JUNHAO WANG (HARRY)

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RESEARCH INTERESTS

Computational imaging, single-photon sensing (SPAD), inverse problems, generative modeling, 3D/4D reconstruction, differentiable rendering, safe/robust vision.

EDUCATION

University of Toronto (UofT) — Toronto, ON, CA
Bachelor of Applied Science in Engineering Science (Machine Intelligence Major, Business Certificate) — 09/2021 – 05/2026
CGPA: **3.91/4.00** — Elected Class Representative (2023-2024)
Relevant Courses: Machine Learning, Neural Networks, Reinforcement Learning, Statistics, Probabilistic Reasoning, Signals

PUBLICATIONS

* denotes equal contribution

- **FeatureEndo-4DGS: Real-Time Deformable Surgical Scene Reconstruction and Segmentation with 4D Gaussian Splatting** (2025) [paper]
  Kai Li*, **Junhao Wang***, William Han, Ding Zhao. *AHLI Machine Learning for Health (ML4H) Symposium Proceedings 2025.*
- **23,000-Exposures/s 360fps-Readout Software-Defined Image Sensor with Motion-Adaptive Spatially Varying Imaging Speed** (2024) [paper]
  Roberto Rangel, Xiaonong Sun, Ayandev Barman, Rahul Gulve, Savo Bajic, Jingmin Wang, **Harry Wang**,
  David B. Lindell, Kiriakos N. Kutulakos, Roman Genov. *IEEE Symposium on VLSI Technology and Circuits 2024.*
- **Comparing Defensive Pressures Using Possession Retention Probability and Expected Goals** (2023) [paper]
  David Awosoga*, Justin Cui*, Aujin Li*, Jaden Majumdar*, **Junhao Wang***. *Linköping Hockey Analytics Conference (LINHAC) Proceedings 2023.*

RESEARCH EXPERIENCE

Toronto Computational Imaging Group — 08/2025 – Present
Computer Vision Research Intern — *Toronto, ON, CA*

- Thesis on generating color images/videos/bursts from binary quanta frames using single-photon imaging at **100,000 fps**.
- Utilize real data captures from single photon avalanche diode.
- Examine distribution of generations and performance of system in low-light conditions where conventional CMOS cameras fail.
- Calibrate SPAD dataset to implement a non-parametric single photon simulation pipeline from standard RGB datasets.
- Perform downstream tasks, such as segmentation and detection, solely from on one-bit images based generations.

Safe AI Lab, Carnegie Mellon University — 08/2024 – Present
Computer Vision Research Intern — *Pittsburgh, PA, US*

- Co-first author of *FeatureEndo-4DGS: Real-Time Deformable Surgical Scene Reconstruction and Segmentation with 4D Gaussian Splatting* (**ML4H Symposium 2025, PMLR**)
- Innovate **first real-time** 4D Gaussian Splatting pipeline that **jointly reconstructs & segments** deformable surgical scenes via **feature distillation** from 2D foundation models.
- Leveraged **foundation models** for semantic scene understanding.
- Outperformed SOTA (LGS, EndoGaussian, EndoNeRF) on **PSNR, SSIM, LPIPS, RMSE**.
- Achieved competitive segmentation vs. **SAM/SAM2/MedSAM** with higher Dice and IoU.
- Ablations show a lightweight semantic feature decoder boosts segmentation scores by up to **10%**.
- Worked with **CUDA & C++** to adapt a parallelized rasterizers for training and rendering of images and feature maps.
- Explored **autoregressive large models** with diffusion-loss prediction of Gaussians and camera properties for rigid objects.

Intelligent Sensory Microsystems Laboratory (ISML) — 04/2023 – 09/2023
Computer Vision Research Intern — *Toronto, ON, CA*

- Automated fundamental matrix calculation for pixel-coded epipolar imaging with **OpenCV** (>**600%** speed-up).
- Adapted RAFT-inspired deep learning for optical flow using **flux** over intensity-based methods.
- Devised frame-differencing for colour-coded flow maps and motion estimation.
- Generated banded mask patterns to filter indirectly/directly lit light.
- Implemented **Huffman**, **RLE**, and **Wavelet** transforms for optimized lossless compression.

Solar Energy Research Institute of Singapore (SERIS, NUS) — 05/2022 – 08/2022
ML Research Intern — *Singapore*

- Trained **CNNs** for parametric estimation of Perovskite Solar Cells (PSCs).
- Achieved high-precision thickness estimation (**<2 nm**) for specific layers using **Bayesian Optimization**.
- Used transfer matrix methods, diverse sampling, and optical simulations for dataset generation.
- Authored a report/literature review comparing traditional approaches vs. my optimized deep learning pipelines.

