Rui Zhao

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Education Experience

Peking University *2020.09 – Present*
Ph.D. Candidate, Computer Science, School of Computer Science
- Institute for Video Technology, Supervisor: Ruiqin Xiong
- Research Topics: Optical flow estimation and image reconstruction for neuromorphic cameras

Tianjin University *2016.09 – 2020.07*
Bachelor of Engineering, Communication Engineering, Qiushi Honor College
- GPA: 94.5/100, 3.94/4.00; Rank: 1/125

Nankai University *2017.09 – 2020.07*
Bachelor of Economics, Finance, School of Finance

Publications

First-Authored (Including Jointly First-Authored) Papers:

[1] Boosting Spike Camera Image Reconstruction from a Perspective of Dealing with Spike Fluctuations
Rui Zhao, Ruiqin Xiong, Jing Zhao, Jian Zhang, Xiaopeng Fan, Zhaofei Yu, Tiejun Huang
IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**) 2024 (**CCF-A**)
Intro: Analyzing statistics of spikes' quantitative effects from a perspective of spike fluctuations, proposing robust spike representation and alignment strategy in spike-based image reconstruction.

[2] Optical Flow for Spike Camera with Hierarchical Spatial-Temporal Spike Fusion
Rui Zhao, Ruiqin Xiong, Jian Zhang, Xinfeng Zhang, Zhaofei Yu, Tiejun Huang
AAAI Conference on Artificial Intelligence (**AAAI**) 2024 (**CCF-A**)
Intro: Proposing a hierarchical spatial-temporal fusion representation for spikes, improving the accuracy of the description for correlation volume in spike-based optical flow estimation.

[3] Learning Optical Flow From Continuous Spike Streams
Rui Zhao, Ruiqin Xiong, Jing Zhao, Zhaofei Yu, Xiaopeng Fan, Tiejun Huang
Annual Conference on Neural Information Processing Systems (**NeurIPS**) 2022 (**CCF-A**)
Intro: Constructing relationships between the continuousness of the recording for scenes of spike cameras and the continuousness of motion, improving the accuracy of motion estimation based on temporal context.

[4] Optical Flow Estimation for Spiking Camera
Liwen Hu#, **Rui Zhao**#, Ziluo Ding, Lei Ma, Boxin Shi, Ruiqin Xiong, Tiejun Huang (# Jointly First Author)
IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**) 2022 (**CCF-A**)
Intro: Proposing the first simulator and dataset for spike-based optical flow, and proposing a optical flow neural network for spike camera based on motion-guided prior.

[5] Spike Camera Image Reconstruction Using Deep Spiking Neural Networks
Rui Zhao, Ruiqin Xiong, Jian Zhang, Zhaofei Yu, Shuyuan Zhu, Lei Ma, Tiejun Huang
IEEE Transactions on Circuits and Systems for Video Technology (**TCSVT**) 2024 (**CCF-B**, **SCI Q1**, **IF=8.4**)
Intro: Processing continuous spikes output from spike cameras using temporally continuous spiking neural networks, realizing continuous scene reconstruction.

[6] MRDFlow: Unsupervised Optical Flow Estimation Network With Multi-Scale Recurrent Decoder
Rui Zhao, Ruiqin Xiong, Ziluo Ding, Xiaopeng Fan, Jian Zhang, Tiejun Huang
IEEE Transactions on Circuits and Systems for Video Technology (**TCSVT**) 2022 (**CCF-B**, **SCI Q1**, **IF=8.4**)
Intro: Introducing dual motion injection, multi-scale processing, and loss function that preserves high-resolution information in the upsampling of flow into the recurrent decoding of unsupervised optical flow estimation.

[7] Optical Flow Estimation Between Images of Different Resolutions via Variational Method
Rui Zhao, Ruiqin Xiong, Shuyuan Zhu, Bing Zeng, Tiejun Huang, and Wen Gao
IEEE International Conference on Visual Communications and Image Processing (**VCIP**) 2020

Intro: Proposing an energy function for optical flow estimation between images of different resolutions and iteratively solving the flow based on the Eular-Lagrange Equation.

