Theme
Advances in Recognition Systems

IARIA Congress 2025 & DigiTech 2025

PANEL #2

VENICE
2025

Moderator

Prof. Dr. Alexander Lawall, IU International University of Applied Science, Germany

Panelists

Prof. Dr. Przemyslaw Pochec, University of New Brunswick, Canada

Dr. Gábor György Gulyás, Vitarex Stúdió Ltd., Hungary

Prof. Dr. Ping Wang, Robert Morris University, USA

Prof. Dr. Vicente Casares Giner, Universitat Politècnica de València, España

Prof. Dr. Constantine Kotropoulos, Aristotle University of Thessaloniki, Greece

Chair Introduction

VENICE 2025

Alexander Lawall

IU International University of Applied Sciences

Recognition Systems at the Crossroads of Innovation

- **Explosion of Sensing in IoT**: Billions of devices now contribute real-time sensory data.
- **AI-Driven Recognition**: Deep learning architectures (CNNs, Transformers, GNNs) are pushing the boundaries of perception, prediction, and understanding.
- **New Challenges**: Systems must perform robustly in open-world, noisy, and multi-domain environments.

Chair Introduction

VENICE 2025

Current Topics & Unresolved Questions in Recognition Systems

Possible Debate Topic	Guiding Question
Architectures	Are end-to-end deep models the best path, or should we revisit modularity?
Multimodal Learning	Can we build generalist models that learn from vision, audio, haptics, etc., efficiently?
Bias & Fairness	How do we quantify and mitigate systemic bias in recognition datasets and models?
Ethics & Privacy	How do we balance recognition performance with data minimization and consent?
Synthetic Data & Self-Supervision	Can generated data and unlabeled corpora fully replace supervised learning?

Alexander Lawall

IU International University of Applied Sciences

Chair Introduction

VENICE 2025

Alexander Lawall

IU International University of Applied Sciences

From Narrow Perception to Intelligent Understanding

- **Real-Time Recognition in Embedded Systems** (e.g. edge AI in smart vehicles, wearables)
- **Cross-Domain Adaptation** (learning generalizable representations)
- **Interdisciplinary Crossovers**:
  - Neuroscience: biologically-inspired attention models
  - Social Sciences: fairness by design
  - Arts & Media: creative and affective recognition
- **Lifelong Learning & Continual Adaptation**
- **Explainability for Trust & Regulation**

Panelist Position

VENICE 2025

Przemyslaw Pochec
Faculty of Computer Science
University of New Brunswick
Canada

- Recognition
  - **Matching: 2=2, 2!=3** *(supervised)*
  - **Clustering: {2,2,3,2,3}, {7,7,7,8,8,8,8}** *(unsupervised)*
  - **Reasoning: grandfather(X, Y) :- father(X,Z), parent(Z,Y).**

PATTERN

- Recognition Systems
  - Object (character, 3D)
  - Biometric (facial, voice, emotion)
  - Environment (action, self driving cars)
  - General knowledge

- Learning (ML), semantic description

TOKEN

- Tokenization
- Training
  - Supervised
  - Unsupervised
  - Feature engineering vs raw data
  - Synthetic data (multiverse simulation Nvidia Cosmos: training AI powered robots)

Panelist Position

VENICE
2025

Przemyslaw Pochec
Faculty of Computer Science
University of New Brunswick
Canada

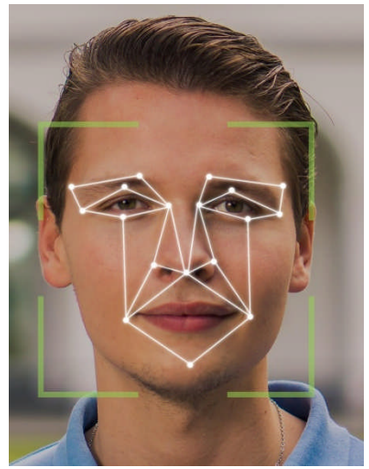
- **Challenges**
  - **Training:**
    ownership of training data sets
    bias, accuracy, reliability, verifiability
  - **Real time (training and execution):**
    energy consumption (Grok 3 Colossus Data Center: 250MW for 200,000 Nvidia H100 GPUs)
  - **Accessibility:**
    data
    computing power
  - **Ubiquitousness:**
    privacy (stored representations)
    privacy (operations)
  - **Regulatory approval**

