Dynamic Knowledge Adapter with Probabilistic Calibration for Generalized Few-Shot Semantic Segmentation

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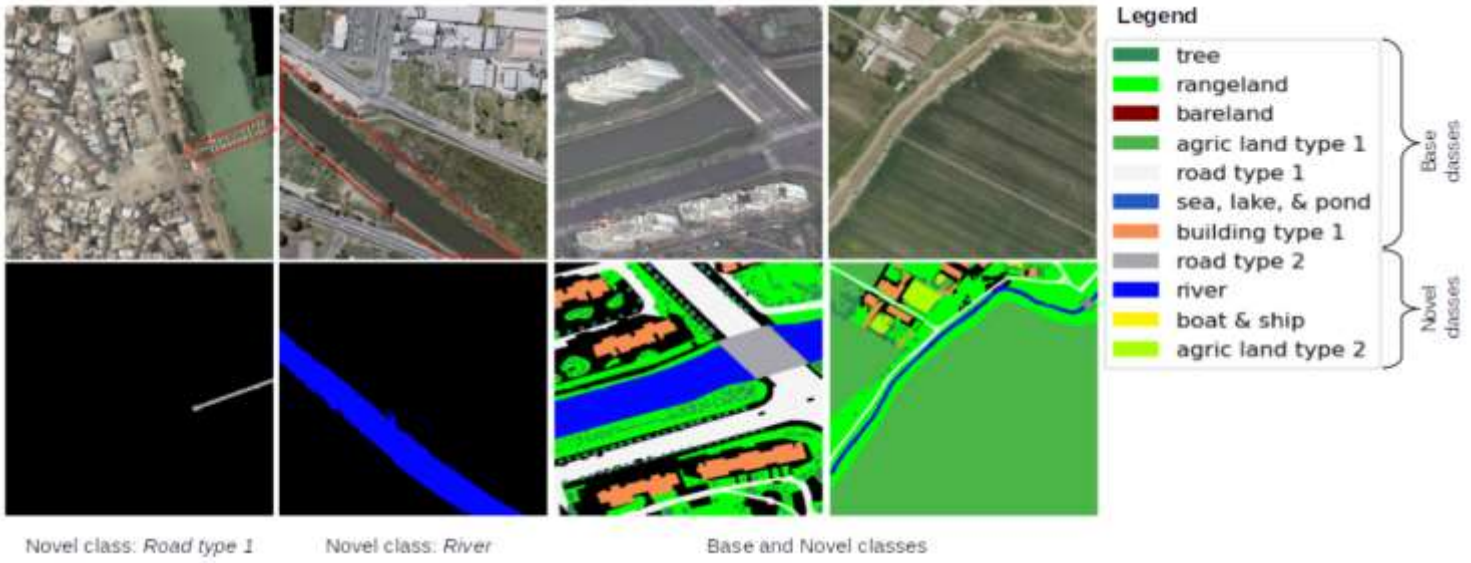
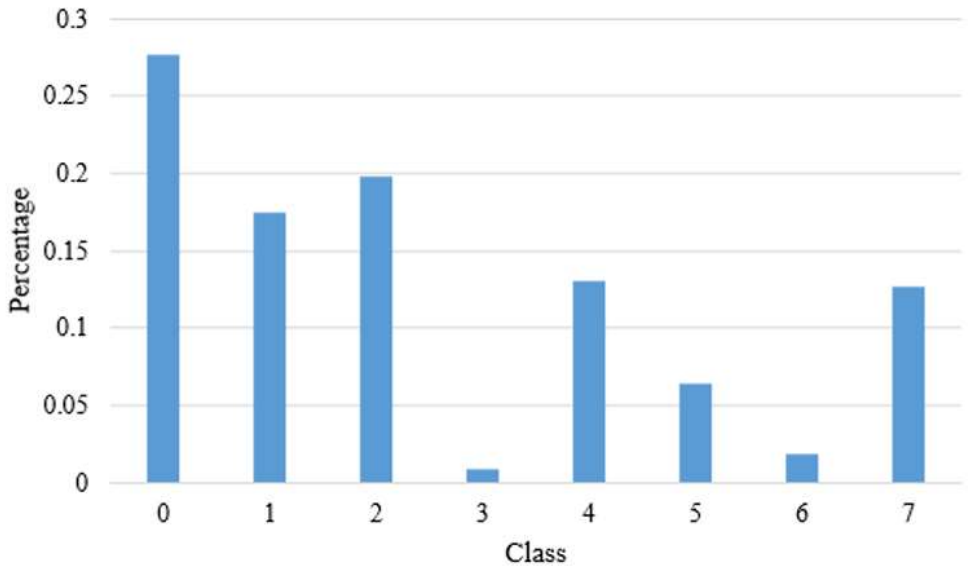
Generalized Few-Shot Semantic Segmentation (GFSS)

