

Zhiqiang Lao

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Nationality: US citizen

QUALIFICATION SUMMARY

- 20 years' R&D experience of machine learning/pattern recognition /image processing/computer vision /biometrics in both academic and industry.
 - PhD in computer science, 3 years postdoc training focusing on machine learning, pattern recognition, computer vision and image data-based data mining.
 - Effective experience working closely with cross-functional teams and multi-disciplinary team members.
 - Extensive experience in mentoring junior scientists and offering internal counsel to peers/colleagues.
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RESEARCH EXPERIENCES

11/2016-now, computer vision, image processing, deep learning-based object detection and segmentation, Futurewei Technologies, Inc., Sr staff researcher / engineer

Deep learning

- MoT (Mode of Transportation) recognition based on smartphone sensor signal
- Hivision top-level image classification (MobileNet v1 with 11 categories)
- Hivision top-level object detection & classification (MobileNet + SSD + transfer learning, 13 categories)
- Logo detection & classification in the wild (Faster RCNN + ZF net).
- Human body segmentation from selfie photos.
- Salient object detection & segmentation.

Image processing and special effects

- Dense CRF based foreground segmentation refinement (*transferred to HQ R&D team*).
- Automatic generation of color splash effect (foreground segmentation + special effect rendering, *prototype*).

Technology validation

- Photo aesthetics evaluation
- Photo triage (same scene or moment photo ranking)
- Human pose estimation/classification
- Style transfer
- Face swap

05/2012-11/2016, machine learning, pattern recognition, computer vision and image processing, Safran MorphoTrust USA, principal research scientist

Face recognition

- FFT frequency analysis-based illumination removal (***prototype, validated and delivered to product***).
- LBP (Local binary pattern) based feature extraction (***implemented and delivered to product***)
- Demographic classification (including gender, ethnicity and age) algorithm with novel feature definition and machine learning techniques (***prototype, validate and delivered to product, patent filed***).
- Novel mapping score-based feature definition for face recognition (general purpose feature definition for fusion of various face recognition algorithms, ***prototype, validate and delivered to product***).
- VGG feature based face recognition (***delivered to product***).
- Face template (feature vector) quantification to 8-bit, 4-bit, 2-bit or even 1 bit for fast matching purpose (***delivered to product***).
- Fusion of VGG and AlexNet based face recognition (implemented, validated and delivered to product, but was not the best face recognition algorithm pipeline)
- Fusion of multiple face recognition algorithms based on higher level matching score-based feature definition, reduction and discriminant enhancement (***implemented and delivered to product***).
- Optimal algorithm pipeline selection in face recognition (extensive experience based on tons of experiments).
- Score fusion of multiple face recognition algorithms (major technique is the normalization of matching score from different face recognition algorithms).

Machine learning

- PCA, LDA, SVM (support vector machine), NN (Neural network: feed-forward, recurrent, convolutional, etc)
- Metric learning, triplet training and Joint Bayesian for improving discriminant ability
- Tailored Joint Bayesian formulation so that it can work with PCA for feature reduction (original formulation cannot work with PCA directly)
- Adaboost in training for improving discriminant ability
- Deep learning (CNN, RNN, etc) with software package of *caffe*, *tensorflow* and network structure of VGG, FCN
- Large scale intensive training of machine learning model with millions of images.

Segmentation

- Fully automatic segmentation of human upper body (hair, face, shoulder and arm with arbitrary condition) from arbitrary background in still image (***prototype, validate and delivered to product, patent granted***).
- *Grabcut* and *CRFasRNN* (conditional random fields as recurrent neural networks, deep learning).
- Fusion of segmented foreground probability with new background for better visualization purpose.

- Image local SVD (singular value decomposition) based hair map generation (included in human upper body segmentation software)

Face hallucination

- High resolution face image reconstruction from low resolution face images (implementation and extensive validation).
- Patch matching based technique

Ear recognition

- Latent ear recognition based on morphological features (government funding proposal)

Technology validation

- Iris recognition algorithm validation test – preparing for participating NIST's Iris recognition competition
- Validation of open source (Alize) as well as commercial speaker recognition algorithms (technology analysis for higher level manager's roadmap planning)
- Statistical evaluation method for biometrics applications (all kinds of statistical curves, including CMC, DET, ROC, FAR, etc in evaluating recognition performance).

