Karam Mahfod

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Summary

Research and development engineer (born 04.06.1998), based in Saint Petersburg, Russia. Holds a Russian residence permit and valid work authorization. Specialized in video coding, compression systems, and computer vision, with strong command of H.265/HEVC and H.264/AVC standards and a solid understanding of error-correction and channel-coding schemes such as polar codes and LDPC. Experienced in developing encoding and decoding pipelines that merge signal-processing principles with deep learning to improve perceptual quality and compression efficiency. Proven track record in designing and deploying real-time AI pipelines for large-scale, production environments, effectively connecting research and industry practice.

Education

ITMO University — St. Petersburg, Russia
Ph.D. in Distributed Video Coding and Transmission using Machine Learning — Sep. 2023

ITMO University — St. Petersburg, Russia
M.Sc. in Network and Cloud Computing (with honors) — Sep. 2021 – June 2023

Higher Institute for Applied Sciences and Technology (HIAST) — Damascus, Syria
B.Sc. in Computer Science; GPA: 4.7 — Sep. 2015 – Aug. 2020

Experience

Cradle Vision — Remote
AI & Computer Vision Engineer — Jun. 2025 – Present

Real-Time Attendance Pipeline: Developed and deployed a real-time AI pipeline for tracking, capable of processing more than **300 4K camera streams** simultaneously. Implemented ROI-based detection focused on entry and exit points to significantly reduce GPU load while maintaining high recognition accuracy.

Classroom Behavior Analysis: Built a multi-model pipeline combining **pose estimation and action classification** to recognize various student behaviors (e.g., inattentive, distracted, bored) and analyze teacher–student interaction patterns during school lectures.

Ongoing Enhancements: Expanding the platform with new features such as **voice-based session summaries**, advanced multi-camera tracking, and improved inference performance for large-scale deployments.

Stack: Python, C/C++ (CMake, Make), DeepStream, GStreamer, Triton Inference Server, PyTorch, TensorFlow, OpenCV, TensorRT, ONNX, Kafka, Docker

ITMO University — St. Petersburg, Russia
Research Engineer — AI-Based Image Compression (JPEG-AI) — Dec. 2024 – Present

Project Leadership: Leading a team in the research and development of next-generation neural image compression methods.

Perceptual Quality Metric: Developed a perceptual quality metric trained directly on **Mean Opinion Score (MOS)** and validated against subjective human evaluations. Achieved higher correlation with human perception compared to traditional metrics such as **VMAF, MS-SSIM, and PSNR**. (Patent under review)

Compression Efficiency: Achieved **25% bitrate reduction** for the 0.075 model and **31% reduction** for the 0.012 model compared to baseline methods, demonstrating significant gains in compression efficiency without perceptual quality loss.

Training Strategy Research: Investigated both **fixed-quality** and **fixed-bitrate** training paradigms to balance efficiency and visual fidelity across multiple model sizes.

Stack: Python, PyTorch, TensorFlow, NumPy, Pandas, FFmpeg, Docker, LaTeX

ITMO University St. Petersburg, Russia
Research Engineer — H.265/HEVC-Based Transcoding System Dec. 2023 – Dec. 2024

Perceptual Re-Compression: Developed two architectures for perceptual **H.265/HEVC bitstream re-compression** by combining **OpenHEVC** and **x265** in a unified pipeline. Enabled parameter reuse from the input bitstream, achieving **50% faster** (Re-compressor) and **13% faster** (Transcoder) processing than the standard FFmpeg+x265 setup.

Neural SUR Module: Built a neural **Satisfied User Ratio (SUR)** predictor estimating ΔQP from block distortion and visibility, trained on **VideoSet (H.264)** and fine-tuned for **H.265/HEVC** re-compression.

HVS-Based Color Pre-Filter: Designed an **HVS-based pre-filter** operating in the CIELAB color space that detects perceptually insignificant chroma variations using **MacAdam ellipses** and ΔE_{94} color difference. The filter preserves visually irrelevant details to improve compression efficiency without quality loss.

