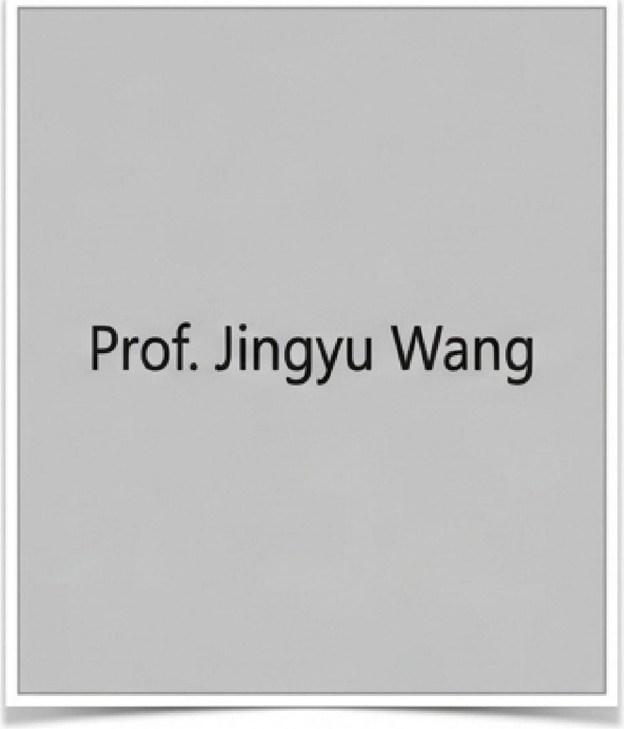
From Internet of Everything to Intent Cognitive Synergy (ICS): A Technical Overview

Research Achievements of Professor Jingyu Wang's Team
Beijing University of Posts and Telecommunications (BUPT)



Changjiang Scholar

CIC Fellow

IEEE Senior Member

Professor, School of Computer Science (BUPT)

Research Philosophy: Industrial-Grade System View

Prioritizing end-to-end system innovation over isolated algorithm optimization. Closing the loop between Theory (Algorithms) and Practice (Deployment).

