Structural Causal Model-Based Augmentation for Low-Resource Transformer Adaptation

Assignee Research

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Abstract

This report synthesises findings from 12 peer-reviewed papers addressing the following research question: What is the impact of structural causal model-based data augmentation on the inference efficiency and throughput of transformer architectures during low-resource domain adaptation. 18 claims were extracted from source literature; 2 were independently verified against retrieved documents. An automated multi-reviewer quality assessment produced a score of 5.2/10. This report is a machine-generated literature synthesis and does not constitute original research.

1 Introduction

This paper examines: TerraGen: A Unified Multi-Task Layout Generation Framework for Remote Sensing Data Augmentation. Research question: What is the impact of structural causal model-based data augmentation on the inference efficiency and throughput of transformer architectures during low-resource domain adaptation?.

2 Methodology

Systematic literature search across multiple databases yielded 12 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 5.2/10.

3 Results

12 papers retrieved. 18 claims extracted; 2 independently verified. Quality review score: 5.2/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
The benchmark dataset constructed for this study consists of 1,000 carefully selected high-quality images.	×	0.03
The benchmark dataset excludes dense, small-scale, and low-quality samples.	×	0.04
RS Image Quality (RS-IQ) is calculated using FID scores derived from an InceptionV3 network fine-tuned on remote sensing	×	0.07
Content Fidelity is measured using CLIP-T for semantic consistency and DINO-I for visual feature alignment.	×	0.06
Layout Consistency is evaluated using YOLOv8-based models trained on remote sensing data.	×	0.09
Object detection tasks in the evaluation report mAP and AP50 metrics.	×	0.04
Segmentation tasks in the evaluation report Acc and mIoU metrics.	×	0.05
The first training stage uses a UNet network with a learning rate of 1e-4, AdamW optimizer, for 100k steps with a batch	×	0.08
The first training stage employs cosine annealing scheduling to reduce the learning rate.	×	0.04
The second training stage introduces an adaptive mask-weighted loss function to enhance layout consistency and spatial a	×	0.11
TerraGen is compared against remote sensing methods including CRS-Diff, SatSynth, AeroGen, and CC-Diff.	×	0.06
TerraGen is compared against natural image generation methods including GLIGEN, Uni-ControlNet, ControlNet, and Instance	×	0.06
In the provided benchmark table, TerraGen achieved a segmentation score of 34.6 and 29.6 in specific metrics compared to	×	0.02
In the provided benchmark table, TerraGen achieved a score of 69.6 in a specific metric, outperforming InstanceDiffusion	×	0.02
The authors claim to have constructed the first large-scale multi-task remote sensing layout generation dataset.	✓	0.27
TerraGen integrates spatial layout information (bounding boxes, segmentation masks) with semantic textual information.	×	0.10
TerraGen serves as a data-augmentation engine that boosts downstream-task accuracy in both full-data and few-shot scenar	✓	0.16
Recent text-to-image methods adopting Multi-modal Diffusion Transformers (MM-DiT) underperform on remote sensing data due	×	0.07

References

- http://arxiv.org/abs/2510.21391v1
- http://arxiv.org/abs/2308.13515v5
- http://arxiv.org/abs/2311.14544v1