Ictu Oculi: Exposing AI Created Fake Videos by Detecting Eye Blinking. In *IEEE Workshop on Information Forensics and Security (WIFS)*, Hong Kong, December 2018 (Acceptance rate 32% of 105 submissions).

86. [ICIP18] Lipeng Ke, Ming-Ching Chang, Honggang Qi, and Siwei Lyu. Multi-scale supervised network for human pose estimation. In *IEEE Conference on Image Processing (ICIP)*, Athens, Greece, 2018.

87. [AIC18a] Milind Naphade, et.al., and Siwei Lyu. The 2018 NVIDIA AI City Challenge. In *IEEE Workshop on AI City Challenge (in conjunction with CVPR)*, Salt Lake City, UT, United States, 2018.

88. [AIC18b] Ming-Ching Chang, Yi Wei, Nenghui Song, and Siwei Lyu. Video analytics in smart transportation for the AIC'18 challenge. In *IEEE Workshop on AI City Challenge (in conjunction with CVPR)*, Salt Lake City, UT, United States, 2018.

89. [ICPR18b] Yi Wei, Ming-Ching Chang, Yiming Ying, Ser Nam Lim, and Siwei Lyu. Explain black-box image classifications using superpixel-based interpretation. In *International Conference on Pattern Recognition (ICPR)*, Beijing, China, 2018.

90. [ICPR18a] Cong Zhang, Dawei Du, Lipeng Ke, Honggang Qi, and Siwei Lyu. Global contrast enhancement detection via deep multi-path network. In *International Conference on Pattern Recognition (ICPR)*, Beijing, China, 2018.

91. [AVSS17] Siwei Lyu and et.al. AVSS 2017 challenge on advanced traffic monitoring. In *International Conference on Advanced Video and Signal-Based Surveillance (AVSS)*, Lecce, Italy, 2017.

92. [AIC17b] Ming-Ching Chang, Yi Wei, Nenghui Song, Lipeng Ke, and Siwei Lyu. Traffic analysis based on object detection and vehicle tracking. In *2017 IEEE AI City Challenge*, San Jose, CA, United States, 2017. IEEE.

93. [AIC17a] Milind Naphade, David C. Anastasiu, Anuj Sharma, Vamsi Jagrlamudi, Hyeron Jeon, Kaikai Liu, Ming-Ching Chang, Siwei Lyu, and Zeyu Gao. The NVIDIA AI City Challenge. In *2017 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computed, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/CBDCom/IOP/SCI)*, SmartWorld'17, San Jose, NJ, United States, United States, 2017. IEEE.

94. [VOT17] (as participating team). The visual object tracking VOT2017 challenge results. In *ICCV Workshop on Visual Object Tracking Challenge*, Venice, Italy, 2017.

95. [ICIP17] Shengkun Li, Dawei Du, Longyin Wen, Ming-Ching Chang, and Siwei Lyu. Hybrid structure hypergraph for online deformable object tracking. In *IEEE Conference on Image Processing (ICIP)*, Beijing, China, 2017

96. [IJCNN17] Andrew Pulver and Siwei Lyu. LSTM with working memory. In *International Joint Conference on Neural Networks (IJCNN)*, Anchorage, AK, United States, 2017.

97. [HUMANOID16] Shuai Li, Siwei Lyu, and Jeff Trinkle. Contact aware robotics manipulation. In *Work Shop on Tactile Sensing for Manipulation: New progress and Challenges (in conjunction with IEEE RAS-Humanoids)*, Cancun, Mexico, 2016.

98. [WIFS16] Honggang Qi, Andrew Pulver, and Siwei Lyu. Using 3D face model for forensic analysis of lighting environment. In *IEEE Workshop on Information Forensics and Security*

(WIFS), Abu Dhabi, United Arab Emirates, 2016 (Acceptance rate 32% out of 108 submissions).