300+ High-Level Papers

NSDI, SIGCOMM, CVPR, USENIX ATC

Awards

National Tech Progress Award (2nd Class), AAAI Distinguished Paper

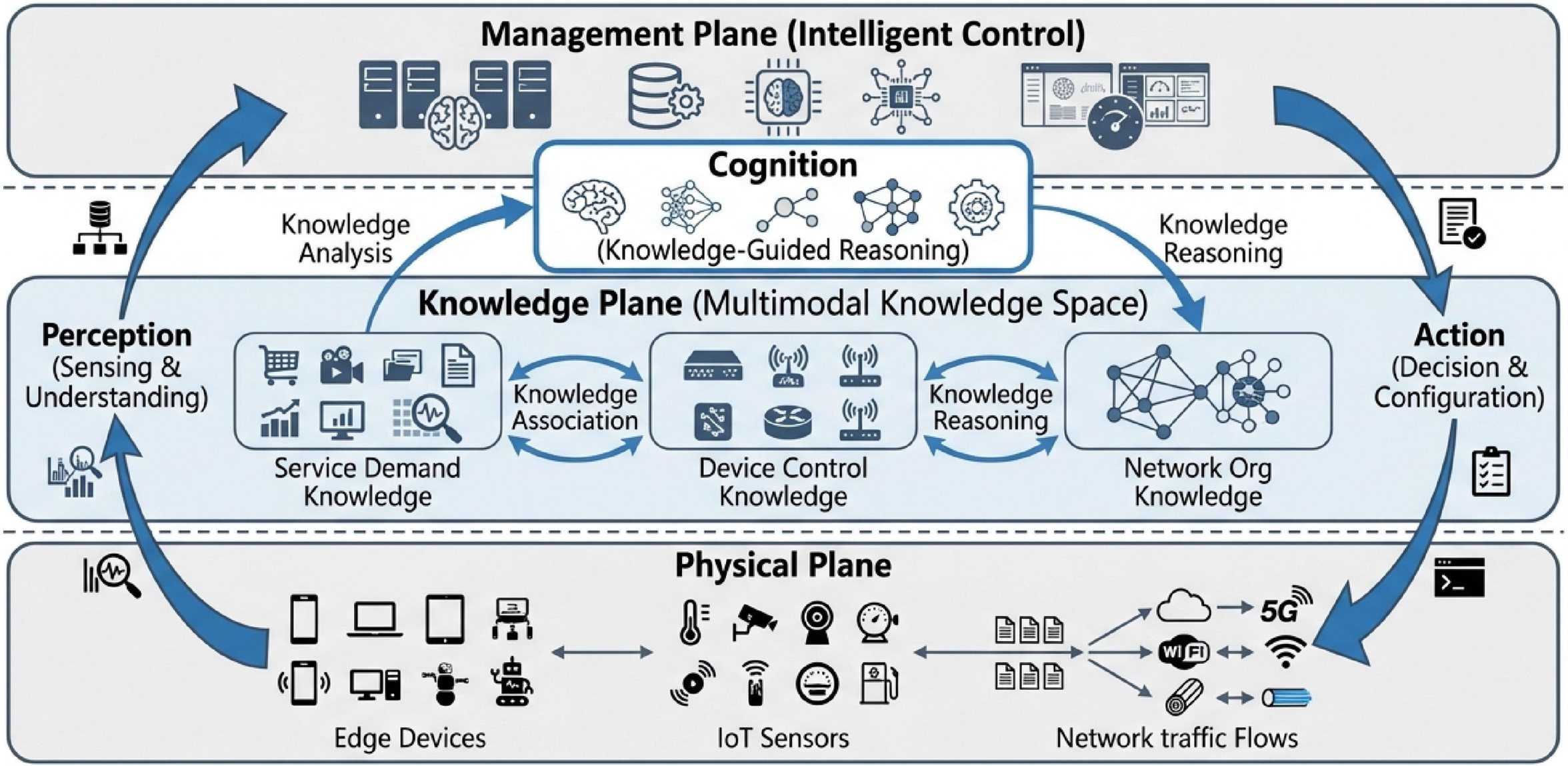
Patents

50+ Authorized Invention Patents

Deployment

Systems operational in 15+ provincial units including China Mobile & State Grid

Theoretical Framework: The Intent Cognitive Synergy (ICS) Loop



Transitioning from managing connectivity (IoE) to managing intent (ICS).

Network Intelligent Control I:
LLM-Empowered Intent Translation

Papers: Following the Compass (ICNP 2024); Hierarchical Index Retrieval (TMC 2025)

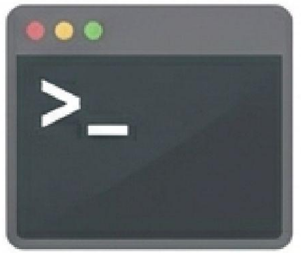
Input: Vague Natural Language

Restrict access for unauthorized users in Zone B.

