Parameter Efficient Self-Supervised Geospatial Domain Adaptation

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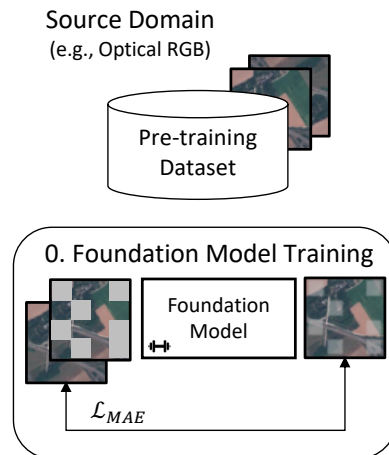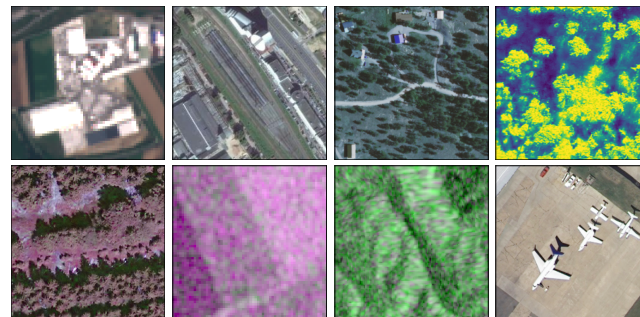
Background

Remote sensing data:
- Large amounts of unlabeled data
- Heterogeneous sensors
  - RGB, multi-spectral, synthetic aperture radar, …

Visual foundation models:
- MAE, SatMAE, ScaleMAE, …

VFMs on unseen modalities and tasks:
- Poor zero-shot capabilities
- Fine-tuning is computationally expensive
- Often infeasible with small labeled datasets

Source Domain
(e.g., Optical RGB)