99. [AVSS16] Yueming Yang, Ming-Ching Chang, Longyin Wen, Peter Tu, Honggang Qi, and Siwei Lyu. Efficient large-scale photometric reconstruction using divide-recon-fuse 3D structure from motion. In *International Conference on Advanced Video and Signal-Based Surveillance (AVSS)*, Colorado Springs, CO, United States, 2016.

100. [OPT15] Martin Boissier, Yiming Ying, Siwei Lyu, and Dingxuan Zhou. Fast convergence of online pairwise learning algorithms. In *NIPS Workshop on Optimization for Machine Learning*, Montreal, QC, Canada, 2015.

101. [VOTIR15] (as participating team). The visual object tracking VOTITR2015 challenge results. In *ICCV Workshop on Visual Object Tracking Challenge*, Santiago, Chile, 2015.

102. [VOT15] (as participating team). The visual object tracking VOT2015 challenge results. In *ICCV Workshop on Visual Object Tracking Challenge*, Santiago, Chile, 2015.

103. [ICIP15] Yueming Yang, Ming-Ching Chang, and Siwei Lyu. Seeing as it happens: Real time 3d video event visualization. In *IEEE Conference on Image Processing (ICIP)*, Quebec, Canada, 2015.

104. [ASIA15] Andrew Pulver, Ming-Ching Chang, and Siwei Lyu. Shot segmentation and grouping for ptz camera videos. In *Annual Symposium on Information Assurance (ASIA)*, Albany, NY, United States, 2015.

105. [SPIE15] Amanda Danko and Siwei Lyu. Fused methods for visual saliency estimation. In *SPIE Symposium on Electronic Imaging*, San Jose, CA, United States, 2015.

106. [ICCE15] Amanda Danko and Siwei Lyu. Better together: Fusing visual saliency methods for retrieving perceptually similar images. In *IEEE Conference on Consumer Electronics (ICCE)*, Las Vegas, NV, United States, 2015.

107. [RSSW14] Shuai Li, Siwei Lyu, Jeff Trinkle, and Wolfart Burgard. An evaluation of particle filters for contact-SLAM problems. In *RSS Workshop on Information-based Grasp and Manipulation Planning*, Berkeley, CA, United States, 2014.

108. [ICIP14a] Xing Mei, Baogang Hu, and Siwei Lyu. Non-blind image restoration with symmetric generalized Pareto priors. In *IEEE Conference on Image Processing (ICIP)*, Paris, France, 2014.

109. [ICIP14b] Xing Zhang and Siwei Lyu. Blind estimation of pixel brightness transform. In *IEEE Conference on Image Processing (ICIP)*, Paris, France, 2014.

110. [MANDM14a] Eric Lifshin, Siwei Lyu, Yudal P. Kandel, and Richard L. Moore. The use of regularized least squares minimization for the deconvolution of SEM images. In *Microscopy & Microanalysis*, Hartford, CT, United States, 2014.

111. [MANDM14b] Eric Lifshin, Yudal P. Kandel, Richard L. Moore, and Siwei Lyu. Improved SEM image resolution through the use of image restoration techniques. In *Microscopy & Microanalysis*, Hartford, CT, United States, 2014. (invited paper).

112. [ICLS14] Weiyi Sun, Jianwei Zhang, Hui Jin, and Siwei Lyu. Analyzing online knowledge building discourse using probabilistic topic models. In *International Conference of the Learning Sciences (ICLS)*, Boulder, CO, United States, 2014. (Acceptance rate 30% of 749 submissions).

113. [NIPSW13] Weiyi Sun, Jianwei Zhang, Hui Jin, and Siwei Lyu. Probabilistic topic analysis of online knowledge building discourse. In *NIPS Workshop on Data Driven Education*, South Lake Tahoe, CA, United States, 2014.

114. [CHINASIP13a] Siwei Lyu. An upper-bound on second-order dependency. In *IEEE International Conference and China Forum on Signal and Information Processing (ChinaSIP)*, Beijing, China, July 2013.