- Setting
  - Trained on base classes
  - Fed few-shot novel classes
- Task
  - Segment for all classes (including base and novel classes)
- Key
  - Base-class performance + novel-class generalizability



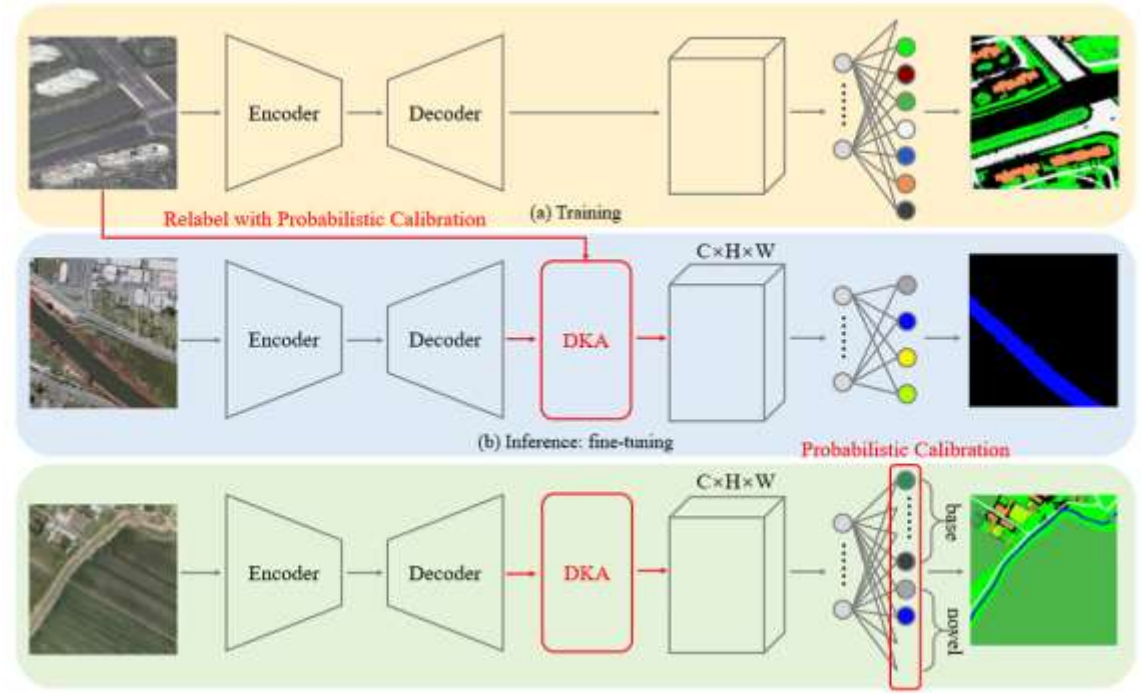
Dilemma

- The lack of adaptability to learn novel classes
- The catastrophic forgetting of base classes
- The biased prediction of imbalanced classes