Panelist Position

VENICE
2025

Face recognition and privacy

- Face recognition is becoming infrastructure. But how ethically we do that?
- Regulation Is Fragmented and Reactive. There's no global norm: the EU is restrictive, China is permissive, and the U.S. is mixed.
- Can privacy tech be part of the solution?
  - On-device processing, anonymization, and user-controlled ID verification (e.g., zero-knowledge proofs), etc.



Dr. Gábor Gulyás, PhD
Vitarex Studio Ltd.
Managing Partner

Panelist Position

VENICE 2025

- **Gen AI & Privacy/Ethics**
  - AI-enabled/assisted apps (e.g. healthcare)
  - Data input, collection, communication, discourse analysis
  - Privacy policies/informed consent/privacy controls
  - Transparency of underlying algorithms
- **Gen AI & Cybersecurity** (double-edged sword)
  - AI-assisted Pentesting
    - Early threat detection and response
    - Automation, efficiency, and accuracy in vulnerability and risk analysis
    - Help human pentesters to predict threat profiles and make recommendations
  - Security Risks & Limitations
    - Malicious misuse for more powerful & automated attacks
      CNBC report 6/22/25: More harmful outputs with increasing AI usage
      e.g. hate speech, sexual content, copyright infringements
    - Potential disclosures of private/sensitive/copyrighted information
    - Hallucinations with misleading misinformation
    - Replace human intelligence/creativity in defense decision making
    - Challenges in securing AI lifecycle: development, deployment, maintenance
    - More testing, training, approval conditions for AI models

