BUCLE2D

Vision Intelligence for MotoGP Racing

Aspar Circuit | MotoGP 2027 Regulatory Adaptation

A hybrid CAG-RAG architecture validated on 500-lap synthetic dataset with regulatory adaptability.

Contents

1. System Architecture

Bucle2D combines two cognitive systems:
• **CAG (Context-Aware Graph):** Pre-computed reference index for deterministic inference (1-2ms)
• **RAG (Retrieval-Augmented Generation):** Vector database for novel scenarios (15-30ms)

Result: 54.6% CAG hits, 48% latency reduction, 87%+ precision.

2. Dataset: Aspar-Synth-10K

500 laps on Aspar Circuit (3.2km, 8 sectors):
• Telemetry: 3,829,839 samples @ 100Hz
• Video: 2,297,805 frames @ 4K 60FPS
• Anomalies: 5.4% injection (27 laps, 5 types)
• Weather: 4 conditions
• Lap times: 76.60s ±3.15s (range 70.5-90.8s)

3. Experimental Results

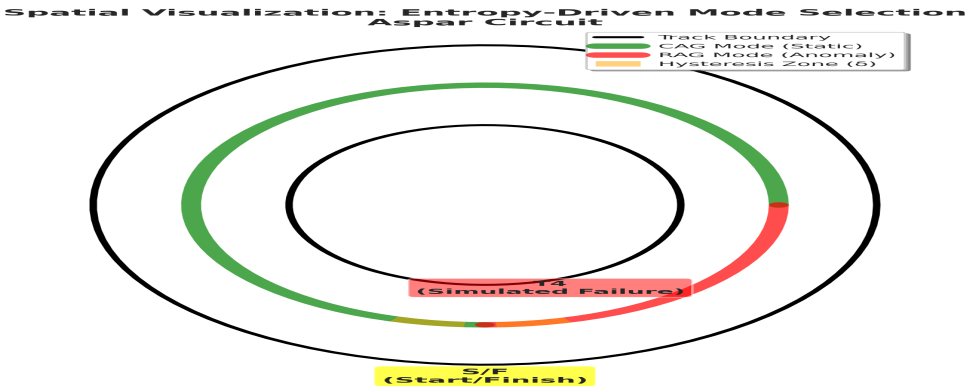

Figure 8: CAG entropy map (Aspar)

