

Evaluating the Transferability of 3DMASC Random Forest Models Across Mobile LiDAR and SfM Point Clouds for Urban Feature Classification

Simiso Ntuli and Mayshree Singh (South Africa)

Key words: Laser scanning; Photogrammetry; Remote sensing; Urban renewal; Mobile laser scanning; 3D point cloud classification; Random Forest; 3DMASC, UAS-SfM Photogrammetry; 3D Urban Mapping

SUMMARY

Accurate classification of urban point clouds is critical for application in planning, infrastructure monitoring and environmental management. Transferability across sensing modalities remains uncertain. This study evaluates a classical, feature-based approach. We test 3DMASC Random Forest models on two datasets. The first dataset is Toronto-3D mobile LiDAR (MLS), while second is an UAS Structure-from-Motion (SfM) dataset from Umngeni Valley. Multi-scale geometric descriptors were extracted, including linearity, planarity, sphericity, eigenvalue ratios and Z-range. The study evaluated three scenarios, namely training and testing within a single modality; cross-modality transfer between datasets and merged-dataset training with subsequent testing on each modality separately. Class balance was maintained using a 70:30 training-to-testing split and performance was evaluated through accuracy, precision, recall, and F1-score. The results showed strong within-modality performance, with MLS achieving 85% overall accuracy and SfM 76%. Cross-modality transfer, however, resulted in marked declines, the UAS-SfM to MLS transfer achieved only 69% accuracy and MLS to UAS-SfM dropped further to 52%. These findings demonstrated the sensitivity of vegetation and building classes to acquisition geometry and point density differences. By contrast, merged-dataset training improved robustness. The combined model yielded 83% accuracy when tested on MLS and 72% on SfM. Feature importance analysis confirmed the dominance of coarse-scale descriptors, with sphericity identified as the most influential feature. MLS performance benefited from the incorporation of vertical range information, while SfM relied more heavily on shape-based descriptors. Classical, feature-based models can generalise across heterogeneous urban point clouds when trained on combined data. Transfer remains class-dependent due to viewpoint and density differences. This study provides insights into the potential for classical, feature-based classifiers to transfer across heterogeneous urban datasets, which may reduce the need to retrain models for each new dataset.

Evaluating the Transferability of 3DMASC Random Forest Models Across Mobile LiDAR and SfM Point Clouds for Urban Feature Classification (13695)

Simiso Ntuli and Mayshree Singh (South Africa)

FIG Congress 2026

The Future We Want - The SDGs and Beyond

Cape Town, South Africa, 24–29 May 2026