LLM Translation Module

- Retrieval-Augmented Generation (RAG)
- Hierarchical Index Retrieval

Output: Deterministic Configuration

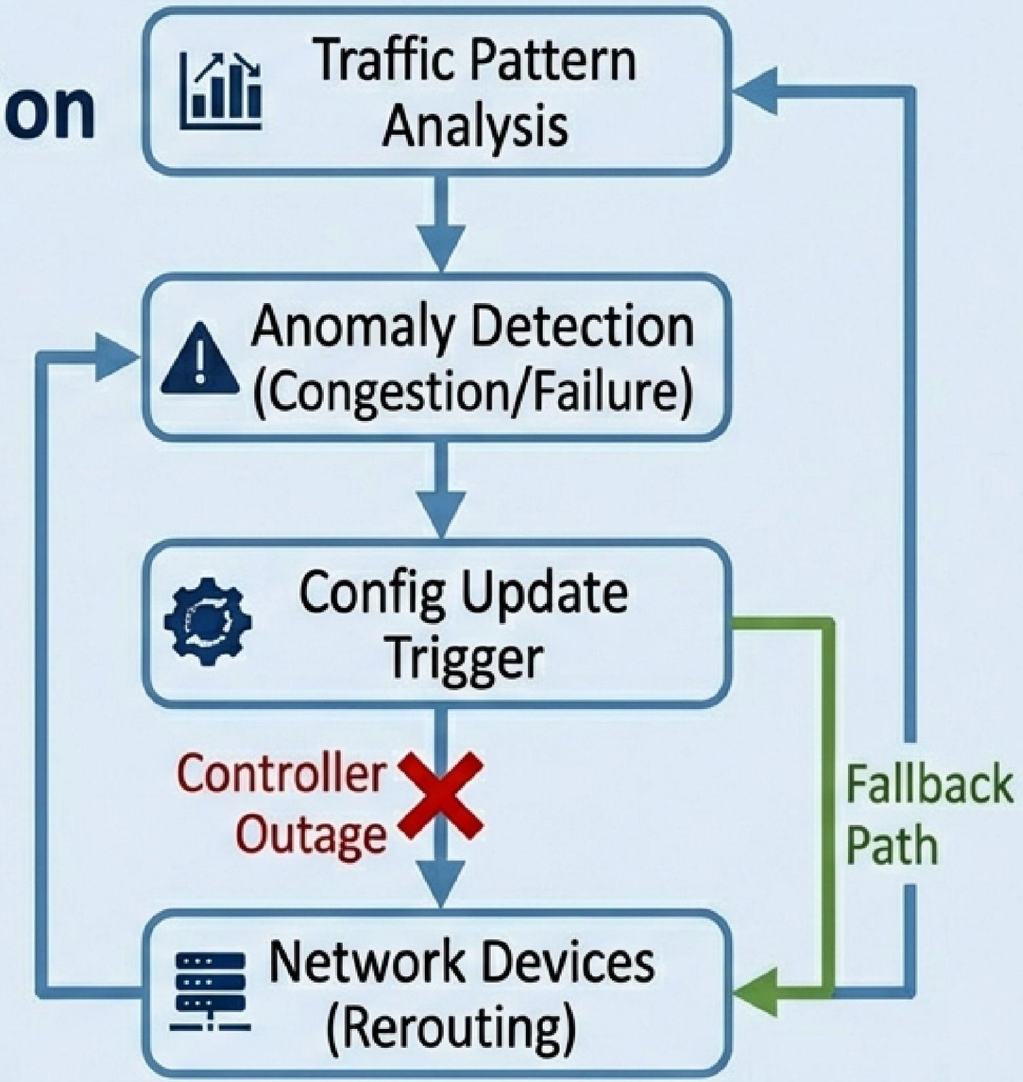


ACL Policy: DENY 192.168.1.0/24 PORT 80

RELEVANCE TO INTENT UNDERSTANDING: Bridges the semantic gap between abstract human administrative requirements and binary network configurations.

Network Intelligent Control II: **Autonomous Resilience & Configuration**

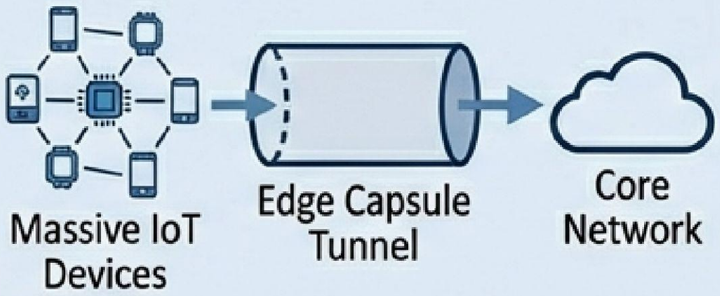
- **Mechanism:** Autonomous configuration updating based on traffic patterns.
- **Logic:** Proactive mitigation of transient congestion and automated fallback.
- **Papers:** NetKeeper (USENIX ATC 2025); Network Copilot (INFOCOM 2025).



RELEVANCE TO INTENT UNDERSTANDING: Intent Assurance—The system understands the 'Intent of Service Continuity' and autonomously reconfigures to maintain SLAs

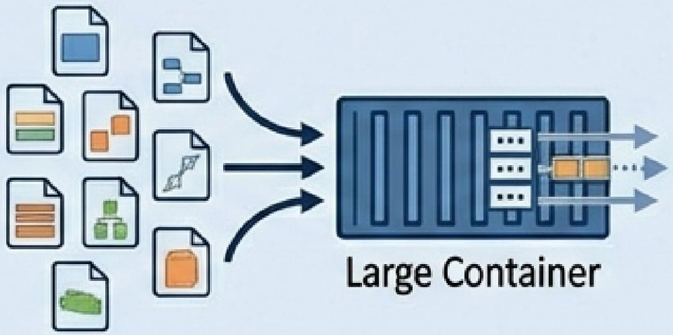
Network Intelligent Control III:
Massive IoT & Edge Orchestration

HyperWay
(IoT Journal)



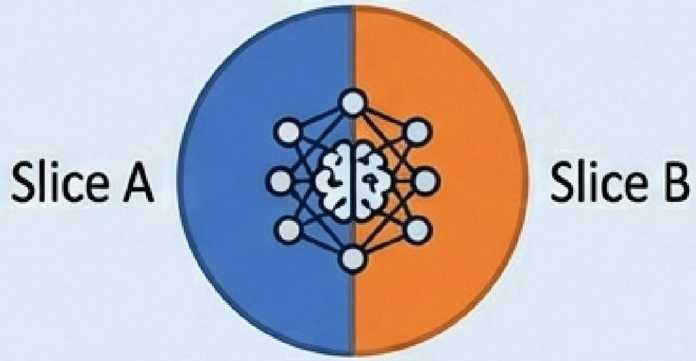
Proactive path adjustments for massive concurrent connections.

ShuttleBus
(TMC 2024)



Dense packet assembling with QUIC stream multiplexing.