RESEARCH REPORT

- **Geometric Parameter Estimations of Perovskite Solar Cells Based on Optical Simulations** (2022) [paper]
  Junhao Wang. *arXiv preprint.*

SCHOLARSHIPS & AWARDS

- **Select Equity Data Science Award in Engineering Science** ($16,000)   Aug 2023
  Issued by University of Toronto; funded by Select Equity Group L.P.
- **Ian and Shirley Rowe Innovation & Global Impact Award** ($10,000 team)   Aug 2023
  Awarded for Praxis III project demonstrating collaboration and sustainable impact.
- **NSERC Undergraduate Student Research Awards**   Apr 2023
  National award supporting outstanding undergraduates in research.
- **Engineering Science Research Opportunities Program (ESROP) Global**   Feb 2023
  Awarded a selective fellowship to conduct TEM research at the Max Planck Institute (Hamburg, Germany)
  (Opted for another opportunity).
- **Barbara Zdasiuk Scholarship**   Aug 2022
  Issued by University of Toronto for academic standing.
- **Governor General's Academic Medal**   Jun 2022
  Highest academic standing in secondary institution (Canada).
- **Engineering Science Research Opportunities Program (ESROP) Global**   Feb 2022
  Fellowship to conduct PSC research at National University of Singapore.
- **René Descartes Scholarship (National Mathematics Scholarship)** ($20,000)   Apr 2021
  University of Waterloo CS Program; one of ten national recipients (declined).
- **Dean's List Scholar (x6)**   Sep 2021 – May 2024
  University of Toronto.
- **Engineering Science Entrance Scholarship**   Apr 2021
  University of Toronto.
- **National AP Scholar**   May 2019, May 2020
  College Board.
- **Canadian Seniors Mathematics Competition Honour Roll & Provincial Team Champions**   Nov 2019
  Ranked 99th percentile individually; team won provincial champions.

PROFESSIONAL EXPERIENCE

Cerebras Systems   05/2024 – 06/2025
ML Compiler Engineer Intern   *Toronto, ON, CA*
- Migrated legacy assembler to an **LLVM**-based backend, enabling modular compilation and eliminating scalability bottlenecks.
- Utilized **TableGen** and **LIT**, adding support for next-gen architectures on Wafer-Scale Engines.
- Implemented instructions, features, and templates for new architectures, passing **100%** kernel unit tests.
- Revamped debugging framework, improving diagnostics and team efficiency; eliminated recurring crashes.
- Disabled legacy fallback; shifted to auto-generated infrastructures; reduced runtime issues by >**20%**.

EXTRACURRICULAR EXPERIENCE

University of Toronto Sports Analytics Student Group   01/2023 – 06/2023
Sport Analyst (Hockey)   *Toronto, ON, CA*
- Co-authored paper *Comparing Defensive Pressures Using Possession Retention Probability and Expected Goals* (LINHAC 2023).
- Finalist: **Top 5/50+** international teams; invited to present at Linköping University, Sweden; paper published in Proceedings.
- Analyzed Sportlogiq SHL dataset; built visualizations with **matplotlib** and **seaborn**.
- Contributed to **XGBoost** modeling connecting offense generation to body/stick checks via Δ expected goals.
- Produced key figures and diagrams for the paper.

University of Toronto Machine Intelligence Student Team (UTMIST)   09/2023 – Present
Research Director & Academic Director & Project Developer   *Toronto, ON, CA*
- Launched and led undergraduate research initiatives; supervised aspiring researchers through project scoping and implementation.
- Built and ran a targeted recruiting pipeline for high-potential researchers and team leads.
- Matched students with labs/faculty advisors and turned open questions into well-scoped, high-impact ML projects.
- Oversaw academic and research directives; curated **SOTA** paper readings, mentorship sessions and resume review a joint IEEE UofT $\times$ CSSU $\times$ UTMIST clinic.
- Held office hours to guide undergrads in ML coursework and research.
- Built sequence modeling and **DRL** pipeline for trading via buy/sell signal classification based on risk-to-reward, not naive price prediction. Planned broker integration.
- Conibuted to MVP of FashionBot, AI powered recommendation systems for personalized outfit suggestions.

SKILLS

Programming & Tools	C/C++, LLVM, Python, CUDA, Scikit-learn, pandas, OpenCV, PIL, NumPy, PyTorch, MATLAB
Systems & HW	SystemVerilog, RISC-V, FPGA
Optimization	Linear / Quadratic Programming

LANGUAGES

English	Native/Bilingual Proficiency
Mandarin	Native/Bilingual Proficiency
French	Elementary Proficiency

REFERENCES

Available upon request.