Semi-Supervised Multi-Label Classification of Remote Sensing Images

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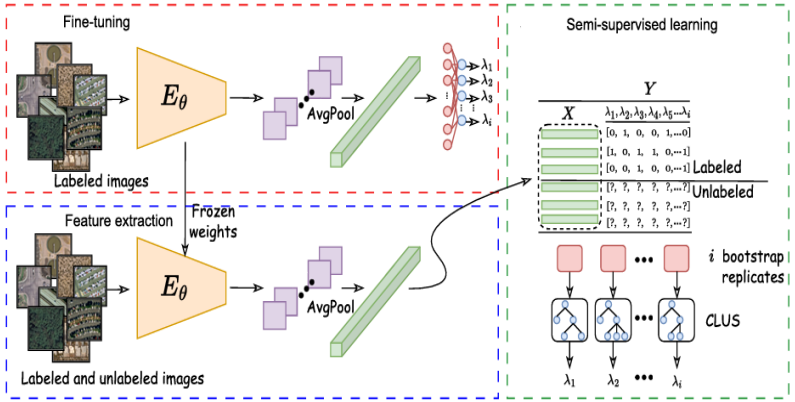
Summary

- Project addresses the challenge of limited labeled data in remote sensing image classification by implementing a semi-supervised learning (SSL) framework.
- Combining deep convolutional feature extractors with SSL predictive clustering trees, the method leverages both labeled and unlabeled data to improve classification accuracy.
- Key results showed that SSL methods outperformed their SL (Supervised Learning) counterpart methods, especially with scarce labels, achieving superior performance on datasets.
- This approach reduces annotation costs while maintaining accuracy, enabling environmental monitoring.

Objective

To develop an SSL framework that reduces reliance on labeled data while maintaining high accuracy for Remote Sensing Images classification.

Approach



1. Feature Extraction: Pretrained CNN backbones (ResNet, EfficientNet) extract high-dimensional features.

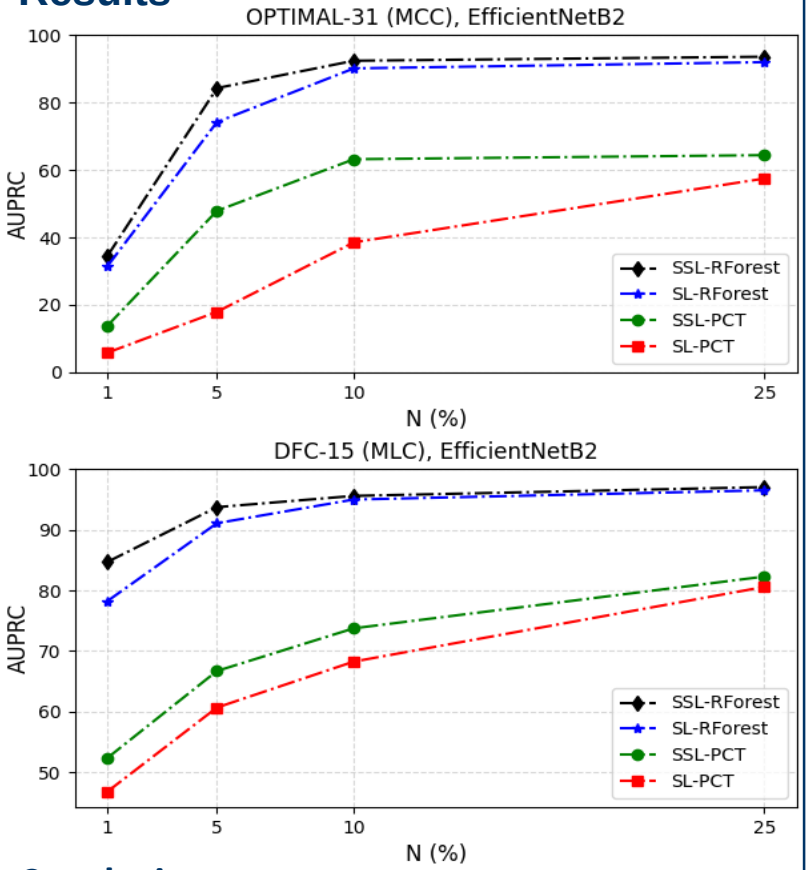
2. SSL Predictive Clustering Trees: PCTs handle structured outputs using a variance function:

$$\mathrm{Var}_f = w \cdot \mathrm{Var}_f(Y) + (1 - w) \cdot \mathrm{Var}_f(X)$$

- w balances label and feature variance (optimized via cross-validation).
- Ensembles (SSL-RForest) aggregate predictions from 50 trees.

3. Training: Fine-tuned on 1–25% labeled data; tested on 2 RSI datasets for MLC and 1 for MCC.

Results



Conclusion

The SSL framework significantly reduces the need for expensive manual labeling of remote sensing images, the method achieves higher classification accuracy than supervised approaches.