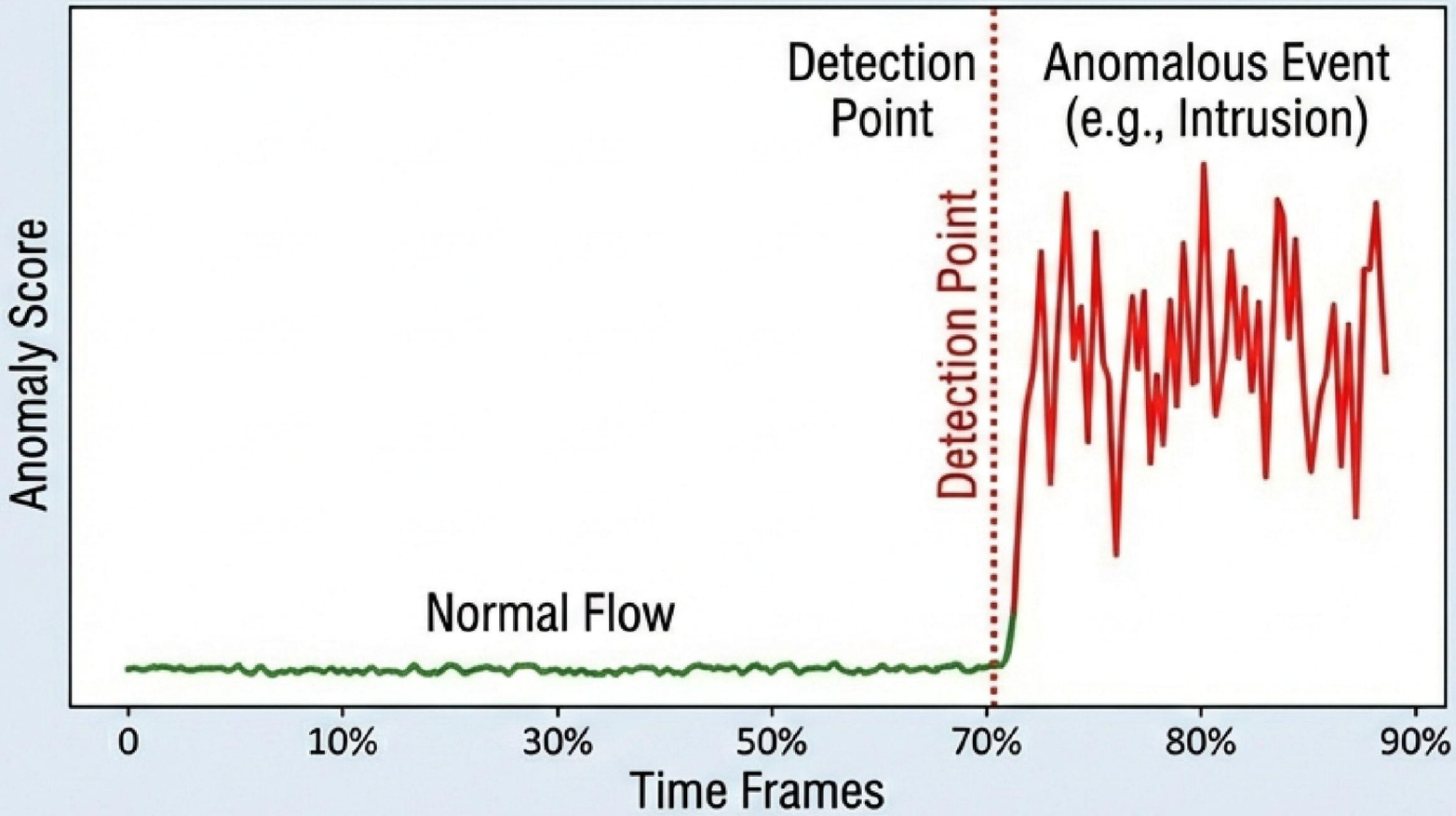
Resource Orchestration
(IEEE ToN)



Cross-Slice Federated Learning for cold-start resource allocation.

RELEVANCE TO INTENT UNDERSTANDING: Intent Scalability—Preserving high-level connectivity intent in resource-constrained edge environments.

