

Beyond Pixels, Toward Understanding

Data→Patterns→Focus→Self-Learning→Trust→Temporal Insight→Creativity

Lei Wang¹

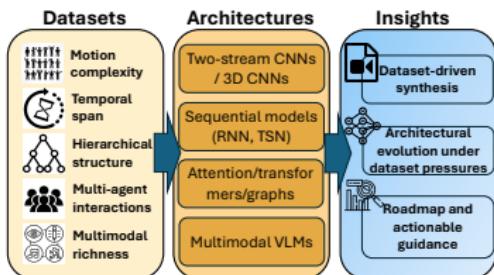
Griffith University

14 October 2025



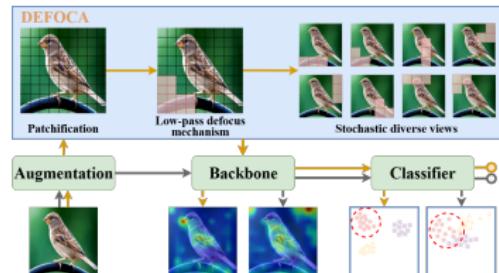
¹Lei Wang is an ARC Research Hub Research Fellow (Grade 2), trained under Professor Yongsheng Gao (2025 ARC Industry Laureate Fellow) on leading-edge research projects since 17 February 2025. **All works presented here were conducted during this period.**

From Data to Design: How Structure Shapes Intelligence

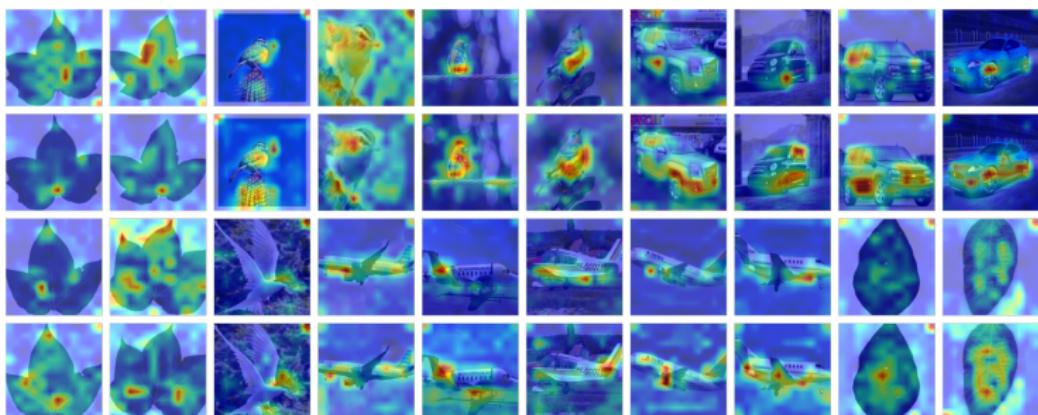


- **Data has structure:** motion, hierarchy, modality, etc.
- **Data shapes design:** models adapt to structure
- **Unified view:** data \leftrightarrow bias \leftrightarrow architecture
- **Goal:** robust, generalizable video AI