Pre-training Dataset

0. Foundation Model Training

Foundation Model

$\mathcal{L}_{MAE}$

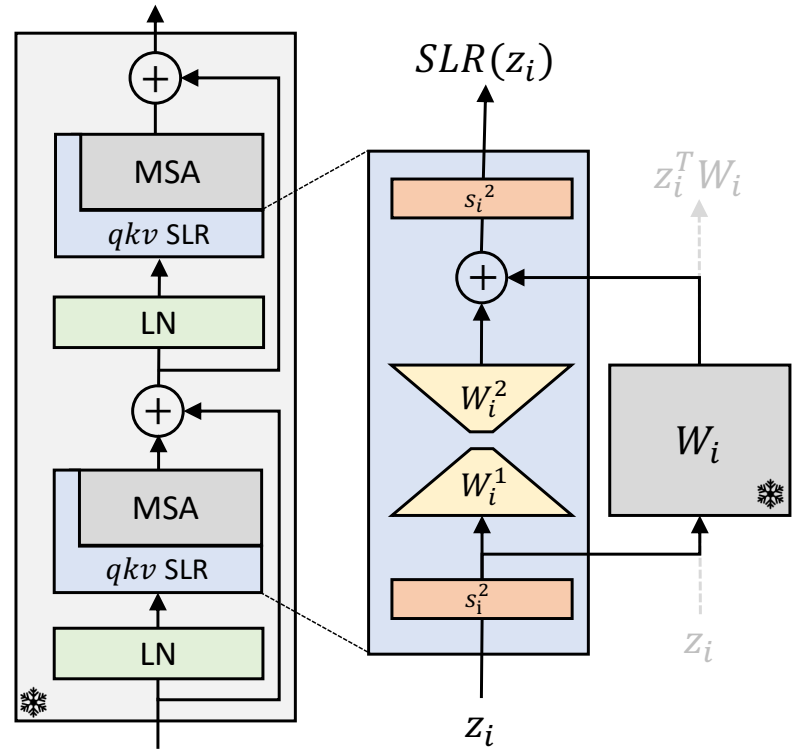University of St.Gallen
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How to adapt visual foundation models for downstream tasks on unseen geospatial modalities?
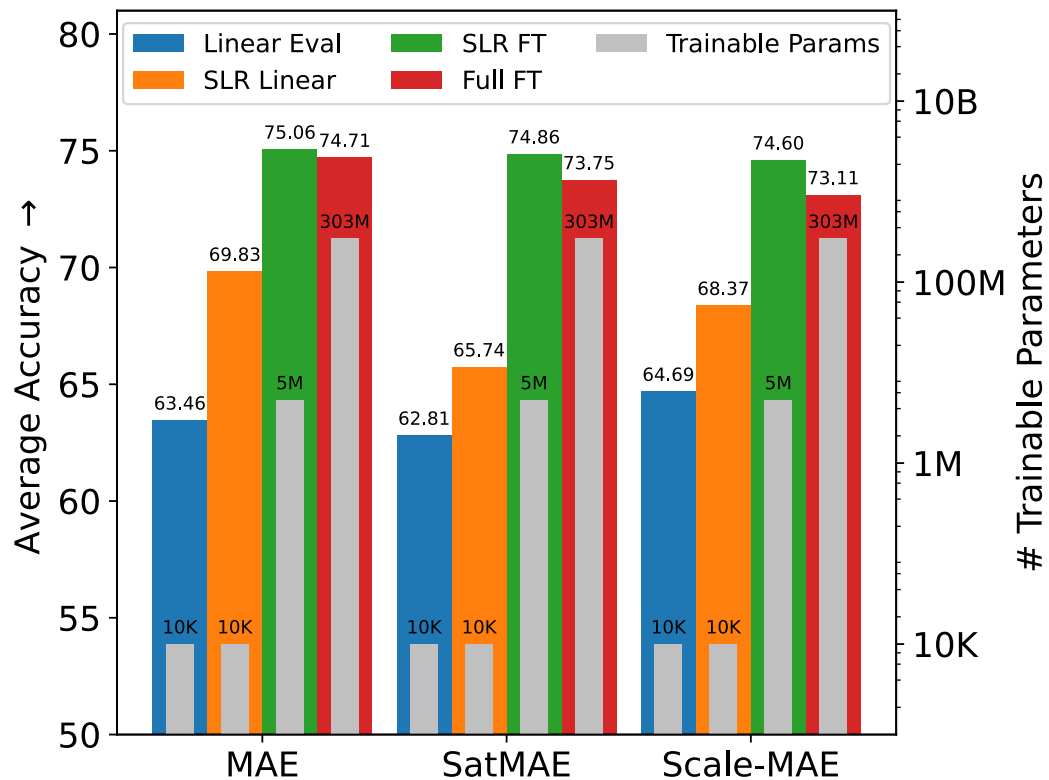
Method
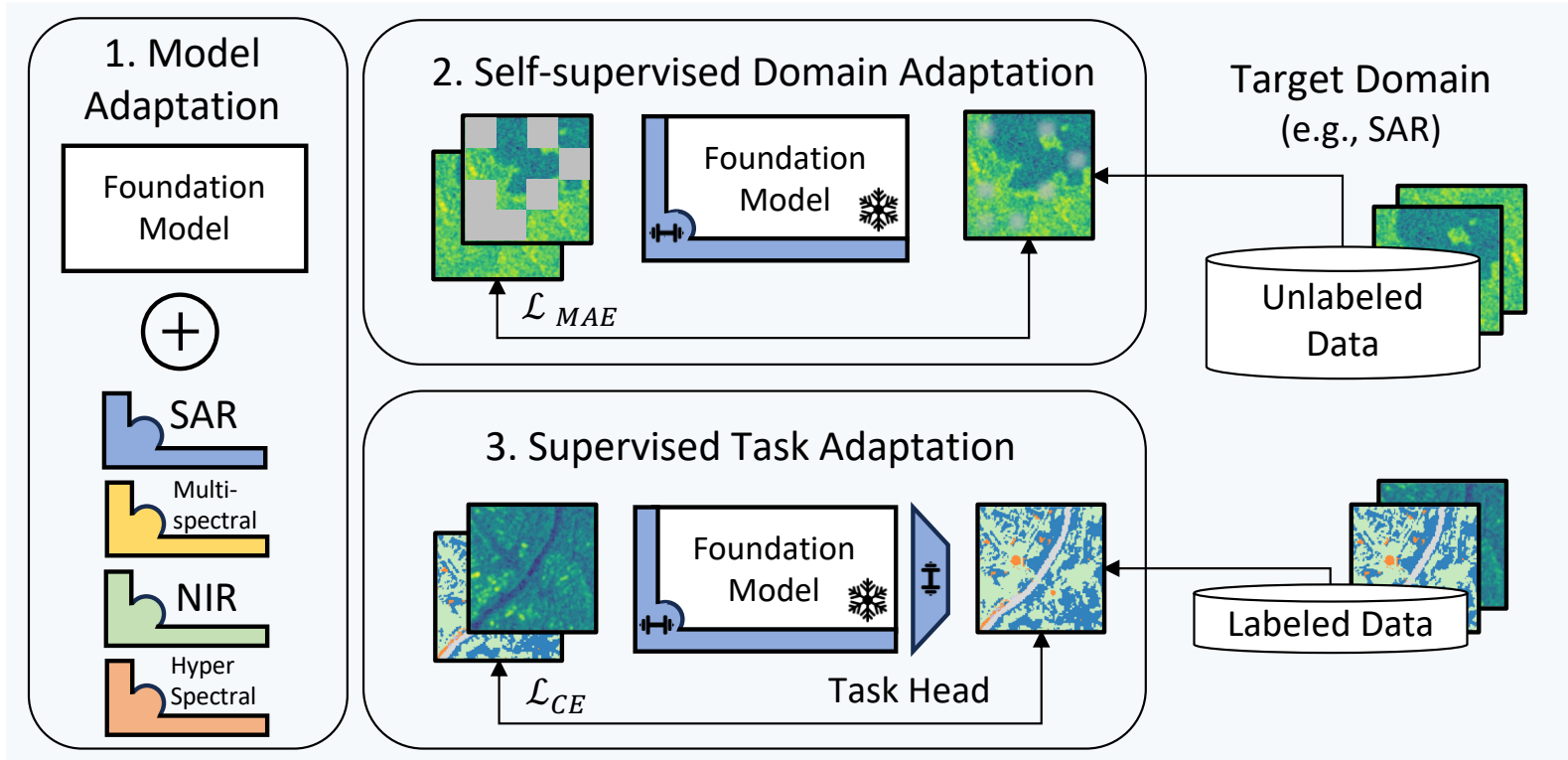
SLR Adapters