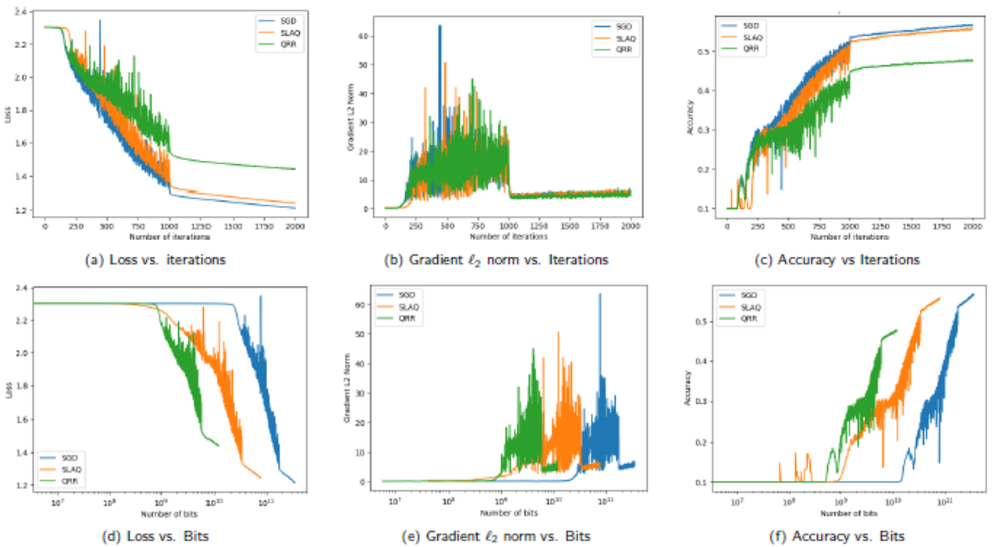
Ping Wang
RMU
USA

Panelist Position

VENICE 2025

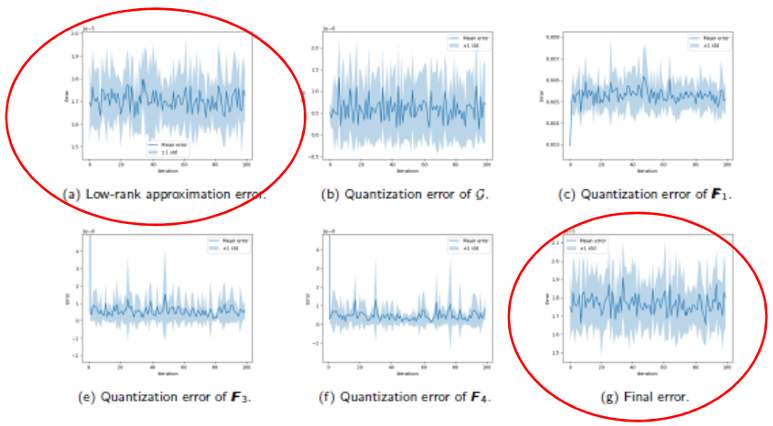
- **Panel #2 Advances in Recognition Systems**
- **Federated Learning**
  - Reduce the communication load
  - Analyze the impact of error sources
    - low-rank approximation
    - quantization

CIFAR 10: VGG-like CNN



(a) Loss vs. iterations (b) Gradient ℓ_2 norm vs. Iterations (c) Accuracy vs Iterations

(d) Loss vs. Bits (e) Gradient ℓ_2 norm vs. Bits (f) Accuracy vs. Bits



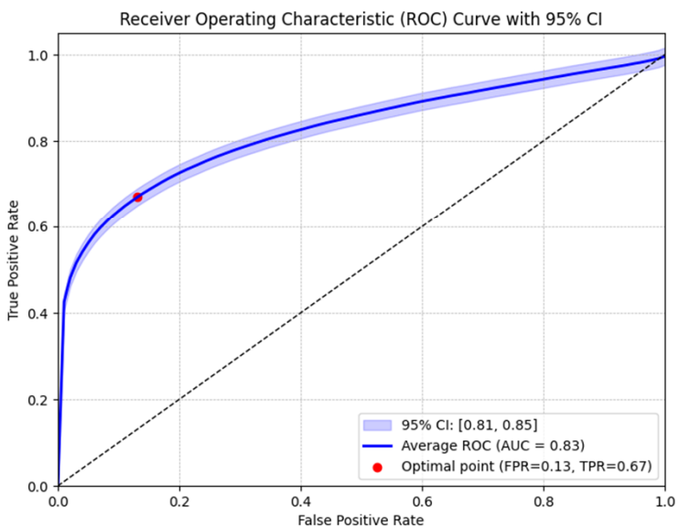
(a) Low-rank approximation error. (b) Quantization error of G. (c) Quantization error of F_1. (d) Quantization error of F_2.