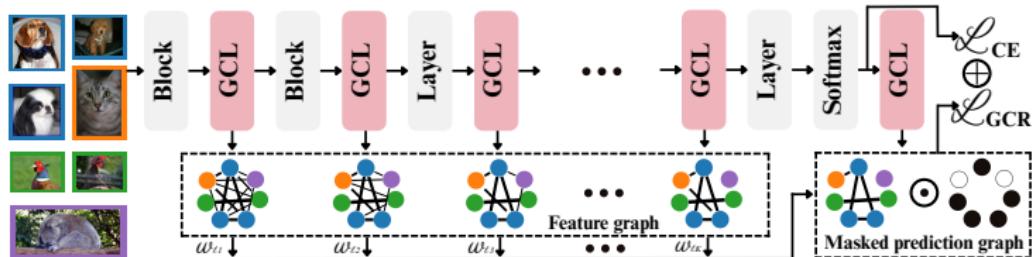
Defoca: Letting Data Guide Attention



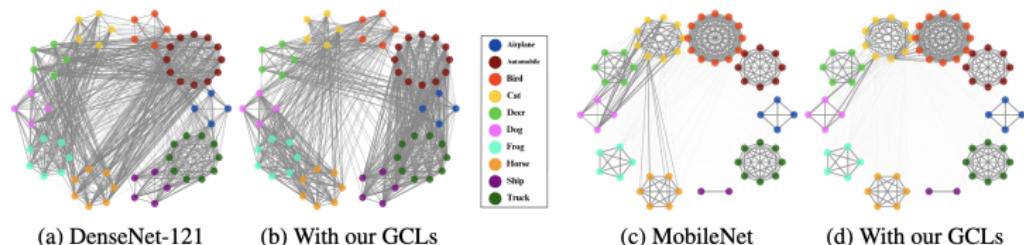
- **Challenge:** Tiny details define the class
- **Idea:** Blur random patches → focus on real cues, data-level attention
- **Result:** Robust, generalizable recognition, no extra parameters



Learning from Behavior: Self-Prompting Networks

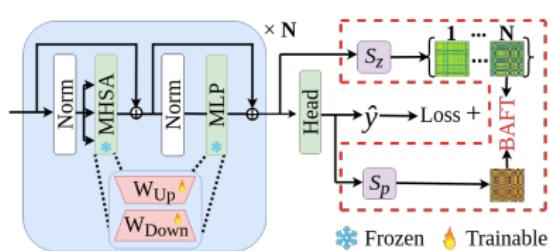
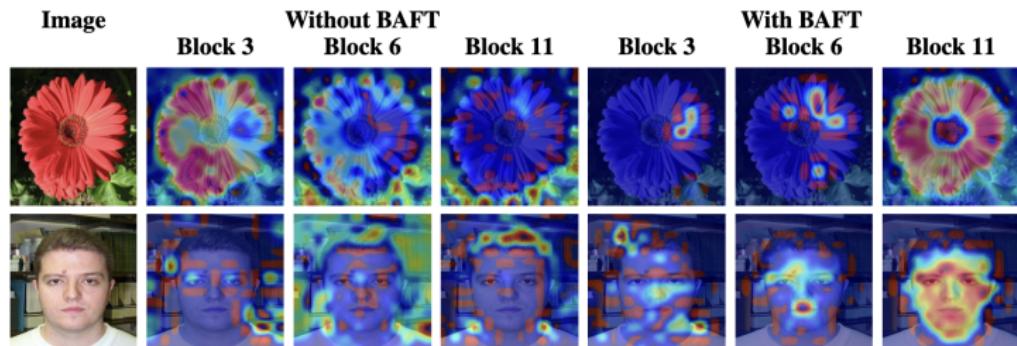


- **Challenge:** Features can be noisy or inconsistent
- **Idea:** Align prediction & feature graphs → self-prompts
- **Impact:** Cleaner, semantically consistent representations



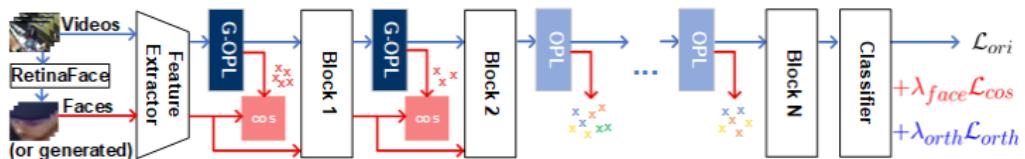
[1] Xi Ding*, Lei Wang*, Piotr Koniusz, Yongsheng Gao. "Graph Your Own Prompt." *Advances in Neural Information Processing Systems (NeurIPS)*. 2025.