Award, patent filing and funding proposal

- ***Product/Technology Innovation Award 2013*** (for the work of human upper body segmentation).
- one granted patent and several patent applications and funding proposals

10/2007 – 5/2012, Carestream Health Inc, Image processing and analysis, senior algorithm scientist

- Computer aided breast cancer detection in mammography (***MammoCAD, got FDA approval for digitized film***)
- 3D Tomosynthesis image reconstruction and enhancement (***CUDA based parallel processing for faster reconstruction speed, prototype, validate and delivered to product, patent granted***).
- Dense (fibroglandular) tissue segmentation in mammography images (statistical model of dense tissue to discriminate it from fatty tissue in mammogram).
- Architectural distortion detection algorithm in mammography (***boost breast cancer detection accuracy by 8%, 1st algorithm in detecting architectural distortion in MammoCAD industry***)
- Pneumothorax enhancement in X-ray images.
- Carina detection in chest x-ray images (***feature extraction + linear classification***).
- Collimation segmentation in X-ray images (***feature extraction/selection + decision tree, delivered to product***).
- Chest X-ray image enhancement (***patent granted***).
- Author of 3 granted patents and more filed patent applications.

07/2002 – 10/2007, section of biomedical image analysis, department of radiology, University of Pennsylvania, postdoc & senior research investigator

- Morphological feature based central nerves disorders detection in brain MRI.
- Segmentation of diabetes, ischemic and white matter lesion in 3D brain MRI.
- Statistical analysis of various control vs pathology population.
- Medical image enhancement.
- VBM (voxel based morphometry) based analysis of brain tissue volume change.
- Participation in several large scale clinical studies.

09/2000 – 06/2002, Center for Biomedical Image Analysis, Johns Hopkins University, Postdoc

- Statistical modeling of prostate cancer distribution.
- Skull strip in brain MRI images.
- Analysis of brain tissue longitudinal changes using brain MRI.

10/1998 – 08/2000, Center for Graphics and Image Technology, Nanyang Technological University, Singapore, research fellow

- Ill-posed inverse problem solving based 3D human posture estimation using human motion video.
- Model-based approach to human recognition using human motion video.
- Object tracking in video.

01/1998 – 10/1998, Siemens Shanghai Mobile Communications, Ltd, PR China, engineer

TECHNICAL SKILLS

- **Image processing related techniques:** *image signal processing with probability and statistic theory*, PCA, ICA, TBM, VBM, AAM, ASM, SVM, Neural Network, intensity normalization, bias field correction, noise reduction, rigid transformation based co-registration & nonlinear registration, deformable model (segmentation, registration, recognition, etc), feature extraction (intensity, texture, morphological, etc.), feature selection, pattern recognition, classification, etc.
- **Programming Skills:** Matlab, C/C++/C#, *Python under Unix, Linux and Windows, version control with Git, SVN etc.*
- **Standards and software:** various imaging/visualization/statistics software and libraries, such as: OpenCV, Lapack, OpenBLAS, ITK, VTK, DICOM standard, etc. Various deep learning based software platforms, such as: caffe, tensorflow etc, as well as various network structures, mbilenet, vgg, resnet, etc.