115. [CHINASIP13b] Siwei Lyu. Bayesian supervised learning with non-Gaussian latent variables. In *IEEE International Conference and China Forum on Signal and Information Processing (ChinaSIP)*, Beijing, China, July 2013

116. [ICASSP12] Xunyu Pan, Xing Zhang, and Siwei Lyu. Detecting splicing in digital audios using local noise level estimation. In *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Kyoto, Japan, 2012.

117. [SPIE12] Xunyu Pan, Xing Zhang, and Siwei Lyu. Blind local noise estimation for medical images reconstructed from rapid acquisition. In *SPIE Symposium on Medical Imaging*, San Diego, CA, United States, 2012.

118. [MMSEC11] Xunyu Pan, Xing Zhang, and Siwei Lyu. Exposing image forgery with blind noise estimation. In *ACM Workshop on Multimedia and Security (MM&Sec)*, Niagara Falls, NY, United States, 2011.

119. [MMSEC10] Siwei Lyu. Estimating vignetting function from a single image for image authentication. In *ACM Workshop on Multimedia and Security (MM&Sec)*, Rome, Italy, 2010.

120. [ICIP10] Siwei Lyu. Single image vignetting correction with natural image statistics in derivative domains. In *IEEE Conference on Image Processing (ICIP)*, Hong Kong, September 2010.

121. [ICASSP10b] Xunyu Pan and Siwei Lyu. Detecting image region duplication using SIFT features. In *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Dallas, United States, United States, 2010.

122. [ICASSP10a] Siwei Lyu. Nonnegative matrix factorization with matrix exponentiation. In *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Dallas, United States, United States, 2010.

123. [SPIE07] Siwei Lyu and Eero P. Simoncelli. Statistically and perceptually motivated nonlinear image representation. In *IS&T/SPIE 19th Annual Symposium of Electronic Imaging*, San Jose, CA, United States, 2007 (invited paper).

124. [ARTMATH05] Siwei Lyu, Dan Rockmore, and Hany Farid. Wavelet analysis for art authentication. In *Art+Math=X*, Boulder, CO, United States, 2005.

125. [SPIE05] Micah Kimo Johnson, Siwei Lyu, and Hany Farid. Steganalysis of recorded speech. In *SPIE Symposium on Electronic Imaging*, San Jose, CA, United States, 2005.

126. [SPIE04] Siwei Lyu and Hany Farid. Steganalysis using color wavelet statistics and one-class support vector machines. In *SPIE Symposium on Electronic Imaging*, San Jose, CA, United States, 2004.

127. [CVPRW03] Hany Farid and Siwei Lyu. Higher-order wavelet statistics and their application to digital forensics. In *CVPR Workshop on Statistical Analysis in Computer Vision*, Madison, Wisconsin, United States, 2003.

AWARDS AND HONORS

- Google AI. Google Faculty Research Award, 2019.
- State University of New York. Chancellor's Award for Excellence in Research and Creative Activities, 2019.
- University at Albany, State University of New York. President's Award for Excellence in Research and Creative Activities, 2018.
- IEEE Signal Processing Society. Best Paper Award for paper [TIFS06], 2011.
- Faculty Early Career Award (CAREER). National Science Foundation, 2010.