Behavior-Guided Fine-Tuning: Efficient Adaptive Learning

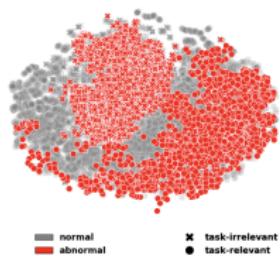


- **Problem:** Fine-tuning can be passive, misaligned with task
- **Idea:** Align prediction structure with internal features → behavior-guided tuning
- **Benefit:** Better interpretability, task-aware adaptation without adding parameters

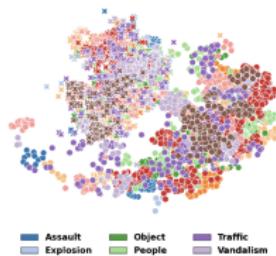
Ethical Intelligence: Privacy-Aware Vision Systems



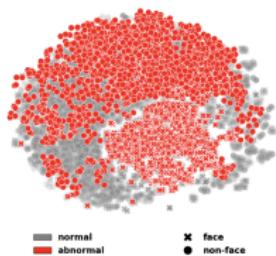
- **Goal:** Ethical, privacy-aware video anomaly detection
- **Idea:** Remove facial identity while keeping action cues → Guided OPL
- **Impact:** Protects privacy and improves robustness & interpretability



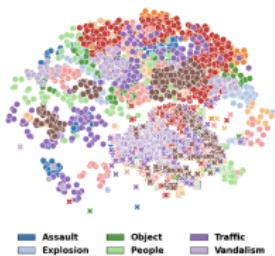
(a) OPL.



(b) OPL (anomaly type)



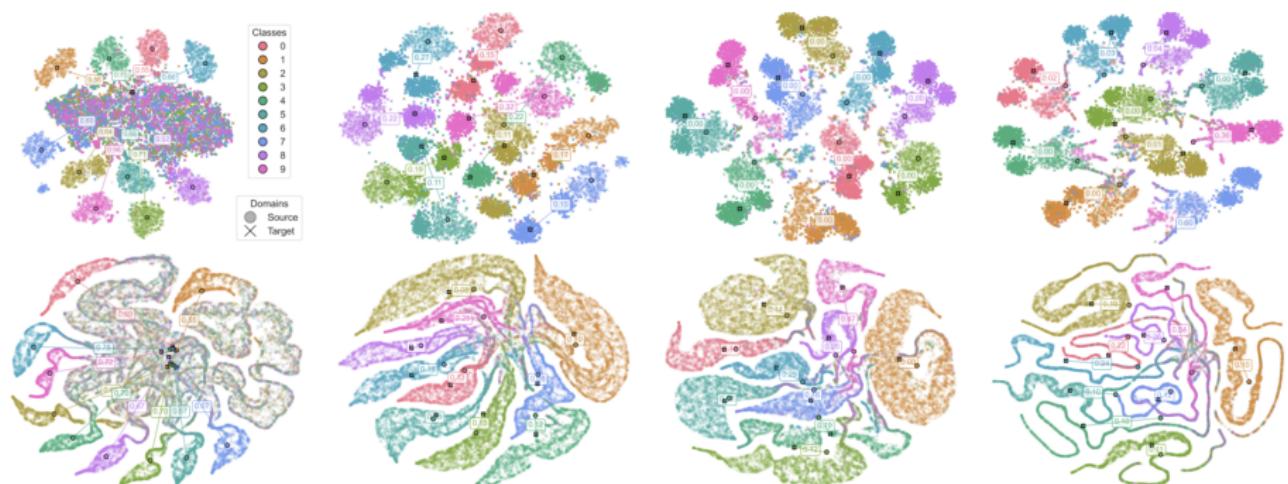
(c) G-OPL



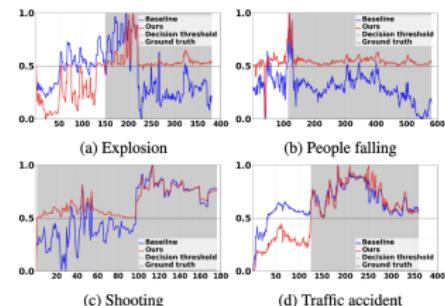
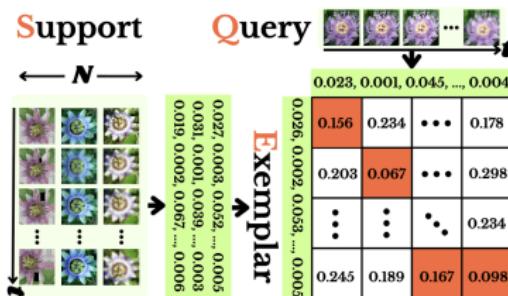
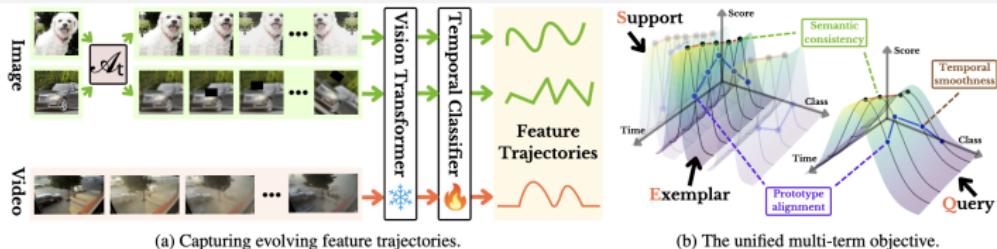
(d) G-OPL (anomaly type)