AFFILIATIONS

Institute of Electrical and Electronics Engineering (IEEE)
International Society for Optics and Photonics (SPIE)

SERVICES TO EXTERNAL ACADEMIC COMMUNITIES

Reviewers for

- International Conference of Pattern Recognition (ICPR) – 2012-2018
- International Conference of Computer Vision (ICIP), 2018
- Asian Conference on Computer Vision (ACCV) – 2010, 2012
- IJCARS (International Journal of Computer Assisted Radiology and Surgery)
- IEEE Transaction on Biomedical Engineering
- Mathematics and Computers in Simulation
- International Journal of Computer Graphics
- Journal of Data Acquisition and Processing
- Journal of Zhejiang University
- Specially invited reviewer for Press of Zhejiang University
- Journal of Zhejiang Chemical Industry
- NeuroImage
- AJNR (American Journal of Neuroradiology)

EDUCATION

University of Pennsylvania, Postdoc, machine learning & image analysis, 2002-2003
Johns Hopkins University, Postdoc, machine learning & image analysis, 2000-2002
Zhejiang University, PR China, Ph.D., Artificial Intelligence, 1994-1997

PUBLICATIONS

Journal Papers:

1. M Bilello, **Z Lao**, J Krejza, AE Hillis, EH Herskovits, Atlas-based classification of hyperintense regions from MR diffusion-weighted images of the brain: preliminary results, the neuroradiology journal 25 (1), pp.112-120, 2012.
2. LH Coker, PE Hogan, NR Bryan, LH Kuller, KL Margolis, K Bettermann, RB Wallace, **Z Lao**, R Freeman, ML Stefanick, SA Shumaker, Postmenopausal hormone therapy and subclinical cerebrovascular disease: the WHIMS-MRI Study, *Neurology*, 2009 Jan 13; 72(2): 125-34.
3. **Z Lao**, D Shen, DF Liu, AF Jawad, ER Melhem, LJ Launer, NR Bryan, C. Davatzikos, Computer-Assisted Segmentation of White Matter Lesions in 3D MR Images, Using Support Vector Machine, *Academic Radiology*, Volume 15, Issue 3, Pages 300-313, 2008.
4. M Bilello, **Z Lao**, J Krejza, AE Hillis, EH Herskovits, Statistical atlas for acute stroke MR diffusion-weighted-images of the brain, *Neuroinformatics* Vol 4, No 3, pp.235-242, 2007.

5. **Z Lao**, D Shen, et al, "Morphological Classification of brains via high-dimensional shape transformations and machine learning methods", *NeuroImage*, Vol 21(1), pp 46-57, 2004.
6. D Shen, **Z Lao**, J. Zeng, W. Zhang et al, Optimizing of biopsy strategy by a statistical atlas of prostate cancer distribution, *Medical Image Analysis*, 8(2): 139-150, 2004.
7. **Z Lao**, L Li, "Video-based approach to human animation", Computer Graphics Forum, 3rd issue, vol. 19, 2000.
8. **Z Lao**, Y Pan, "A model-based approach to human animation", Chinese Journal of Advanced Software Research, vol. 11, no. 4, pp.435-440, 2000.
9. **Z Lao**, Y Pan, "Survey of human body animation", Chinese Journal of Computer Science, vol. 25, no. 1, 1998.
10. **Z Lao**, Y Pan, "A knowledge representation model for video-based animation", Chinese Journal of CAD and Computer Graphics, vol. 10, no. 4, 1998, pp.367-376.
11. **Z Lao**, Y Pan, "The design and implementation of a distributed shading algorithm", Journal of Computer Science and Technology, vol. 13 Supplement, 1998, pp.27-32.
12. **Z Lao**, Y Pan, "IFS-based fast image encoding algorithm", Chinese Journal of Computer Research and Development, vol. 35, no. 3, March 1998, pp.280-284.
13. **Z Lao**, Y Pan, "A knowledge representation model for video-based animation", Journal of Computer Science and Technology, vol. 13, no. 3, May 1998, pp.228-237.
14. **Z Lao**, Y Pan, "A feature-based image deformation algorithm", Chinese Journal of CAD and Computer Graphics, 1998, 10(1), pp.1-6.
15. J Dong, **Z Lao**, "CSCW and its key techniques", Chinese Computer Users, June 1997, pp.5-11.
16. **Z Lao**, J Shi, "The design and implementation of a distributed hidden surface removal algorithm", Chinese Journal of Computer Aided Engineering, vol. 6, no. 4, December 1997, pp.25-29.
17. **Z Lao**, Y Pan, "A global optimization based video deformation method", Chinese Journal of Computer Engineering, vol. 23, no. 5, September 1997, pp.60-63.
18. **Z Lao**, "Digital revolution and computer animation", Chinese Computer Users, no. 2, Feb 1997, pp.1-3.
19. **Z Lao**, J Shi, "A distributed shading algorithm via image space distribution", Journal of Software, vol 8, no. 8, 1997, pp. 585-592.
20. **Z Lao**, D Xu, Y Pan, "Multisource analogy generation in video generation", Journal of Data Acquisition of Processing, vol. 11, no. 4, 1996, pp.308-311.
21. **Z Lao**, D Xu, Y Pan, "The application of multisource analogical generation in video-stream generation", Chinese Journal of Computer Science, vol. 24, no. 3, 1997.
22. B Bai, **Z Lao**, X Jiang, "Theory of driver design under DOS system (II)", Journal of Kunming Metallurgy College, No.3, 1997.
23. **Z Lao**, B Bai, X Jiang, "Theory of driver design under DOS system (I)", Journal of Kunming Metallurgy College, No.4, 1996.
24. Z Yin, Z Pan, X Ma, **Z Lao**, "Eiffel: an object-oriented programming language