- Introduce new parameters for new modalities
- 1-2% additional model parameters
- Scaling and low-rank transformations

Results

Average performance over 8 remote sensing datasets for different VFMs

EuroSAT, RESISC45, FireRisk, TreeSatAI, EuroSAT-SAR, BENGE-8K, BENGE-8k segmentation, UCMerced

Results

Few-shot learning

Method	Params	$k = 10$	$k = 100$
Linear Eval.	10k	75 ± 0.5	89 ± 0.5
SLR Linear	10k	74 ± 0.2	92 ± 0.5
SLR Scale	0.5M	87 ± 0.6	$\mathbf{96 \pm 0.1}$
SLR FT	7.3M	$\mathbf{88 \pm 2.0}$	$\mathbf{96 \pm 0.1}$
Fine-tune	304M	82 ± 2.0	95 ± 0.4

Table 3. Few-shot results with SatMAE on EuroSAT.

Method	Params	$k = 10$	$k = 100$
Linear Eval.	10k	63 ± 0.8	63 ± 0.2
SLR Linear	10k	71 ± 2.9	75 ± 0.1
SLR Scale	0.5M	$\mathbf{74 \pm 3.0}$	77 ± 0.3
SLR FT	7.3M	72 ± 3.0	$\mathbf{82 \pm 1.0}$
Fine-tune	303M	64 ± 1.6	77 ± 3.0

Table 4. Few-shot results with MAE on EuroSAT-SAR.

Conclusions

- SLR adapters improve linear and fine-tuning performance in remote sensing
- Self-supervised adapter training allows large models to adapt to new modalities
- Training as little as 1-2% of model parameters suffices

Code: github.com/HSG-AIML/GDA   **Poster Session 6:** #355

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