

SOVEREIGN: How does negative sampling affect inference efficiency and accuracy tradeoffs across different model scales in

SOVEREIGN Research Kernel

Autonomous draft — Owner review required before publication

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Abstract

This paper presents a focused investigation into real-time segmentation in unstructured environments, a crucial aspect for enabling autonomous navigation in off-road robots. To address this challenge, an improved variant of the DDRNet23-slim model is proposed, which includes a lightweight network architecture and reclassifies ten different categories, including drivable roads, trees, high vegetation, obstacles, and buildings, based on the RUGD dataset. The model's design includes the integration of the semantic-aware normalization and semantic-aware whitening (SAN-SAW) module into the main net

1 Introduction

Analysis of: Real-Time Segmentation of Unstructured Environments by Combining Domain Generalization and Attention Mechanisms. Research goal: How does negative sampling affect inference efficiency and accuracy tradeoffs across different model scales in domain-agnostic question answering?.

2 Methodology

Multi-query arXiv search (4 parallel queries, Relevance-sorted). TF-IDF cosine semantic verification (bigrams, threshold=0.15). NIM nv-embedqa-e5-v5 (dim=1024) for semantic indexing. Tribunal v2: 3-role parallel review (SKEPTIC/VALIDATOR/SYNTHESIZER) with revision round if score < 6.5.

3 Results

11 papers retrieved. 9 claims extracted, 8 verified. Tribunal: 7.2/10 → APPROVE (revision_round=0). Policy: AUTO_APPROVE.

4 Uncertainties

NIM free tier latency varies. TF-IDF verification is a weak signal. arXiv Relevance ranking is query-dependent. Tribunal consensus is LLM-based and prompt-sensitive.

5 Extracted Claims

Claim	Verified	Confidence
An improved variant of the DDRNet23-slim model is proposed for real-time segmentation in unstructured environments	✓	0.33
The model reclassifies ten different categories based on the RUGD dataset	✓	0.16
The SAN-SAW module is integrated into the main network to improve generalization ability	✓	0.21
Channel attention and spatial attention mechanisms are fused in the low-resolution branch	✓	0.21
A rare class sampling strategy (RCS) is employed to address category imbalance	✓	0.19
The improved model achieves a 14% increase mIoU in the invisible domain	✓	0.23
The model has a parameter count of 5.79M	×	0.12
The model achieves mAcc of 85.21% and mIoU of 77.75%	✓	0.23
The model has been deployed on a Jetson Xavier NX ROS robot	✓	0.18

References

- <https://www.semanticscholar.org/paper/c35051462af93e64d25df5e16f74119de5b6be10>
- <https://www.semanticscholar.org/paper/8cf38ea4b4b4977a330a5017a6e1f9fd9b9a2712>
- <https://www.semanticscholar.org/paper/6fec1d74222816801df763b80f3c2964db07a00b>