and environment”, Journal of Computer Engineering and Application, No 1, 1993.

Conference Papers:

1. **Z Lao**, X Zheng, Q Zou, “Statistical representation of high-dimensional enhancement fields with application to consistent enhancement of chest x-ray images”, SPIE Medical Imaging, February 9-14, 2013, Orlando, Florida.
2. **Z Lao**, X Zheng, Q Zou, “Carina detection in ICU images via integrating geometrical and thoracic anatomy based features”, ICPR, November 11-15, 2012, Tsukuba Science City, Japan.
3. **Z Lao**, X Zheng, “Multiscale quantification of tissue spiculation and distortion for detection of architectural distortion and spiculated mass in mammography”, SPIE Medical Imaging, February 12-17, 2011, Orlando, Florida
4. **Z Lao**, Z Huo, “Quantitative assessment of breast tissue on mammograms”, ICIP 2009, November 7-10, 2009, Cairo, Egypt.
5. **Z Lao**, D. Shen, K. Bilge, ER, Melhem, NR, Bryan, C. Davatzikos, “Automated Segmentation of White Matter Lesions in 3D Brain MR Images, Using Multivariate Pattern Classification”, Third IEEE International Symposium on Biomedical Imaging (ISBI 2006), April 6-9, 2006, Arlington, VA, USA.
6. C. Davatzikos, D. Shen, **Z Lao**, Z. Xue, B. Karacali, "Morphological classification of medical images using nonlinear support vector machines", *IEEE International Symposium on Biomedical Imaging (ISBI)* (invited paper), Arlington, VA, April 15-18, 2004.
7. **Z Lao**, Dinggang Shen, Christos Davatzikos, “Statistical Shape Model for Automatic Skull-Stripping of Brain Images”, *ISBI2002*, D.C. 7-10 July 2002.
8. D Shen, **Z Lao**, J. Zeng, E.H. Herskovits, G. Fichtinger, C. Davatzikos, “A Statistical Atlas of Prostate Cancer for Optimal Biopsy”, *MICCAI2001*, Utrecht, The Netherlands, 14-17 October 2001.
9. D. Shen, **Z Lao**, J. Zeng, EH Herskovits, G. Fichtinger, C. Davatzikos, "Statistically Optimized Biopsy Strategy for the Diagnosis of Prostate Cancer", *The Fourteenth IEEE Symposium on Computer-Based Medical Systems (CBMS 2001)*, 26-27 July, 2001 at the Natcher Center, 9000 Rockville Pike, Bldg. 45, Bethesda, Maryland 20892.
10. **Z Lao**, L. Li, "Video-based Approach to Human Animation", *Eurographics 2000*, Interlaken, Switzerland, 20-25 August 2000.
11. **Z Lao**, L. Li, "Model-based Approach to Human Recognition", *International Conference on Computer Vision, Pattern Recognition and Image Processing (CVPRIP'2000)*, Feb. 27-Mar.3, 2000, Atlantic City, USA.
12. **Z Lao**, L. Li, "A Three-step to Object Tracking", *International Conference on Computer Vision, Pattern Recognition and Image Processing (CVPRIP'2000)*, Feb. 27-Mar.3, 2000, Atlantic City, USA.
13. **Z Lao**, L. Li, "Multi-modal Edge Extraction from Motion Video", *Proc. of 2nd International Conference on Information, Communications & Signal Processing (ICICS'99)*, December 7-10, 1999, Singapore.

