LIN Jie

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R&D ACHIEVEMENTS

Since 2018, I lead the Edge AI group in I^2R, with the focus on development of compact neural networks and the applications for the **next-generation deep learning hardware**, **efficient deep learning on encrypted data for privacy preserving**, **TinyML for IoT**, etc.

From 2011 – 2014, I served as core contributor to the MPEG-7 International standardization on **Compact Descriptors for Visual Search (CDVS)** [*]. Contributions on **scalable and compact global descriptor** are adopted by MPEG CDVS as one of the three core technologies, competitors include Stanford IVMS lab, Huawei, University of Surrey, Samsung, ST Electronics, etc. Over 20 proposals have been submitted, with 8 patents granted, one of the grants received the 19^{th} **China Excellent Patent Award** (National Award). The invented technology has been adopted by Tencent **WeChat open platform**[†], **Baidu mobile app**[‡], etc. It also initiated a startup **Boyun Vision**[§] in Beijing, China.

EDUCATION

Beijing Jiaotong University, Beijing, China

- Ph.D. in Computer Engineering — Sep 2006 – Sep 2013
  - Thesis: Compact Aggregated Descriptors for Mobile Visual Search
  - Keywords: Mobile Image Search, Data Compression, MPEG-7 Standardization
- B.S. in Computer Science and Technology — Sep 2002 – Jul 2006

RESEARCH INTERESTS

Deep Learning, AI Hardware, Privacy Preserving Machine Learning, Data Compression, Computer Vision

WORK EXPERIENCE

Institute for Infocomm Research, A*STAR, Singapore

- Group Leader / Edge AI Group, Principal Investigator — Jun 2018 – present
  - Develop the next-generation edge AI hardware via full stack hardware-software co-optimization from deep learning algorithms down to silicon
  - Develop new methods for compressing deep neural networks torwards fast, small and energy-efficient neural network inference for privacy-preserving applications
  - Develop multi-modal deep learning and semi-supervised deep learning algorithms for perception tasks in challenging environments
- Research Scientist — Aug 2014 – May 2018
  - Develop multi-modal (video, audio, text) deep learning system for YouTube8M video classification (Kaggle competition, ranked at **Top 3% out of 650 teams**)
  - Develop 3D CT-scan lung cancer detection system using YOLO architecture and 3D Convolutional Neural Networks (CNN) (Kaggle Data Science Bowl 2017, ranked at **Top 2% out of 1972 teams**)
  - Develop deep learning based compact representations (**64∼1024 bits**) to enable ultra-fast image and video search

Institute of Digital Media, Peking University / ROSE lab, Nanyang Technological University

- Visting scholar, Advisor: Prof. DUAN Lingyu, Prof. GAO Wen — Sep 2011 – Jul 2014
  - Participate in the MPEG-7 international standardization on Compact Descriptors for Visual Search (CDVS)
  - Develop compact global descriptor termed **Scalable Compressed Fisher Vector (SCFV)**, which has been adopted as one of the three key technologies in final MPEG CDVS.

PROJECTS

Principal Investigator - Hardware-Software Co-optimization for Deep Learning (Work Package 1)

- S$ 8,358,000.00, Jun 2018 – May 2023
- Develop the next-generation deep learning inference hardware with 10x to 100x improvements on bandwidth and throughput

Principal Investigator - Accelerating Homomorphic Encryption (Work Package 1)

- S$ 1,200,000.00, Feb 2020 – Jan 2023
- Develop compact neural networks for secure and fast deep learning inference on encrypted data.

[*] http://mpeg.chiariglione.org/standards/mpeg-7/compact-descriptors-visual-search

[†] http://open.wechat.com/cgi-bin/newreadtemplate?t=overseas_open/docs/mobile/smart#mobile_smart

[‡] https://itunes.apple.com/us/developer/beijing-baidu-netcom-science-technology-co-ltd/id372585298

[§] http://www.boyunvision.com.cn

Principal Investigator - Edge SoC with AI Acceleration

- S$ 640,000.00, Apr 2020 – Jun 2021
- Develop full System-on-Chip platform with custom deep learning accelerator for ultra-low power IoT applications.

Work Package Lead - Deep Learning 2.0 Programme

- S$ 1,950,000.00, May 2017 – Nov 2018
- Solve hard cross-disciplinary problems in deep learning, e.g. multi-modal deep learning, deep learning on embedded devices, incorporating knowledge into deep learning, etc.