Video Anomaly Monitoring I:
Temporal Pattern Recognition

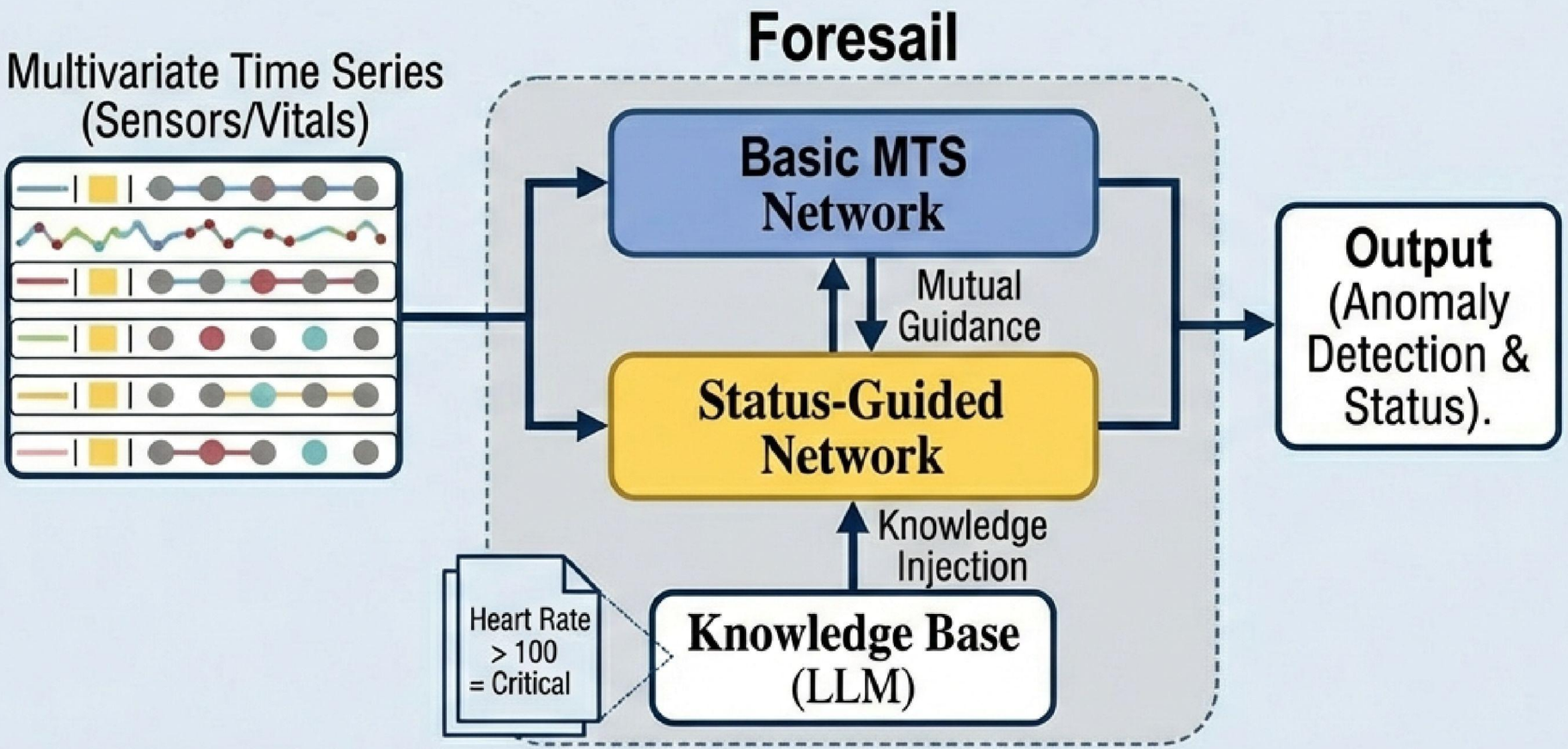


Papers: Video-UTR (IEEE TASLP); Focus the Neglected (CVPR).

Method: Weakly supervised learning using Transformer-based temporal analysis.

RELEVANCE TO INTENT UNDERSTANDING: Intent Perception—The system learns the ‘Intent of Normal Operation’ and flags deviations as security breaches.

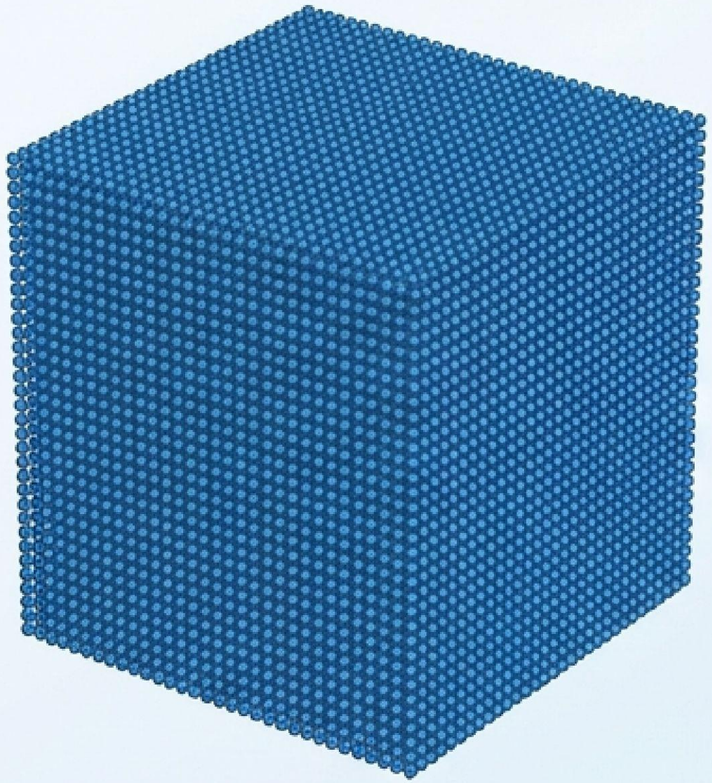
Video Anomaly Monitoring III:
Status-Guided Time-Series Analysis