14. **Z Lao**, Y. Pan, "The Implementation of Distributed Shading Algorithm", *Proc. of 1997 Int. Workshop on Computational Science and Engineering (IWCSE'97)*, Hefei, P.R.China, 1997.5, pp.108-115.
15. Y. Zhuge, **Z Lao**, Y. Pan, "Knowledge Based System for Art Pattern Design", *Proc. of the CJCAl'96*, Changsha, P.R.China, 1996.10.
16. **Z Lao**, D. Xu, Y. Pan, "Multisource Analogy Generation based Animation", *Proc. of Chinagraph'96*, Hangzhou, P.R.China, 1996.10, pp.366-371.
17. **Z Lao**, Y. Zhuge, J. Shi, "Distributed Approach to Shading Based on Image Space Distribution", *Proc. of the 6th National Computer Youth Conference(NCYCS'96)*, Hangzhou, P.R.China, 1996.10, pp.547-552.
18. **Z Lao**, J. Shi, "A Distributed Hidden-Surface-Removal Algorithm Based on Image Space Distribution", *Proc. of the 6th National Computer Youth Conf.(NCYCS'96)*, Hangzhou, P.R.China, 1996.10, pp.602-603.
19. **Z Lao**, Z. Pan, W.Zheng, J. Shi, "DGPSL: A Distributed Graphics Processing Support Library for Graphics and Image", *Proc. of IEEE TENCON'93*, Beijing, 1993.10, P.R.China.
20. **Z Lao**, Z. Pan, J. Shi, "Distributed Approach to Shading in Image Space", *Proc. of 3rd Int. Conf. on CAD & CG*, Beijing, 1993.8, P.R.China.
21. **Z Lao**, J. Shi, "Designing and Implementation of Distributed Scan-Conversion algorithm", *Proc. of the 6th National Conf. on CAD & CG*, Wuxi, P.R.China, Vol.2, 1993, pp.541-545.
22. **Z Lao**, J. Shi, "Implementation of Distributed Object-Oriented Volume Rendering", *Proc. of Int. Modelling & Simulation & Control Conf., ASME MSC'92*, Hefei, P.R.China, Vol.2, 1992, pp.797-805.

PATENT APPLICATIONS

1.

Investigation of distribution graphics processing system, Chinese patent ID: CG2000022472
2. Assessment of breast density and related cancer risk, pending.
3. Computer aided detection of architectural distortion in mammography, pending.
4. Enhanced visualization for medical images (Patent #: US8861886 B2).
5. Method for enhancing reconstructed 3D tomosynthesis volume image (Patent #: 9311740).
6. System and method for creating a virtual backdrop (Patent #: 9286685).
7. System and method for demographic estimation using matching score based features.
8. System and method for leveraging soft-biometrics in biometrics enrollment.

HONORS

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2013, Product/Technology Innovation Award, Safran MorphoTrust USA.
- 1998, Outstanding graduate of the year, Zhejiang Province, PR China.
- 1997, Outstanding graduate of the year, Zhejiang University, PR China.
- 1997, Ph.D. Thesis of excellence, Zhejiang University, PR China.

- 1997, Excellent Ph.D. Degree Receiver of the Year, Zhejiang University, PR China.
- 1996, 1st rate prize of Science and Technology of Zhejiang Province, PR China.
- 1994-1997, Graduate School Scholarship, Zhejiang University, PR China.