SELECTED PUBLICATIONS

Full list at Google Scholar, https://scholar.google.com.sg/citations?user=bzhI8wcAAAAJhl=en
($\star$ denotes equal contribution, $\diamond$ denotes corresponding author.)

BOOK CHAPTER

[01] **Jie Lin**, Olivier Morere, Antoine Veillard, Vijay Chandrasekhar, "Deep Learning-Based Descriptors for Object Instance Search," *In Deep Learning in Object Detection and Recognition. Springer*, 2019.

CONFERENCES

[20] Tianyi Zhang, **Jie Lin**$^{\diamond}$, Peng Hu, Bin Zhao, Mohamed M. Sabry Aly, "PSRR-MaxpoolNMS: Pyramid Shifted MaxpoolNMS with Relationship Recovery," *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021.

[19] Peng Hu, Xi Peng, Hongyuan Zhu, Liangli Zhen, **Jie Lin**, "Learning Cross-modal Retrieval with Noisy Labels," *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021.

[18] Chunyun Chen, Zhe Wang, Xiaowei Chen, **Jie Lin**, Mohamed M. Sabry Aly, "Efficient Tunstall Decoder for Deep Neural Network Compression," *Design Automation Conference (DAC)*, 2021.

[17] Peng Hu, Xi Peng, Hongyuan Zhu, Mohamed M. Sabry Aly, **Jie Lin**$^{\diamond}$, "OPQ: Compressing Deep Neural Networks with One-shot Pruning-Quantization," *AAAI Conference on Artificial Intelligence (AAAI)*, 2021.

[16] Peng Hu, Hongyuan Zhu, Xi Peng, **Jie Lin**$^{\diamond}$, "Semi-supervised Multi-modal Learning with Balanced Spectral Decomposition," *AAAI Conference on Artificial Intelligence (AAAI)*, 2020.

[15] Quang-Hieu Pham, Pierre Sevestre, Ramanpreet Singh Pahwa, Huijing Zhan, Chun Ho Pang, Yuda Chen, Armin Mustafa, Vijay Chandrasekhar, **Jie Lin**$^{\diamond}$, "A* 3D Dataset: Towards Autonomous Driving in Challenging Environments," *International Conference on Robotics and Automation (ICRA)*, 2020.

[14] Arko Dutt, Govind Narasimman, **Jie Lin**, Vijay Chandrasekhar, Mohamed M. Sabry, "East-DNN: Expediting architectural simulations using deep neural networks," *International Conference on Hardware/Software Codesign and System Synthesis (CODES+ISSS)*, 2019.

[13] Zhe Wang, **Jie Lin**, Vijay Chandrasekhar, Bernd Girod, "Optimizing the Bit Allocation for Compression of Weights and Activations of Deep Neural Networks," *IEEE International Conference on Image Processing (ICIP)*, 2019. **Top 10% Paper**

[12] Lile Cai, Anne-Maelle Barneche, Arthur Herbout, Chuan Sheng Foo, **Jie Lin**, Vijay Chandrasekhar, Mohamed M Sabry Aly, "TEA-DNN: the Quest for Time-Energy-Accuracy Co-optimized Deep Neural Networks," *IEEE/ACM International Symposium on Low Power Electronics and Design (ISLPED)*, 2019. **Best Paper Finalist**

[11] Lile Cai, Bin Zhao, Zhe Wang, **Jie Lin**, Chuan Sheng Foo, Mohamed Sabry Aly, Vijay Chandrasekhar, "MaxpoolNMS: Getting Rid of NMS Bottlenecks in Two-Stage Object Detectors," *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2019.

[10] Zhe Wang, Kingsley Kuan, Mathieu Ravaut, Gaurav Manek, Sibo Song, Fang Yuan, Kim Seokhwan, Nancy Chen, Luis Fernando D'Haro Enriquez, Luu Anh Tuan, Hongyuan Zhu, Zeng Zeng, Ngai Man Cheung, Georgios Piliouras, **Jie Lin**, Vijay Chandrasekhar, "Truly Multi-modal YouTube-8M Video Classification with Video, Audio, and Text," *CVPR Workshop on YouTube-8M Large-Scale Video Understanding*, 2017.