Papers:
Foresail (ACM MM 2025);
Fine-Grained Relational Modeling

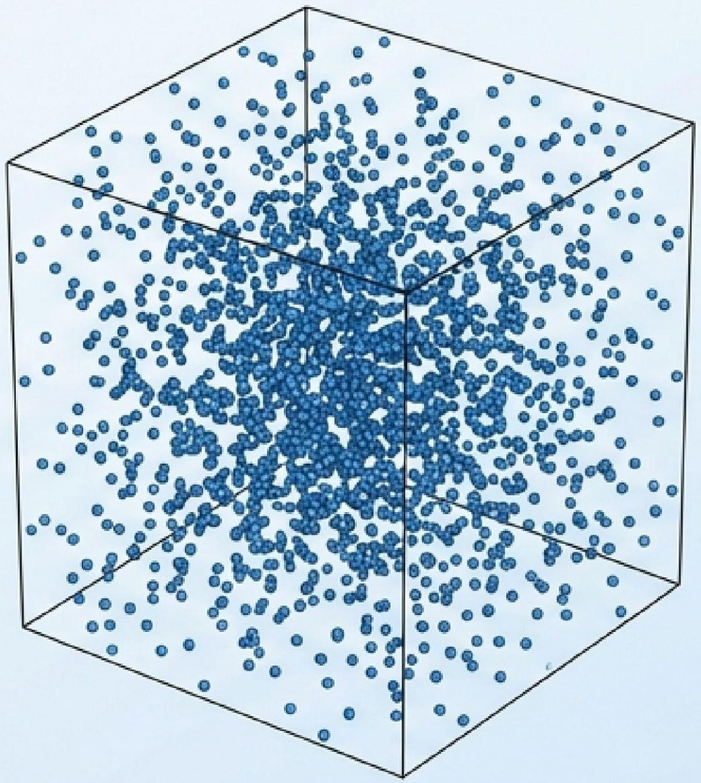
RELEVANCE TO INTENT UNDERSTANDING: Semantic Contextualization—Using LLMs to inject meaning into raw sensor data (Understanding 'System Status' vs 'Just Numbers')

Video Anomaly Monitoring III: Efficient Foundation Models



Standard DNN
(High Latency)

