

Reducing annotation effort: An innovative weakly supervised system for nationwide building extraction leveraging open-source data

Shenglong Chen, Yoshiki Ogawa, Yoshihide Sekimoto

Background

For nationwide building extraction, the diversity of building characteristics poses a challenge to the model's ability to generalize across different regions. Fine-tuning is a common method to enhance generalization capabilities; however, it often necessitates manually annotated datasets, which are time-consuming and labor-intensive. Conversely, open-source footprint data often contains noise, which can degrade model performance when used directly for training.

Object

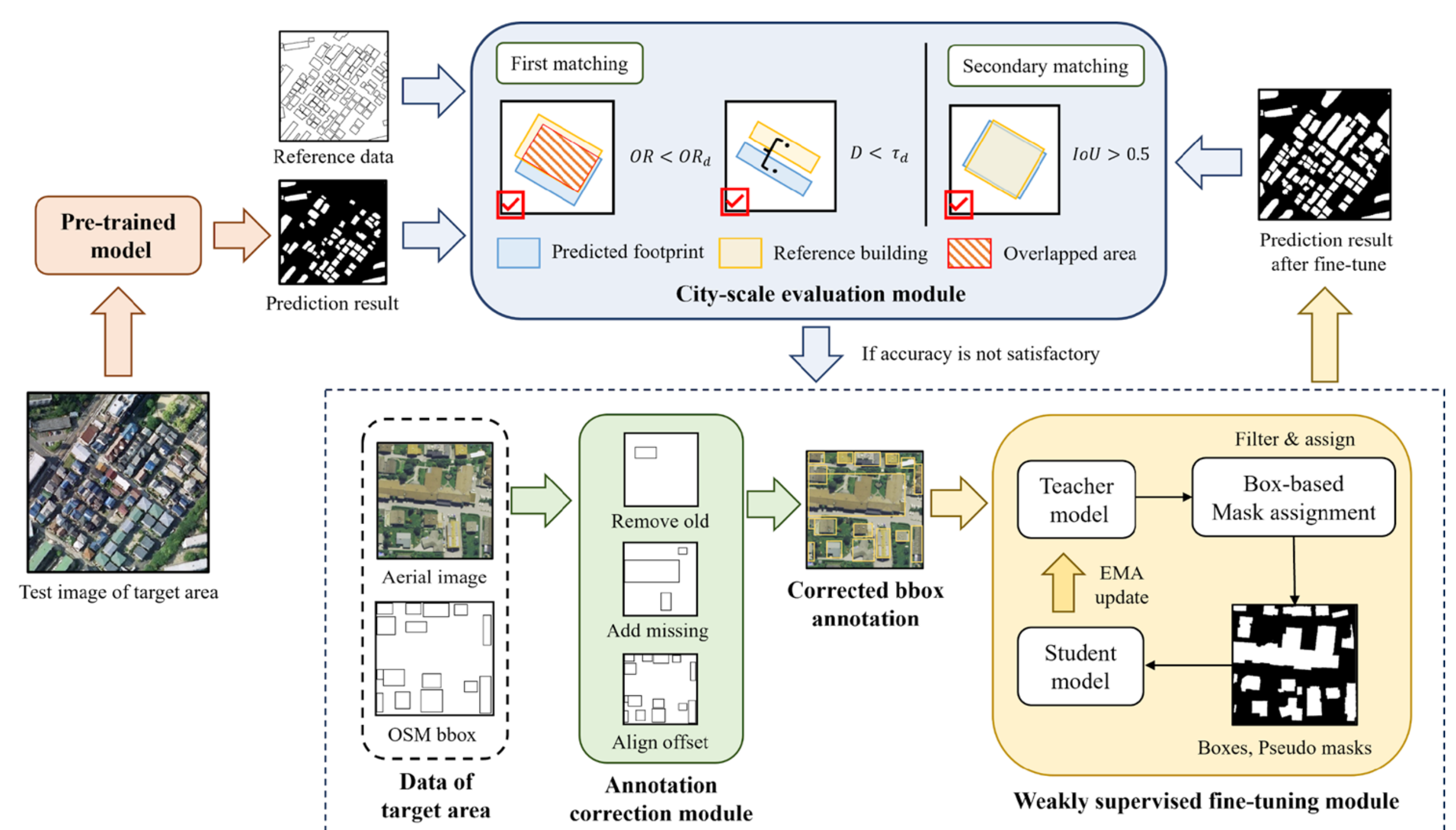
- Develop a generalizable building extraction method using open-source data for nationwide building extraction task without annotation effort.
- Apply the method to conduct building extractions throughout Japan to test the method validity.

Methodology

- Proposed framework comprises two main modules: annotation correction module and weakly supervised fine-tuning module.
- Annotation correction module addresses geometric errors through affine transformations, while also accounting for semantic errors due to chronological changes (New-built or demolished buildings).
- Weakly supervised fine-tuning module uses corrected footprint bounding box as training data and employs a teacher-student learning paradigm to mitigate impact of low-quality pseudo-masks.

Dataset

- **For model pre-trained**
4,821 Google Earth satellite image (0.3m) with manually created annotations.
- **For nationwide extraction:**
Mapbox satellite image (0.6m)
Plateau building dataset (For evaluation); Noisy OSM footprint (For fine-tuning)



Framework of the nationwide building extraction

Result & Conclusion

- We extracted 49,601,089 building footprints across Japan over a period of 33.5 days, achieving precision, recall, and F-value of 0.86, 0.79 and 0.83, respectively.
- By using only 2% of the data for fine-tuning, the average F-value of the model can be increased by 0.12.
- Proposed annotation correction method can improve the bounding box IoU of noisy footprint by 20%; the weakly supervised fine-tuning method can achieve 90% of the performance of fully supervised learning.