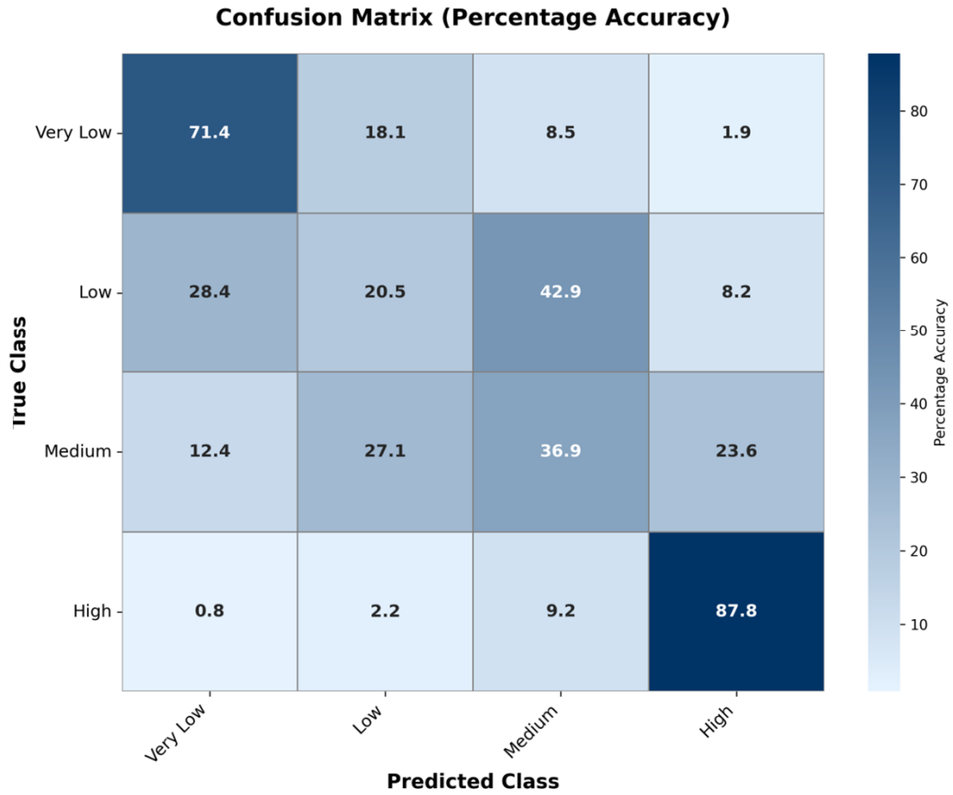
(e) Quantization error of F_3. (f) Quantization error of F_4. (g) Final error.

Low-rank approximation and quantization errors of the gradient of a convolutional layer and its Tucker decomposition

Constantine Kotropoulos AUTH

- **Panel #2 Advances in Recognition Systems**
- **Measuring performance**
  - Experimental protocol should answer the research question.
    In dysarthria detection, we should assess dysarthria severity, not speaker or word recognition. Data splitting recipes, e.g., 75% of data for training and the remaining for testing are inadequate. Datasets should be accompanied by a protocol.
  - Measuring uncertainty





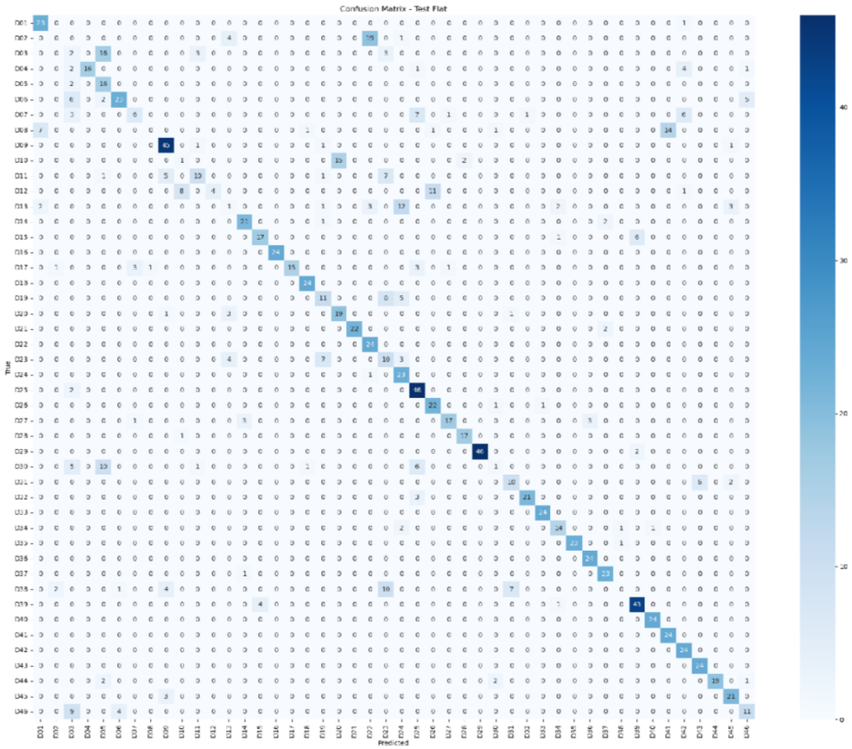
Dysarthria Detection (UA Speech)