Trust-Aware Adaptation: Learning What to Rely On

- **Problem:** Real-world data shifts (lighting, seasons, sensors)
- **Idea:** Weight samples by trust (uncertainty + feature alignment)
- **Impact:** Focus on reliable data → stable, accurate adaptation



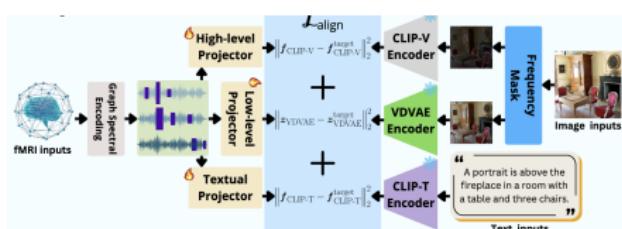
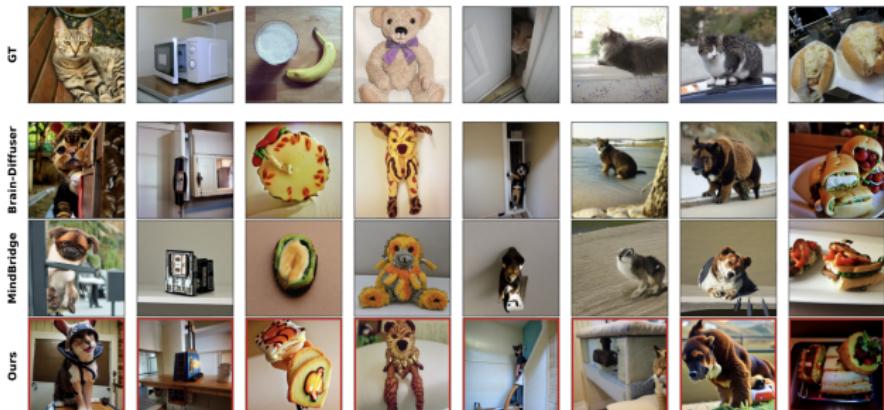
Learning Time: Temporal Reasoning in Static Classifiers



- **Problem:** Classifiers see frames independently, but real-world data evolves
- **Idea:** Structure data as sequences → learn gradual changes with soft-DTW
- **Impact:** Captures temporal patterns → without extra parameters

[2] Xi Ding*, Lei Wang*, Piotr Koniusz, Yongsheng Gao. "Learning Time in Static Classifiers." Submitted to AAAI Conference on Artificial Intelligence (AAAI), 2026.

Beyond Perception: Creative Brain-to-Vision Reconst.



- **Problem:** fMRI reconstruction focuses on pixels, not meaning
- **Idea:** Align brain signals with frequency & semantic structure
- **Impact:** Captures perception & imagination → AI that creates

Foundations for Adaptive and Ethical AI



ARC
Research Hub
Driving farming productivity
and disease prevention



Australian Government
Australian Research Council



HOSTED AT
**GRIFFITH
UNIVERSITY**

- **Core message:** AI intelligence starts with structure: in data, learning, behavior, imagination
- **Impact:** Foundations for adaptive, ethical, creative AI
- **Agriculture:** Systems that see beyond noise, adapt, and operate responsibly
- **Vision:** Bridge fundamental research with real-world impact

Thank you!