GRANTS

- Co-PI. Yard locomotion detection system development. General Electronics (GE), $200,000, 2019-2020.
- Awardee. Google AI. Google Faculty Research Award, $50,000, 2019.
- Co-PI. Online AUC maximization algorithms for streaming data. National Science Foundation, Project IIS-1816227, $498,333, 2018-2021.
- PI. New approaches to combine individual losses. Army Research Office, Project 81852, $375,000, 2018-2021.
- Co-PI. Data collection and preparation. IARPA, Deep Insight of Vision Algorithms (DIVA) Program, $75,000, 2018-2019.
- Co-PI. Advanced metric learning for big data analysis. UAlbany Presidential Innovation Fund for Research and Scholarship, $50,000, 2017-2018.
- PI. Photons, pixels, photoshop and the Internet: Analyzing the life-cycle integrity of visual media. DARPA Media Forensics (MediFor) Program, FA8750-16-C-0166, $448,000, 2016 - 2020.
- Awardee. 3d tracking visualization from surveillance videos. UAlbany Faculty Research Award (Category A), $10,000, 2015-2018.
- Co-PI. Continuation: A dynamic Bayesian approach to real-time estimation and filtering in grasp acquisition and other contact tasks. National Science Foundation, National Robotics Initiative (NRI) Project IIS-1537257, $220,000, 2015 - 2019.
- Co-PI. Practitioner centric video analysis. National Institute of Justice Project, 2013-IJ-CX-K010, $100,000, 2013 - 2015.
- PI. Blind noise estimation using signal statistics in random band-pass domains. National Science Foundation, Project CCF-1319800, $400,000, 2013-2017.
- Co-PI. A dynamic Bayesian approach to real-time estimation and filtering in grasp acquisition and other contact tasks. National Science Foundation, National Robotics Initiative (NRI), Project, IIS-1208463, $210,000, 2012-2016.
- Awardee. Exposing digital forgeries using blind local noise level estimation. UAlbany Faculty Research Award (Category A), $10,000, 2012-2015.
- Co-PI. Recognizing group behavior in surveillance videos. National Institute of Justice, $40,000, 2011 - 2013.

- Awardee. A new statistical framework for natural images with appli- cations in vision. National Science Foundation Early Faculty Career Development Award, Project, IIS-0953373, $500,000, 2010-2015.

- Awardee. Seeing the unseen: Natural image statistics for digital forensics. UAlbany Faculty Research Award (Category A), $10,000, 2009-2012.

- Co-PI. Compressing and mining gps stream data. University Transportation Research Center, $99,848, 2009-2010.

- Co-PI. Statistical patterns to detect financial fraud. IBM Research Center, $40,000, 2009 - 2010.

INVITED TALKS

2018   *Seeing Is Deceiving: Fighting Fake Media with Algorithms*, Computer Science Department, Yale University, New Haven, CT, November 13.

2018   *DeepFake the Menace*, MIT/Harvard AI Research Center, MIT, Boston, MA, September 9.

2018   *Digital Media Forensics*, Institute of Computer Science and Technology, Peking University, Beijing, China, July 16.

2018   *Detecting DeepFake Videos*, Fake News Horror Show, New York City Media Center, New York, NY, June 6.

2017   *The UA-DETRACT Challenge*, IEEE AVSS IS4T Workshop, Lecce, Italy, August 29.

2016   *Multi-Object Tracking with Hyper-graphs*, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, China, July 7.

2016   *Digital Media Forensics*, School of Computer Science, Tianjin University, Tianjin, China, June 16.

2016   *Image Restoration with Pixel Priors*, School of Computer and Information Science, Tianjin Normal University, Tianjin, China, June 5.

2016   *I Know What You Did in Your Last Photoshop Session: Digital Image Forensics*, Computer Science and Engineering Department, Michigan State University, East Lansing, MI, February 5.

2015   *Multi-Object Tracking with Hyper-graphs*, School of Automation, University of Electronic Science and Technology of China, Chengdu, China, July 14.

2014   *Digital Image Forensics*, Binhai College, Nankai University, Tianjin, China, December 14.

2014   *I Know What You Did in Your Last Photoshop Session: Digital Image Forensics*, Kitware Inc., Clifton Park, NY, October 12.

2013   *Detecting Region Splicing with Local Noise Estimation*, National Laboratory of Pattern Recognition, Beijing, China, July 3.

2013   *Detecting Region Splicing with Local Noise Estimation*, College of Information and Computation, Peking University, Beijing, China, June 28.

2013   *Detecting Region Splicing with Local Noise Estimation*, Computer Science Department, Nankai University, Tianjin, China, June 26.

2012   *Modeling Natural Image Statistics*, Munsell Color Science Laboratory, Rochester Institute of Technology, Rochester, NY, January 31.