Co-Authored Papers:

- Spatio-Temporal Recurrent Networks for Event-Based Optical Flow Estimation
  Ziluo Ding, **Rui Zhao**, Jiyuan Zhang, Tianxiao Gao, Ruiqin Xiong, Zhaofei Yu, Tiejun Huang
  AAAI Conference on Artificial Intelligence (**AAAI**) 2022 (**CCF-A**)
  Intro: Proposing a dual feature encoding based on recurrent network and correlation volume in event-based optical flow estimation.
- Unsupervised Optical Flow Estimation with Dynamic Timing Representation for Spike Camera
  Lujie Xia, Ziluo Ding, **Rui Zhao**, Jiyuan Zhang, Lei Ma, Zhaofei Yu, Tiejun Huang, Ruiqin Xiong
  Annual Conference on Neural Information Processing Systems (**NeurIPS**) 2023 (**CCF-A**)
  Intro: Proposing a spike representation based on temporal dilated convolution, and proposing an illumination consistency loss function for spikes.
- Learning to Super-Resolve Dynamic Scenes for Neuromorphic Spike Camera
  Jing Zhao, Ruiqin Xiong, Jian Zhang, **Rui Zhao**, Hangfan Liu, Tiejun Huang
  AAAI Conference on Artificial Intelligence (**AAAI**) 2023 (**CCF-A**)
  Intro: Proposing a spike representation based on adaptive convolutional kernels and a feature fusion strategy based on bi-directional recurrent networks for spike-based super-resolution.
- Optimization-Inspired Deep Network for Image Restoration from Partial Random Samples
  Yanchen Dong, **Rui Zhao**, Ruiqin Xiong, Shuyuan Zhu, Xiaopeng Fan, Tiejun Huang
  IEEE International Symposium on Circuits and Systems (**ISCAS**) 2023 (**CCF-C**)
  Intro: Proposing a deep unfolding neural network based on the unfolding energy-minimization equations for restoring images from partial random sampling.
- Recover the Residual of Residual: Recurrent Residual Refinement Network for Image Super-Resolution
  Tianxiao Gao, Ruiqin Xiong, **Rui Zhao**, Jian Zhang, Shuyuan Zhu, Tiejun Huang.
  IEEE International Conference on Image Processing (ICIP) 2021 (**CCF-C**)
  Intro: Recurrently refining the residual of the residual for image super-resolution neural networks.
- Motion Estimation for Spike Camera Data Sequence via Spike Interval Analysis
  Jing Zhao, Ruiqin Xiong, **Rui Zhao**, Jin Wang, Siwei Ma, Tiejun Huang.
  IEEE International Conference on Visual Communications and Image Processing (**VCIP**) 2020
  Intro: Construct photometric consistency loss for analyzing motion for spike data based on spike intervals, and estimate the motion field of the scene.

Project

- **SpikeCV: An Open-Source Framework for Spike Vision** (Number of Downloads on OpenI: 12k+)
  Main Members: Yajing Zheng(Postdoc), Jiyuan Zhang, **Rui Zhao**, Shiyan Chen, Jianhao Ding, Weijian Wu, et. al.
  My Responsibility: Algorithms and tools (such as assessment and visualization) for optical flow and image reconstruction parts.
  OpenI Community Excellent Incubation Project Award. OpenI Community Excellent Developer Award.

Awards

- President Scholarship for Ph.D. Student of Peking University(2%) 2020, 2021, 2022
- Industrial Bank Scholarship 2023
- UbiQuant Scholarship 2022
- Outstanding Student Model Honorable Mention Scholarship of Tianjin University (0.05%) 2019
- National Scholarship for Bachelor Student of Tianjin University(2%) 2018, 2019

Academic Services

- **Serving as Journal Reviewer:**
  IEEE Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**) (**CCF-A, SCI Q1**)
  IEEE Transactions on Image Processing (**TIP**) (**CCF-A, SCI Q1**)

IEEE Transactions on Circuits and Systems for Video Technology (**TCSVT**) (**CCF-B, SCI Q1**)
IEEE Transactions on Multimedia (**TMM**) (**CCF-B, SCI Q1**)
IEEE Transactions on Intelligent Vehicles (**TIV**) (**SCI Q1**)

- **Serving as Conference Reviewer:**
  IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**) 2022 – 2024 (**CCF-A**)
  IEEE/CVF International Conference on Computer Vision (**ICCV**) 2023 (**CCF-A**)
  Annual Conference on Neural Information Processing Systems(**NeurIPS**) 2024 (**CCF-A**)
  European Conference on Computer Vision (**ECCV**) 2022, 2024 (**CCF-B**)
  AAAI Conference on Artificial Intelligence (**AAAI**) 2023 – 2024 (**CCF-A**)
  IEEE International Conference on Robotics and Automation (**ICRA**) 2024 (**CCF-B**)
  Asian Conference on Computer VIsion (**ACCV**) 2024 (**CCF-C**)
  IEEE International Conference on Image Processing (**ICIP**) 2022 – 2024 (**CCF-C**)

Skills

- Language: Chinese(Native), English(CET-6: 569)
- Programming Language and Tools: Python, Matlab, C++, C; Pytorch, Numpy, OpenCV
- Layout and Office: LaTeX, Microsoft Office