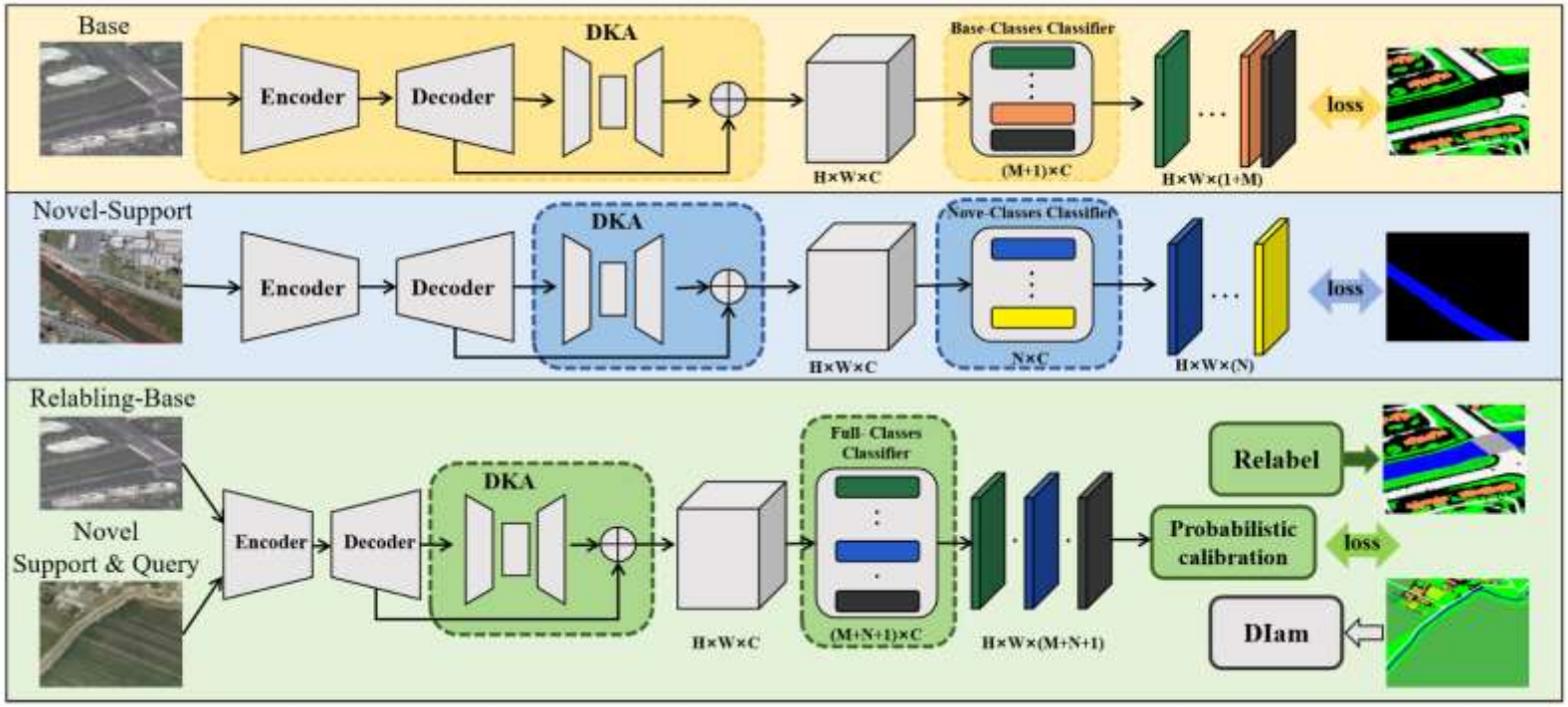
Preliminaries

- Dynamic Knowledge Adapter (DKA)
  - selecting only efficient parameters for finetuning
  - Relabeling: addresses the stability problem
- Probabilistic Calibration Module (PCM)
  - rectify the prediction bias caused by imbalanced data

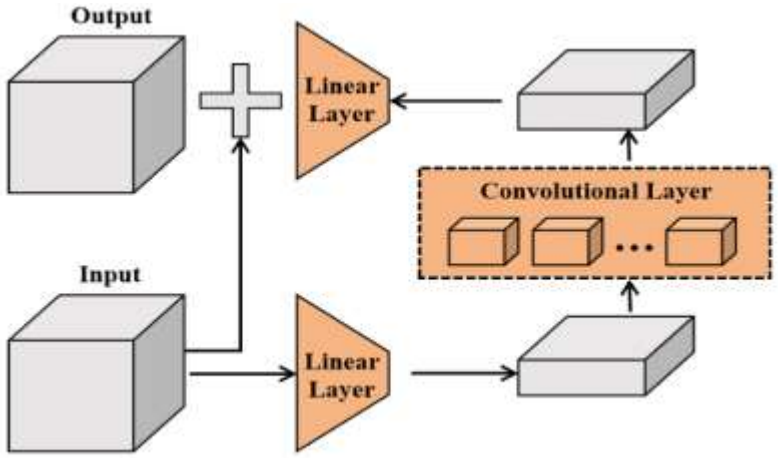


Method framework

- Two-stage training paradigm (training-inference)
  - Training: utilize the base class to train encoder, decoder, DKA
  - Finetuning: fix encoder and decoder
    - Fine-tuning DKA and novel classifier with novel classes
    - Concatenating the novel-class and base-class classifiers initializes a full-classes classifier
    - Randomly sample and relabel base class training samples