2012	*Exposing Region Duplication with Image Feature Matching*, Computer Science Department, Union College, Schenectady, NY, January 15.
2011	*Unifying Non-Maximum Likelihood Learning Algorithms with KL Contraction*, Computer Science Department, Rensselaer Polytechnic Institute, Troy, NY, October 11.
2011	*Dependency Reduction in Natural Images with Divisive Normalization*, Redwood Center for Neural Sciences, UC Berkeley, January 29.
2009	*Radial Gaussianization and Natural Image Statistics*, IBM T.J. Watson Research Center, Hawthorn, NY, November 3.
2009	*Radial Gaussianization and Natural Image Statistics*, GE Global Research Center, Niskayuna, NY, October 16.
2009	*Modeling Natural Image Statistics*, Computer Science Department, Temple University, Philadelphia, PA, April 10.
2009	*Modeling Natural Image Statistics*, GRASP Lab, University of Pennsylvania, Philadelphia, PA, April 9.
2008	*Modeling Natural Image Statistics*, Electronic and Computer Engineering Department, Rensselaer Polytechnic Institute, Troy, NY, October 11.
2008	*Natural Image Statistics for Digital Image Forensics*, Google Research Lab, New York, NY, April 10.
2007	*Natural Image Statistics for Digital Image Forensics*, Computer Science Department, Brooklyn Polytechnic University (now NYU Tanden School of Engineering), November 15.
2007	*Divisive Normalization for Image Processing*, Computer Science Department, Columbia University, New York, NY, October 10.
2007	*Modeling Natural Image Statistics*, Siemens Corporate Research, Princeton, NJ, May 7.
2007	*Modeling Natural Image Statistics*, Computer Science Department, University at Albany, SUNY, April 30.
2007	*Modeling Natural Image Statistics*, Computer Science Department, Brown University, February 17.
2005	*Natural Image Statistics for Digital Image Forensics*, Center for Neural Sciences, New York University, New York, NY, February 7
2005	*Natural Image Statistics for Digital Image Forensics*, Computer Science and AI Lab, MIT, Boston, MA, January 18.

PROFESSIONAL SERVICE

Professional Service	Associate Editor, IEEE Transactions on Information Forensics and Security (2016-2019); Member of IEEE SPS Information Forensics and Security Technical Committee (2017-2019).

Conference Organizer	Program Chair, International Conference on Information Hiding and Multimedia Security (2019); Publicity Chair, IEEE Conference on Advances in Video and Signal based Surveillance (2019); Publication Chair, IEEE NVIDIA Workshop AI City Challenge (2018); Advisory Committee, ECCV Workshop on UAV Surveillance (2018); Area Chair, IEEE International Conference on Image Processing (2017); Challenge Co-Chair, IEEE Conference on Advances in Video and Signal based Surveillance (2017). Co-Chair, special session on *Digital Media Forensics* in the First IEEE ChinaSIP Conference (2013).
Journal Reviewer	IEEE Transactions on Pattern Analysis and Machine Intelligence; IEEE Transactions on Image Processing; IEEE Transactions on Signal Processing; IEEE Transactions on Information Forensics and Security; International Journal on Computer Vision; Journal of Machine Learning Research, Journal of Neural Computation.
Conference Reviewer	Many conferences in machine learning and computer vision, including ECCV, ACM SIGGRAPH, CVPR, ICCV, and NIPS.
Proposal Reviewer	Review panelist for the National Science Foundation (2009, 2010, 2012, 2013, 2014, 2015); Proposal reviewer for The European Research Consortium for Informatics and Mathematics (2011).

PROFESSIONAL MEMBERSHIPS

- IEEE Senior Member (2016 – present), Member (2005 – 2016), Student Member (2001 – 2005).
- ACM Member (2008 – present).
- Omicron Delta Kappa ($O\Delta K$) Member (2016 – present).