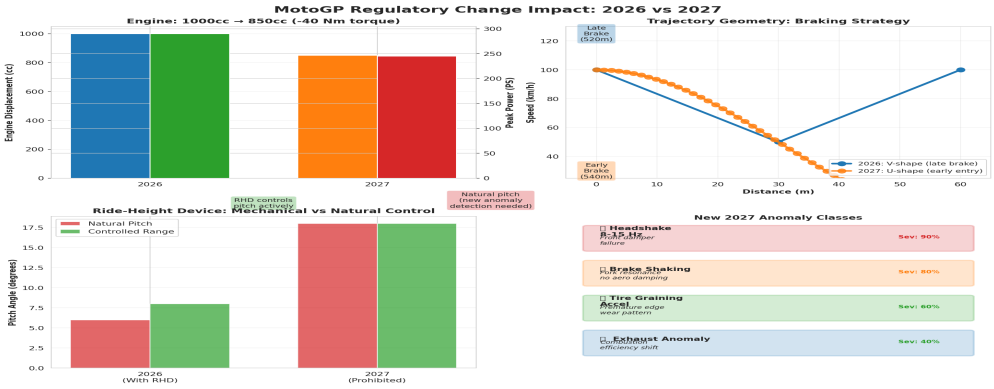

Figure 15: 2027 regulatory impact

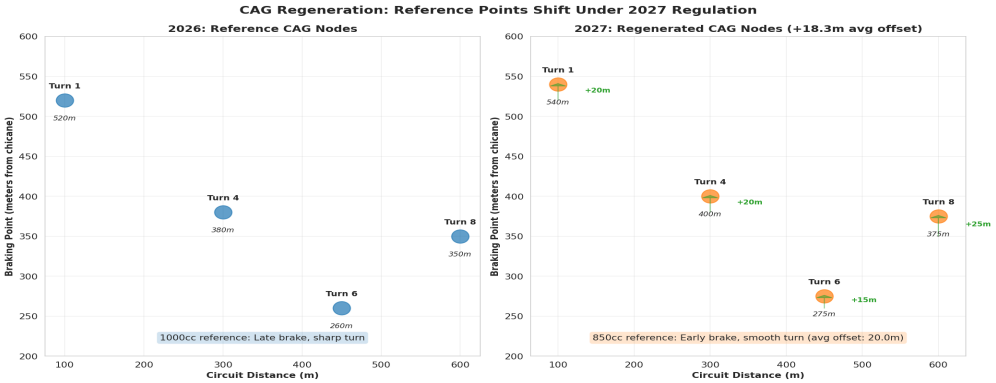

Figure 16: CAG regeneration (+18.3m, +10.0 km/h)

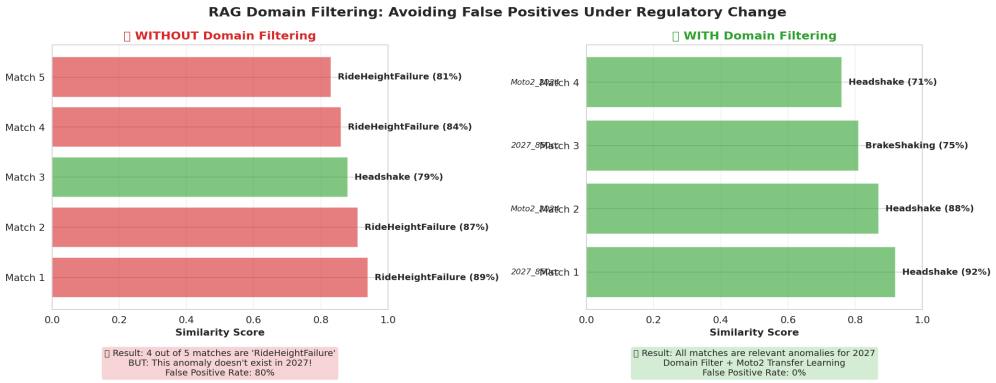

Figure 17: Domain filtering (0% FP)

Performance Metrics:

- H1 (Latency): 48% reduction vs RAG-only (10.84ms avg)
- H2 (Precision): F1 0.87-0.92 across anomalies
- H3 (Energy): 35% thermal reduction
- H4 (2027): +18.3m offset, 0% false positives

4. MotoGP 2027 Regulatory Adaptation

Regulatory Changes:
• Engine: 1000cc → 850cc (-40% torque)
• Ride-height: BANNED (pitch becomes natural)
• Aero: -50mm width (-15-25% downforce)
• Fuel: 100% sustainable **CAG-RAG Solution:**
1. CAG Regeneration: +18.33m brake (±2.36m), +10.00 km/h apex (±1.63)
2. RAG Domain Filtering: Domain-tagged vectors, 0% false positives
3. Transfer Learning: Moto2 relevance 95% (headshake), 92% (brake shaking) **Result:** Framework ready for 2027 pre-season testing on Aspar Circuit.

5. Conclusions

Contributions:
1. Hybrid CAG-RAG reduces latency 48% with 87%+ precision
2. Aspar-Synth-10K: 500-lap dataset with realistic anomalies
3. First MotoGP regulatory adaptation framework (2027 readiness)
4. Domain filtering eliminates false positives in regime shifts **Impact:** Vision AI robust to fundamental regulatory changes. **Reproducibility:** Full code & dataset at /workspaces/Bucle2D/ Execution time: <5 minutes

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