[09] **Jie Lin***, Olivier Morere*, Antoine Veillard*, Lingyu Duan, Hanlin Goh, Vijay Chandrasekhar*, "DeepHash for Image Instance Retrieval: Getting Regularization, Depth and Fine-Tuning Right," *ACM International Conference on Multimedia Retrieval (ICMR)*, 2017.

[08] Olivier Morère*, **Jie Lin***, Antoine Veillard*, Lingyu Duan, Vijay Chandrasekhar*, Tomaso Poggio, "Nested Invariance Pooling and RBM Hashing for Image Instance Retrieval," *ACM International Conference on Multimedia Retrieval (ICMR)*, 2017. **Best Paper Finalist**

[07] Yuan Fang, Kingsley Kuan, **Jie Lin**, Cheston Tan, Vijay Chandrasekhar, "Object Detection Meets Knowledge Graphs," *Proceedings of International Joint Conference on Artifical Intelligence (IJCAI)*, 2017.

[06] Vijay Chandrasekhar*, **Jie Lin***, Qianli Liao*, Olivier Morère, Antoine Veillard, Lingyu Duan, Tomaso Poggio, "Compression of Deep Neural Networks for Image Instance Retrieval," *Data Compression Conference (DCC)*, 2017.

[05] **Jie Lin**, Olivier Morere, Julie Petta, Vijay Chandrasekhar, Antoine Veillard, "Tiny Descriptors for Image Retrieval with Unsupervised Triplet Hashing," *Data Compression Conference (DCC)*, 2016.

[04] Vijay Chandrasekhar, **Jie Lin**, Olivier Morere, Antoine Veillard, Hanlin Goh, "Compact Global Descriptors for Visual Search," *Data Compression Conference (DCC)*, 2015.

[03] Zhe Wang, Ling-Yu Duan, **Jie Lin**, Xiaofang Wang, Tiejun Huang, Wen Gao, "Hamming Compatible Quantization for Hashing," *Proceedings of International Joint Conference on Artifical Intelligence (IJCAI)*, 2015.

[02] **Jie Lin**, Ling-Yu Duan, Tiejun Huang, Wen Gao, "Robust fisher codes for large scale image retrieval," *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2013.

[01] **Jie Lin**, Ling-Yu Duan, Jie Chen, Rongrong Ji, Siwei Luo, Wen Gao, "Learning Multiple Codebooks for Low-Bit-Rate Mobile Visual Search," *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2012.

JOURNALS

[13] Huijing Zhan, **Jie Lin**◇, Kenan Emir Ak, Boxin Shi, Ling-Yu Duan, Alex C. Kot, "A3-FKG: Attentive Attribute-Aware Fashion Knowledge Graph for Outfit Preference Prediction," *IEEE Transactions on Multimedia (T-MM)*, 2021.

[12] Peng Hu, Xi Peng, Hongyuan Zhu, **Jie Lin**, Liangli Zhen, Wei Wang, Dezhong Peng, "Cross-modal Discriminant Adversarial Network," *Pattern Recognition (PR)*, 2021.

[11] Peng Hu, Xi Peng, Hongyuan Zhu, **Jie Lin**, Liangli Zhen, Dezhong Peng, "Joint vs. Independent Multi-view Hashing for Cross-view Retrieval," *IEEE Transactions on Cybernetics (T-CYB)*, 2020.

[10] Huijing Zhan, Chenyu Yi, Boxin Shi, **Jie Lin**, Ling-Yu Duan, Alex C. Kot, "Pose-Normalized and Appearance-Preserved Street-to-Shop Clothing Image Generation and Feature Learning," *IEEE Transactions on Multimedia (T-MM)*, 2020.

[09] Qaisar Ahmad Al Badawi Ahmad, Chao Jin, **Jie Lin**, Mun Chan, Jie Sim, Tan Benjamin, Nan Xiao, Khin Aung, Vijay Chandrasekhar, "Towards the AlexNet Moment for Homomorphic Encryption: HCNN, the First Homomorphic CNN on Encrypted Data with GPUs," *IEEE Transactions on Emerging Topics in Computing (T-ETC)*, 2020.