PATENTS

1. Method and System for Separating Text and Drawings in Digital Ink. U.S. Patent 7298903 (B2), 2007

2. Method and System for Representing and Displaying Digital Ink. U.S. Patent 7450125 (B2), 2008, U.S. Patent 7057615 (B2), 2006, and E.U. Patent EP1271407, 2003

3. Computer Readable Medium for Expressing and Displaying Digital Ink and Computer System. Japan Patent JP2003141100, 2005

4. Systems and Methods for Analyzing Time Series Data Based on Event Transitions. U.S. Patent 9984154, 2018.

COURSES TAUGHT

Undergraduate Courses

Introduction to Data Mining	Fall '08, '09, '10, '11
Introduction to Digital Image Forensics	Spring '09, '10, '11, '12, '13
Introduction to Computer Vision	Spring '10, Fall '10
Introduction to Data Analytics	Fall '12, '13, '14, '16
Introduction to Machine Learning	Fall '10, Spring '12, '14, '16, '17, '18, '19

Graduate Courses

Advanced Data Mining	Fall '08, '09, '10, '11
Advanced Digital Image Forensics	Spring '09, '10, '11, '12, '13, '14
Advanced Computer Vision	Spring '10,
Advanced Machine Learning	Fall '10, Spring '12, '14, '16, '17, '18, '19

MEDIA COVERAGE

- *Deepfake: la peligrosa tecnologa que permite falsificar videos con tus fotos*, Univision TV Interview, 2019.

- *DeepFakes*, Data Skeptics Podcast, September, 2018.

- *The Defense Department has produced the first tools for catching DeepFakes*, MIT Tech Review, August, 2018.

- *Deepfakes are coming. Is Big Tech ready?*, CNN Money, August, 2018.

- *AI created fake news dystopia, but now they could help to fix it*, WIRED Magazine, July, 2018.

- *UAlbany researchers working to develop 'fake news' detector*, Spectrum News, June, 2018.

- *The Eyes have it: DeepFakes Outed by Unblinking Stares*, The Register, June, 2018.

- *How can you tell if a video is a DeepFake just look at the eyes*, New Scientists Magazine, June, 2018.

- *The Reality-Distorting Tools Of The Future*, Science Friday Radio Interview, February, 2018.

- *Wenn wahr und falsch nicht mehr zu unterscheiden sind*, Austrian public broadcaster ORF, April, 2017.

- *Sleuth's Clues Lead To Frustration*, Times Union, May, 2014.

- *We're Smarter Than Buffalo and Rochester and Syracuse and ...*, Albany Business Review, March 2014.

- *Picture Imperfect, Digital Imaging: Insurers, Publishers, Law-Enforcement Agencies And Dating Sites Are Using Software That Can Detect The Digital Manipulation Of Photos*, The Economist Magazine (Technology Quarterly), March 2013.

- *Scientists Develop Method for Authenticating Digital Images by Analyzing "Noise"*, SUNY Albany News, June 2012.

- *Looking For Evidence Of Photoshop Trickery*, Law.com, June 2012.

- *Hot on the trail of photo fakers*, Times Union, May 2010.

- *UAlbany Computer Science Professor Receives Prestigious NSF Award to Develop New Tools to Detect Fake Digital Images*, SUNY Albany News, May 2012.

- *Software Detects the True Artist*, Wired News, November 2004.

- *Computer Analysis Is Bringing Science to Art*, Washington Post, November 2004.

ADVISEMENT
Post-doc Advisor

- Dr. Longyin Wen, Post-doc, 2015 – 2016
  First job: Research Scientist, GE Global Research Center.

- Dr. Xing Mei, Post-doc, 2013 – 2015
  First job: SnapChat Inc.

- Dr. Dawei Du, Post-doc, 2018 – present

Primary Graduate Advisor

- Xunyu Pan, Ph.D. in Computer Science, SUNY Albany, 2011
  Dissertation: *Local Statistical Features For Digital Image Forensics*
  SUNY Albany **Distinguished Dissertation Award**, SUNY Albany, 2012
  First job: Assistant Professor, Computer Science Department, Frostburg State University

- Xing Zhang, M.S. in Computer Science, SUNY Albany, 2012
  First job: Novellus Inc.

- Jianting Wen, M.S. in Computer Science, SUNY Albany, 2012
  First job: Facebook.