Dynamic Knowledge Adapter

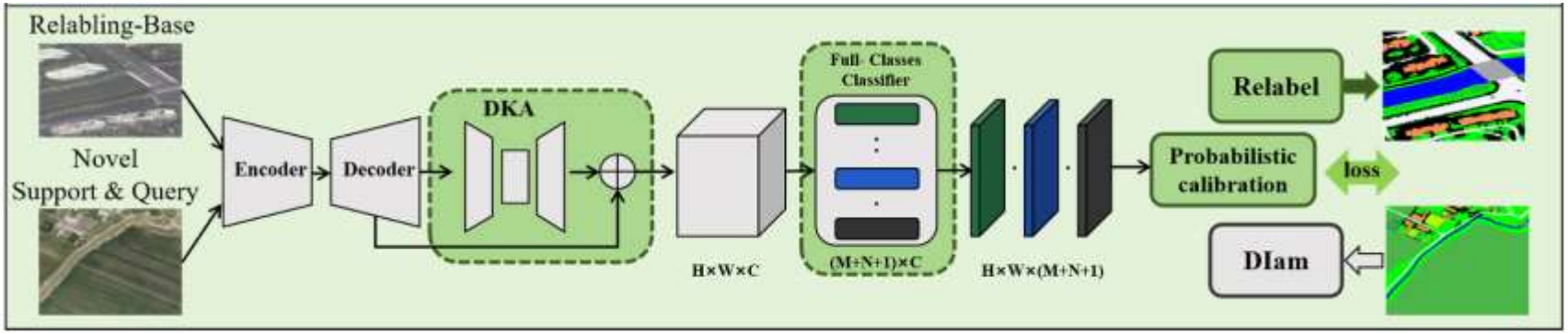


- DKA structure

$$W_{\text{in}} \in \mathbb{R}^{C \times r}, \quad W_{\text{tran}} \in \mathbb{R}^{r \times r \times 1 \times 1} \quad W_{\text{out}} \in \mathbb{R}^{r \times C}$$

- Relabelling
  - sample k × 10 images from the training set
  - k is the total number of categories

Calibrating Probabilistic



- Alleviate the probabilistic bias

$$P = softmax(\tau f_{DKA}(f_{\phi}(X))\theta_n)$$

τ : hyper-parameter

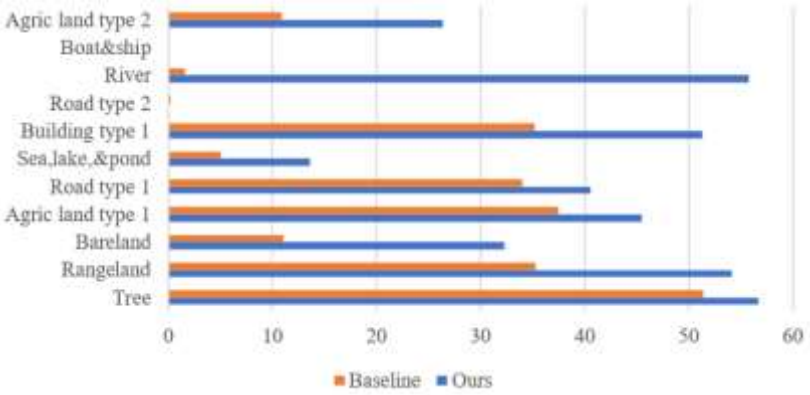
- Mitigate the model's bias towards the background

$$P_{new} = (1 - M) \odot P + \gamma M$$

Experiments

Comparison With Baseline

Method	Base	Novel	Weighted average
Baseline	29.89401	3.15314	13.84949
Ours	**42.00045**	**20.51581**	**29.10967**



Ablation Study

DKA	Relabeling	Probabilistic Calibration	base	novel	Weighted Average
x	x	x	29.89	3.15	13.85
y	x	x	37.20	8.49	19.97
y	y	x	37.93	10.93	21.73
y	y	y	42.00	20.52	29.11

Thanks!