# 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.

### Papers in Submission:

- Super-Resolved Imaging for Spike Camera with Information Selection Strategies
  **Rui Zhao**, Ruiqin Xiong, Lin Zhu, Jian Zhang, Xiaopeng Fan, and Tiejun Huang
  **Submitted to** International Journal of Computer Vision (**IJCV**) (**CCF-A**)
  Intro: Proposes a series of information selection strategies to transfer the high temporal resolution of spikes to spatial resolution.
- SpikeCV: Open a Continuous Computer Vision Era
  Yajing Zheng, Jiyuan Zhang, **Rui Zhao**, Jianhao Ding, Shiyan Chen, Weijian Wu, Ruiqin Xiong, Zhaofei Yu, and Tiejun Huang
  **Submitted to** Science China Information Sciences (**SCIS**) (**CCF-A**)
  Intro: Construct an open-source framework SpikeCV for visual tasks related to spike camera.
- High Dynamic Range Imaging Based on Multi-Level Spike Camera
  Zhenkun Zhu, Ruiqin Xiong, Jing Zhao, **Rui Zhao**, Xiaopeng Fan, Shuyuan Zhu, and Tiejun Huang
  **Submitted to** IEEE Transactions on Circuits and Systems for Video Technology (**TCSVT**) (**CCF-B**)
  Intro: Propose a prototype of spike camera with multi-level firing thresholds for high dynamic range imaging.

## 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%) 2022
- President Scholarship for Ph.D. Student of Peking University(2%) 2021
- President Scholarship for Ph.D. Student of Peking University(2%) 2020
- Leo KoGuan Scholarship 2023
- 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**)
  International Conference on Learning Representations(**ICLR**) 2024 (Top)
  European Conference on Computer Vision (**ECCV**) 2022, 2024 (**CCF-B**)
  AAAI Conference on Artificial Intelligence (**AAAI**) 2023 – 2025 (**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