Panelist Position

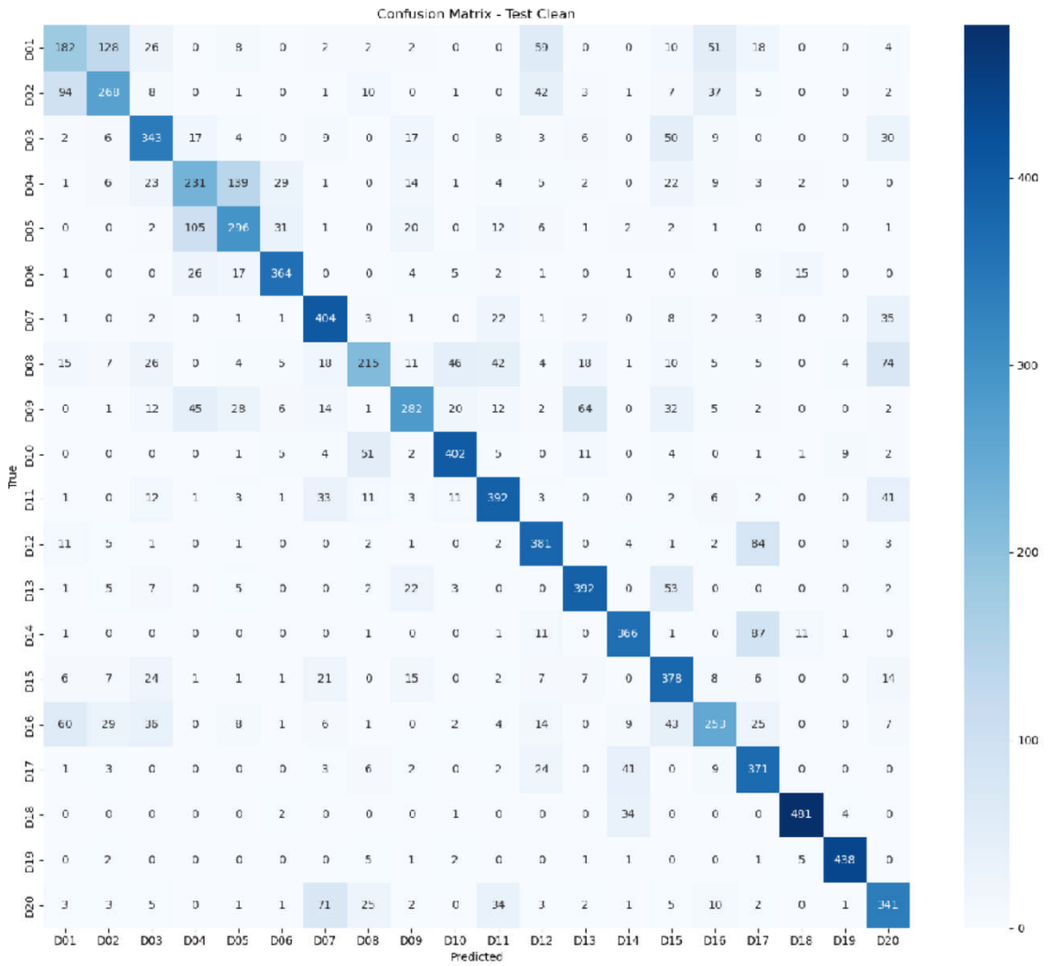
VENICE 2025

- **Panel #2 Advances in Recognition Systems**
- **Measuring performance**
  - Assess the DL architecture on multiple datasets

Case study: Source Device Identification



Floreview



Poliphone

Panelist Position

VENICE 2025

Vicente Casares Giner
Universitat Politècnica de València, España

- **Tools have been there for decades**
  - Markov Chains
  - Memorylessness (systems)
  - Predict the most likely sequence of observations, making them a valuable tool in pattern recognition

- **Patterns Recognition (Data are now available)**
  - Core of recognition systems
  - AI-based pattern recognition is a promising way to explore

THE STAGE IS YOURS