[08] Qaisar Ahmad Al Badawi Ahmad, Bharadwaj Veeravalli, **Jie Lin**, Nan Xiao, Kazuaki Matsumura, Khin Aung, "Multi-GPU Design and Performance Evaluation of Homomorphic Encryption on GPU Clusters," *IEEE Transactions on Parallel and Distributed Systems (T-PDS)*, 2020.

[07] Yuwei Wu, Feng Gao, Yicheng Huang, **Jie Lin**, Vijay Chandrasekhar, Junsong Yuan, Lingyu Duan, "Codebook-Free Compact Descriptor for Scalable Visual Search," *IEEE Transactions on Multimedia (T-MM)*, 2018.

[06] **Jie Lin**, Lingyu Duan, Shiqi Wang, Yan Bai, Yihang Lou, Vijay Chandrasekhar, Tiejun Huang, Alex Kot, Wen Gao, "HNIP: Compact Deep Invariant Representations for Video Matching, Localization and Retrieval," *IEEE Transactions on Multimedia (T-MM)*, 2017.

[05] Sai Manoj Prakhya, **Jie Lin**, Vijay Chandrasekhar, Weisi Lin, Bingbing Liu, "3DHoPD: A Fast Low Dimensional 3D Descriptor," *IEEE Robotics and Automation Letters*, 2017.

[04] Bappaditya Mandal, Liyuan Li, Gang Wang, **Jie Lin**, "Towards Detection of Bus Driver Fatigue Based on Robust Visual Analysis of Eye State," *IEEE Trans. on Intelligent Transportation Systems (T-ITS)*, 2016.

[03] Lingyu Duan, Vijay Chandrasekhar, Jie Chen, **Jie Lin**, Zhe Wang, Tiejun Huang, Bernd Girod, Wen Gao, "Overview of the MPEG-CDVS standard," *IEEE Trans. on Image Processing (T-IP)*, 2016.

[02] Lingyu Duan, **Jie Lin**, Zhe Wang, Tiejun Huang, Wen Gao, "Weighted Component Hashing of Binary Aggregated Descriptors for Fast Visual Search," *IEEE Trans. on Multimedia (T-MM)*, 2015.

[01] **Jie Lin**, Lingyu Duan, Yaping Huang, Siwei Luo, Tiejun Huang, Wen Gao, "Rate-adaptive Compact Fisher Codes for Mobile Visual Search," *IEEE Signal Processing Letters*, 2014.

HONORS & AWARDS

- Top 10% paper at The 26th IEEE International Conference on Image Processing (ICIP) 2019
- Best Paper Finalist at The IEEE/ACM International Symposium on Low Power Electronics and Design (ISLPED) 2019
- $A^\star$STAR TALENT Award 2018
- The 19^{th} China Excellent Patent Award (Ranked at 2 out of the 7 inventors) 2017
- Best Paper Finalist at The ACM International Conference on Multimedia Retrieval (ICMR) 2017
- 1st place in Image Conference and Labs of the Evaluation Forum (ImageCLEF 2017) Lifelog Summarization Benchmarking Competition[¶] 2017
- Ranked at **Top 3% out of 650 teams** in Kaggle Google Cloud YouTube-8M Video Understanding Challenge [‖] 2017
- Ranked at **Top 2% out of 1972 teams** in Kaggle Data Science Bowl 2017 Lung Cancer Detection Challenge [**] 2017
- Core contributor of MPEG International Standard CDVS Ad-hoc Group 2012 – 2014
- Outstanding Individual Award in NELVT [††] 2013
  Top 10 outstanding graduates in National Engineering Laboratory for Video Technology (NELVT), Peking University
- Excellent Fellowship, Beijing Jiaotong University 2004 – 2006
  For attaining a semester GPA ranked at Top 5% out of 400 undergraduates

PROFESSIONAL ACTIVITIES

Reviewers

- CVPR, ICCV, AAAI, IJCAI, ICMR, ICIP, ICME, etc.
- IEEE T-IP, IEEE T-MM, IEEE T-NNLS, IEEE T-CSVT, IEEE RAL, Journal of VCIP, EURASIP Journal on Image and Video Processing, etc.

[¶] http://imageclef.org/2017/lifelog
[‖] Team Name: DL2.0 @ https://www.kaggle.com/c/youtube8m/leaderboard
[**] Team Name: AiDA @ https://www.kaggle.com/c/data-science-bowl-2017/leaderboard
[††] http://idm.pku.edu.cn