OICSR
Compression

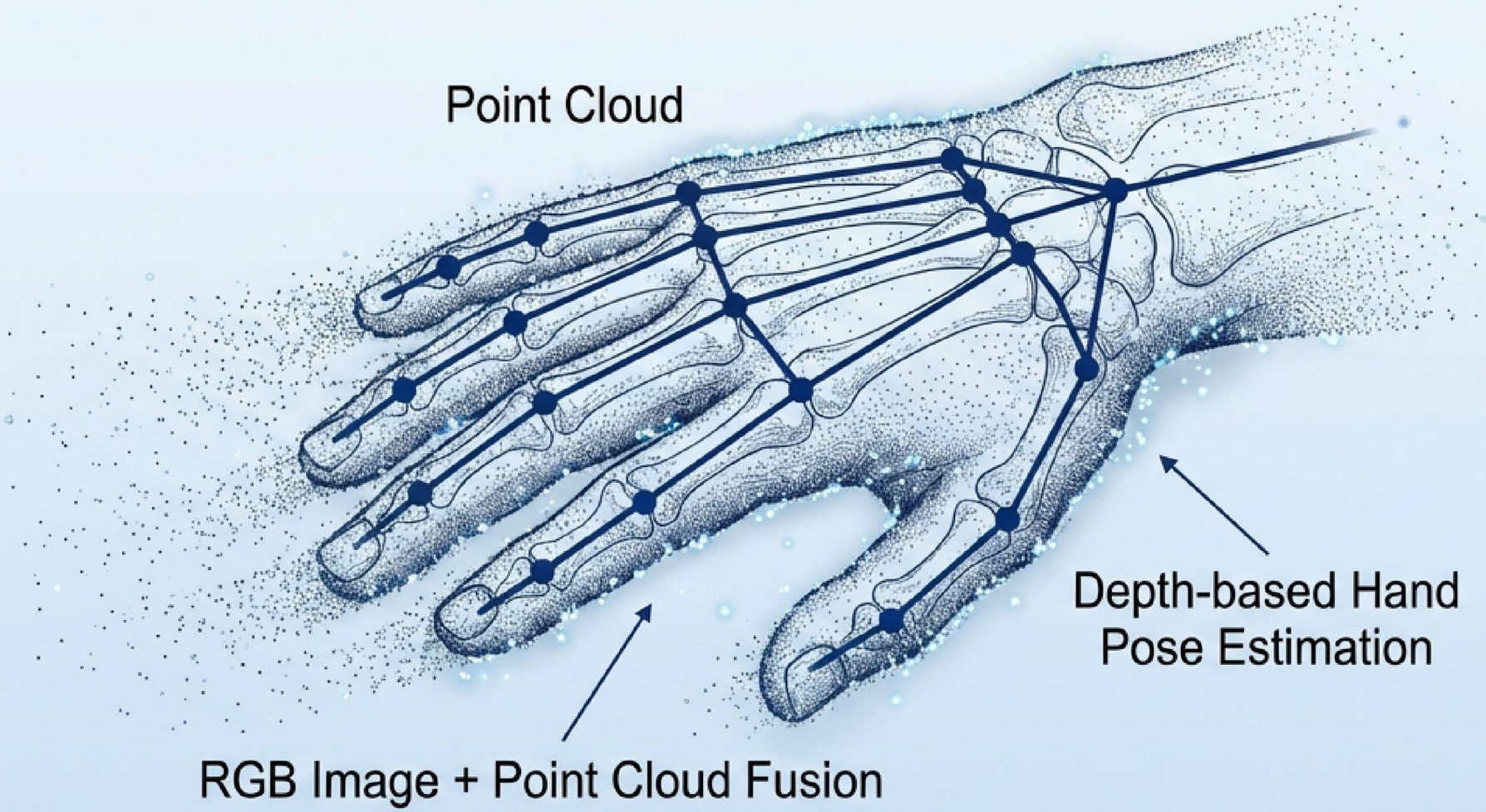


Sparsity Regularized DNN
(Low Latency)

- **Paper**: OICSR (CVPR); ClusterAttn.
- **Technique**: Out-In-Channel Sparsity Regularization.
- **Result**: Deployment of heavy perception models on edge devices.

RELEVANCE TO INTENT UNDERSTANDING: Real-Time Perception—Enabling complex intent understanding directly on edge devices by reducing computational load.

Cross-Reality HCI I: 3D Hand Pose Estimation



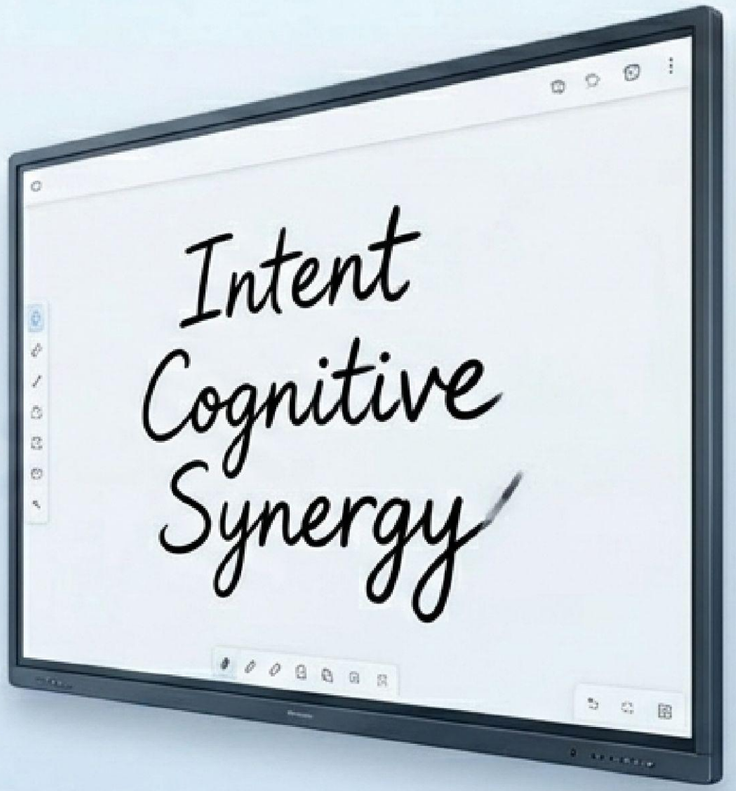
Papers: Two Heads are Better than One (AAAI Distinguished Paper 2023); MegoTrack (ICCV Challenge Champion).

Achievement: Millimeter-level tracking accuracy; Solves occlusion in Egocentric view.

RELEVANCE TO INTENT UNDERSTANDING: Micro-Intent Capture—Translating subtle physical movements into precise digital commands without controllers.