- Amanda Danko, Ph.D. in Computer Science, SUNY Albany, 2015
  Dissertation: *Visual Saliency Estimation: A Cognitive Pre-Attentive and Context-Aware Approach*
  SUNY Albany **Distinguished Dissertation Award**, 2015
  First job: Research Scientist at USAA Research, San Antonio, TX.

- Xin Wang, Ph.D. in Computer Science, SUNY Albany graduated November, 2015
  Dissertation: *Topic Analysis And Application Using Nonnegative Matrix Factorizations (NMF)*
  First job: Research Scientist CuraCloud Inc., Seattle, WA

- Yueming Yang, Ph.D. in Computer Science, SUNY Albany, 2015
  Dissertation: *Efficient Large-Scale Photometric Reconstruction*
  First job: Research Assistant Professor, College of Mount Holyoke

- Andrew Pulver, Ph.D. student in Computer Science, SUNY Albany.

- Shengkun Li, Ph.D. student in Computer Science, SUNY Albany.

- Yuezun Li, Ph.D. student in Computer Science, SUNY Albany.

- Wenbo Li, Ph.D. student in Computer Science, SUNY Albany.

- Lipeng Ke, Ph.D. student in Computer Science, SUNY Albany.

- Yi Wei, Ph.D. student in Computer Science, SUNY Albany. (co-advise with Prof. Ming-Ching Chang).

- Nenghui Song, Ph.D. student in Computer Science, SUNY Albany. (co-advise with Prof. Ming-Ching Chang).

Ph.D. Committee Member (Outside of SUNY Albany)

- Zuoguan Wang, Ph.D. in Electrical, Computer and System Engineering, RPI, graduated 2012.

- Jan Kovosky, Ph.D. in Electrical and Computer Engineering, SUNY Binghamton, graduated 2012.

- Li Zhang, Ph.D. student in Computer Science, RPI, graduated 2013.

- Weiyi Sun, Ph.D. student in Informatics, SUNY Albany, graduated 2014.
- Vojetech Holub, Ph.D. in Electrical and Computer Engineering, SUNY Binghamton, graduated 2014.
- Shuai Li, Ph.D. student in Computer Science, RPI, graduated 2016.

Undergraduate Research Advisor

- Jeremy Birnbaum, Honor Student, Class of 2010, SUNY Albany
  Now Ph.D. student in Computer Science at SUNY Albany
- Adam Polanski, Honor Student, Class of 2012, SUNY Albany

UNIVERSITY SERVICES

Department Services

- Fall '17 – present, Chair of CS Department Graduate Admission Committee.
- Fall '11 – Fall '14, Fall '18 – present, Chair of CS Department Colloquia Series.
- Fall '15 – Spring '16, Chair of Faculty Research Committee for Computer and Electronic Engineering Department for College of Engineering and Applied Science.
- Spring '14, Chair of Analytical Exams in Artificial Intelligence.
- Fall '13, "Evergreen" Teaching Faculty Search Committee for Informatics Department.
- Fall '13 – Spring '14, Provost's team for Network Engineering Program.
- Fall '13 – Spring '14 Curriculum Committee of College of Computing and Information.
- Fall '12, '13 and '14, Faculty Search Committee.
- Fall '13, FRAP Committee.
- Fall '09 – Spring '14, Undergraduate Advisor.
- Fall '10 – Spring '12, Computing Oversight Committee.
- Fall '10 – Spring '12, Undergraduate Curriculum Committee.

University Services

- Spring'18, Center, Institute & Lab Task Force.
- Fall '17, Committee for the University's Strategic Development and Planning Initiative in the subcommittee for Research and Creative Activities.
- Fall '16, University's Strategic Development and Planning Initiative in Engineering and Technology.
- Summer '14, panelist in the University's ITLAL Early Faculty Career Workshop.

SUNY System-wide Services

- Spring '19 – present, Member of SUNY Senior Vice Chancellor?s Scientific Advisory Panel (SAP).