

Introduction

- Roof inspections are vital for safety and longevity of buildings.
- Traditional inspection methods are often time-consuming, expensive, and potentially unsafe.
- Integrating AI techniques into roof inspections can revolutionize the process, offering cost reduction and time savings.
- The applications will cover infrastructure monitoring and urban planning, contributing to cost-effective maintenance and informed decision-making.

Importance of accurate roof segmentation:

- Enhances maintenance strategies and disaster response, improving decision-making processes.
- Quantifies the damage area for repair cost estimation.

Multitask machine learning approach:

- A sub-field of machine learning which handles multiple tasks simultaneously.
- Combining two or more highly correlated tasks could mutually enhance the accuracy.

Case Study & Methods

Architecture Overview: A CNN-based multitask learning model, designed as an encoder-decoder network. Feature decomposition with weight-sharing connections enhances performance across tasks.

Backbone Network: HRNet-W32, pretrained on the PASCAL VOC 2012 dataset, serves as the shared feature extractor.

Case Study:

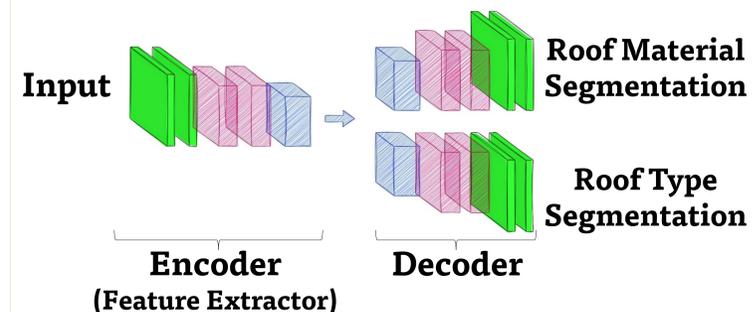
Location: Missouri S&T campus buildings.

Date: April 23, 2023.

Drones Used: DJI Matrice M600 Pro and DJI Phantom 4Pro

Dataset: 100 UAV-captured images, annotated at the pixel level.

Data Split: 90% for training, 10% for testing.



Methodology & Workflow

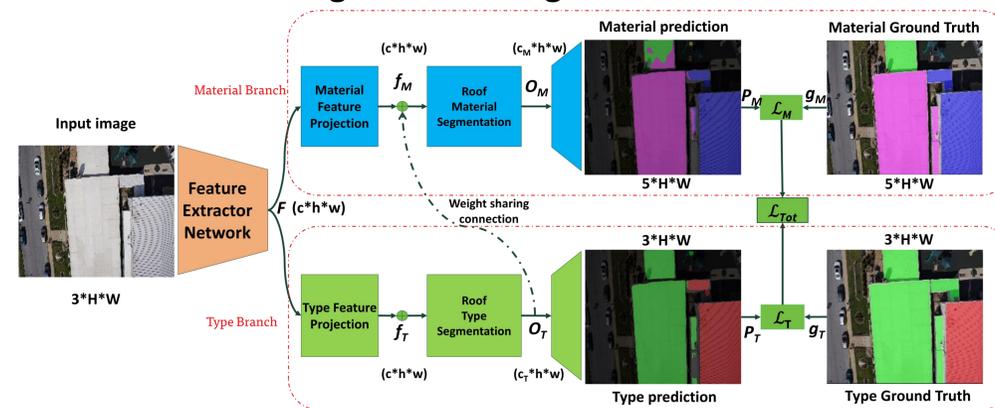
Data Collection:



Roof Images Annotation:



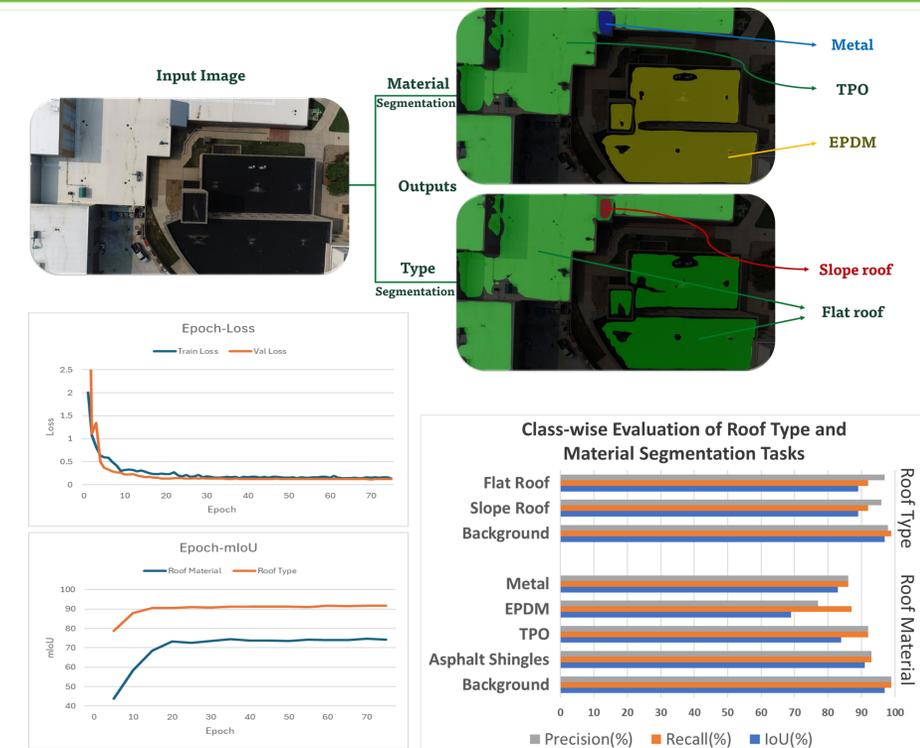
NN Architecture Design and Training:



Correlation Between Roof Types and Materials Based on Expert Consultation and Industry Standards:

Material / Roof type	Slope	Flat
Metal	%80	%20
EPDM	%10	%90
TPO	%10	%90
Asphalt Shingles	%100	%0

Results



Conclusion

1. The proposed multitask learning model achieves effective segmentation of building roof types and materials, with an average mean Intersection over Union (mIoU) score of 85% and nearly 95% accuracy.
2. The strong correlation between the tasks, validated through roofing expert consultations, further supports the model's robust performance.
3. This approach demonstrates the potential of advanced AI techniques for improving infrastructure management and urban planning.

Acknowledgement

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Reference

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