Cross-Reality HCI II: Generative Interaction & Virtual Content

InkFlow:
Habit Transfer



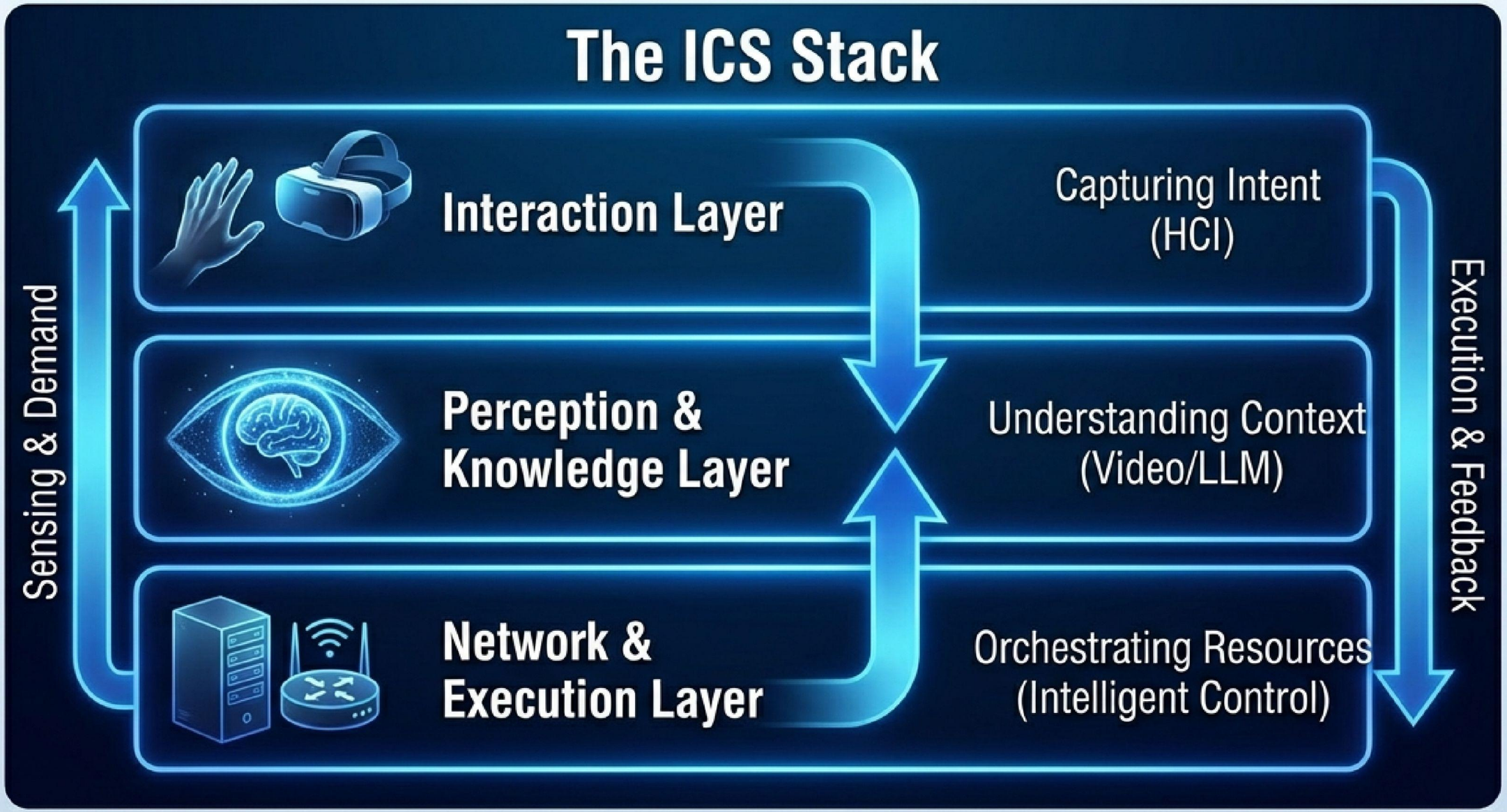
Physical Reality

Virtual Reality

- **Papers:** InkFlow (CSCW 2025); Temporal/Content Co-Awareness Latent Diffusion (CVPR 2026).
- **Core Tech:** Latent Diffusion Models (LDM) for controllable hand image generation.

RELEVANCE TO INTENT UNDERSTANDING: Intent Fidelity—Ensuring the user's communicative intent is perfectly preserved and rendered in the virtual environment

The Integrated Ecosystem: AI4Net & Ubiquitous Computing



Academic Impact & Standardization

Domain	Top-Tier Publications	Key Honors
Systems & Network	NSDI, SIGCOMM, USENIX ATC, EuroSys	IEEE Systems Journal Best Paper (2021)
AI & Computer Vision	CVPR, AAAI, ICCV, ACM MM	AAAI Distinguished Paper (2023)
HCI & Ubiquitous	CHI, CSCW, UbiComp	ICCV Hand Pose Challenge Champion

Standardization & Open Source:

- Contributions to 3GPP, IETF, ETSI (Intent Aware Network Autonomicity).
- Open Source contributions to OPNFV Compass and TVM projects.

Future Outlook: Towards Intent-Native 6G Networks

The transition to 6G requires networks to be cognitive—moving beyond transferring bits to understanding the semantic meaning of data.

Professor Wang's team provides the mathematical and engineering foundation for Intent Cognitive Synergy (ICS).