Results: Achieved **MOS = 0.37** with bitrate savings of **32.6% (Re-compressor)** and **34.1% (Transcoder)** per video, and **22.0% / 22.2%** on dataset level. With pre-filters enabled, reached **MOS = 0.45** and up to **42.8% / 40.4% bitrate reduction**, respectively.

Stack: C/C++ (CMake, Make), Python, OpenHEVC, x265, FFmpeg, Docker

Vishare Technology Remote — Hong Kong
Software Engineer — H.265/HEVC Optimization Jun. 2021 – Feb. 2025

Codec Optimization: Contributed to the design, optimization, and enhancement of **H.265/HEVC video codecs**, improving both **compression efficiency and runtime performance** across multiple platforms. Participated in redesigning critical encoder and decoder modules, optimizing rate-distortion decisions, motion estimation, and entropy coding.

Performance Engineering: Implemented advanced multithreading strategies and low-level optimizations to boost throughput and scalability. Enhanced pipeline concurrency and memory utilization, resulting in significant performance improvements under real-time and batch processing scenarios.

RISC-V Simulator Development: Designed and implemented a feature-rich 32-bit **RISC-V simulator** supporting **multithreading, MESI cache coherence, branch prediction, and detailed performance profiling**, used internally to model hardware–software co-design scenarios for codec acceleration.

Profiling and System Tools: Built custom profiling and debugging utilities using **GProf, Valgrind, and low-level instrumentation** to identify bottlenecks, guide optimization decisions, and validate system-level performance improvements.

System Integration and Deployment: Contributed to **CI/CD workflows**, cross-platform builds, and automated testing pipelines. Worked extensively with containerized environments and continuous benchmarking to ensure robust, maintainable video compression solutions.

Stack: C/C++ (CMake, Make), Python, GStreamer, x265, FFmpeg, Multithreading (OpenMP, Pthreads), GProf, Valgrind, Docker, Git, Bash, RISC-V, Performance Profiling Tools

Syriatel Damascus, Syria
C++ Developer — Network and Backend Systems Mar. 2020 – May 2021

Real-Time Systems: Developed backend C++ modules for telecom network management.

Team Collaboration: Worked with cross-functional teams on feature delivery and debugging.

Foundation Role: First professional role post-graduation, providing exposure to large-scale systems.

Stack: C/C++ (CMake, Make), Docker, Git

Publications

1: **H.265/HEVC Decoding via Iterative Recovery from Incomplete Quantized Measurements**, *IEEE Signal Processing Letters*, 2025. DOI

2: **Multi-Hypothesis Distributed Video Coding using Error-Correction Decoder Feedback**, *IEEE DSPA*, 2025. DOI

3: **Q-Learning Based Adaptive Multipath Routing Algorithm for Data Centre Networks**, *IEEE RusAutoCon*, 2024. DOI

4: **Inter-Frame and Inter-View Quality Enhancement in Distributed Multi-View Video Coding**, *International Symposium on Problems of Redundancy in Information and Control Systems*, 2025 (submitted)

Programming Skills

Languages: C/C++, Python, Bash, MATLAB, Verilog
Technologies: FFmpeg, GStreamer, DeepStream, TensorRT, ONNX, PyTorch, TensorFlow, Triton Inference Server, Kafka, CMake, Make, Docker, GProf, GDB, Valgrind, Git, LaTeX
Development Tools: Visual Studio, VS Code, PyCharm
Operating Systems: Linux, Windows

Other Skills

Competitive Programming: Participated in the ICPC, applying advanced algorithmic problem-solving in a collaborative, high-pressure environment.
Mathematical Foundations: Strong background in mathematics, including probability theory, number theory, and numerical methods, with direct application to video coding and signal processing.
Research and Analysis: Skilled in designing experiments, evaluating algorithmic performance, and interpreting results using statistical and visual analysis techniques.
Project Leadership: Led multiple academic and industry-driven projects; experienced in coordinating cross-functional teams and delivering on deadlines.
Communication and Collaboration: Comfortable presenting technical ideas, writing documentation, and working in both solo and team environments across different domains.

Languages

Arabic (Native), English (C1), Russian (B1)