

Summary

Challenge

The severe data scarcity in hyperspectral images (HSIs).

Contribution

- Formulate a **generalized paradigm** for multi-source-based HSI synthesis, incorporating a series of deep generative models.
- Pioneer to **synthesis abundance** (low-dimensional) instead of HSI sample (high-dimensional).
- Incorporate **multi-source data** to alleviate the issue of limited sample availability.

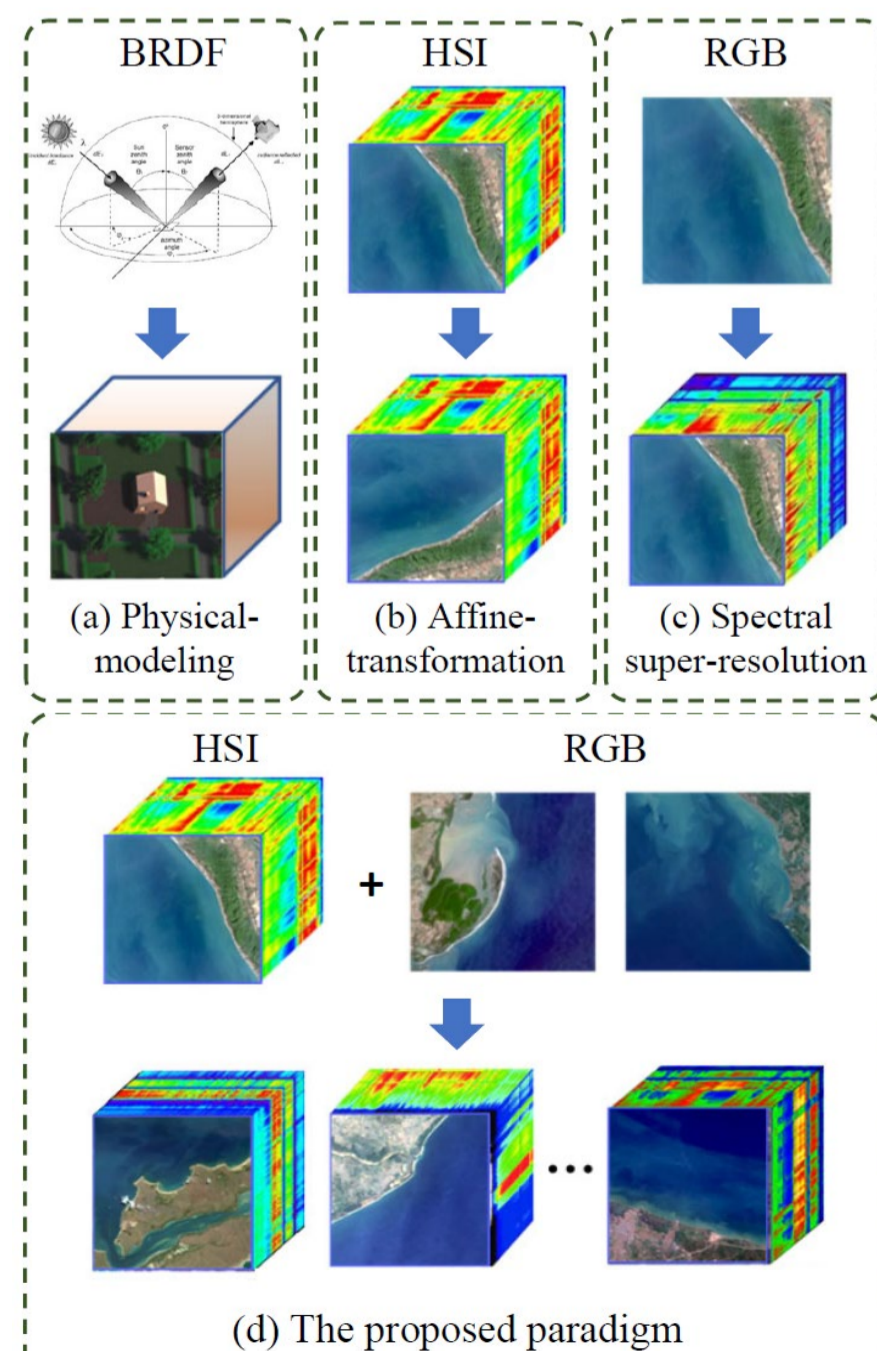
Motivation

Limitations of prior work

- Lack of authenticity
- Restricted diversity
- Inability to produce new HSI samples

New paradigm

- Customizing the unmixing across different scenes
- Introducing auxiliary data from multi-source
- Integrating a series of generative AI models



Method: Unmixing before Fusion

Key observation

- ▶ Similar scenes share common low-rank features that can be described by a few endmembers, while the differences between scenes can be captured in their abundance maps.

Pipeline overview

- **Unmixing across multi-source data**

$$\hat{E}_{HSI}, \hat{A}_{HSI} = \mathcal{U}(\Psi(Y_{HSI}))$$

$$\hat{A}_{RGB} = \mathcal{U}(Y_{RGB}, \hat{E}_{HSI})$$

\hat{E} : endmember; \hat{A} : abundance; Y : Input; $\Psi(\cdot)$: band selection; $\mathcal{U}(\cdot)$: the trained unmixing network.

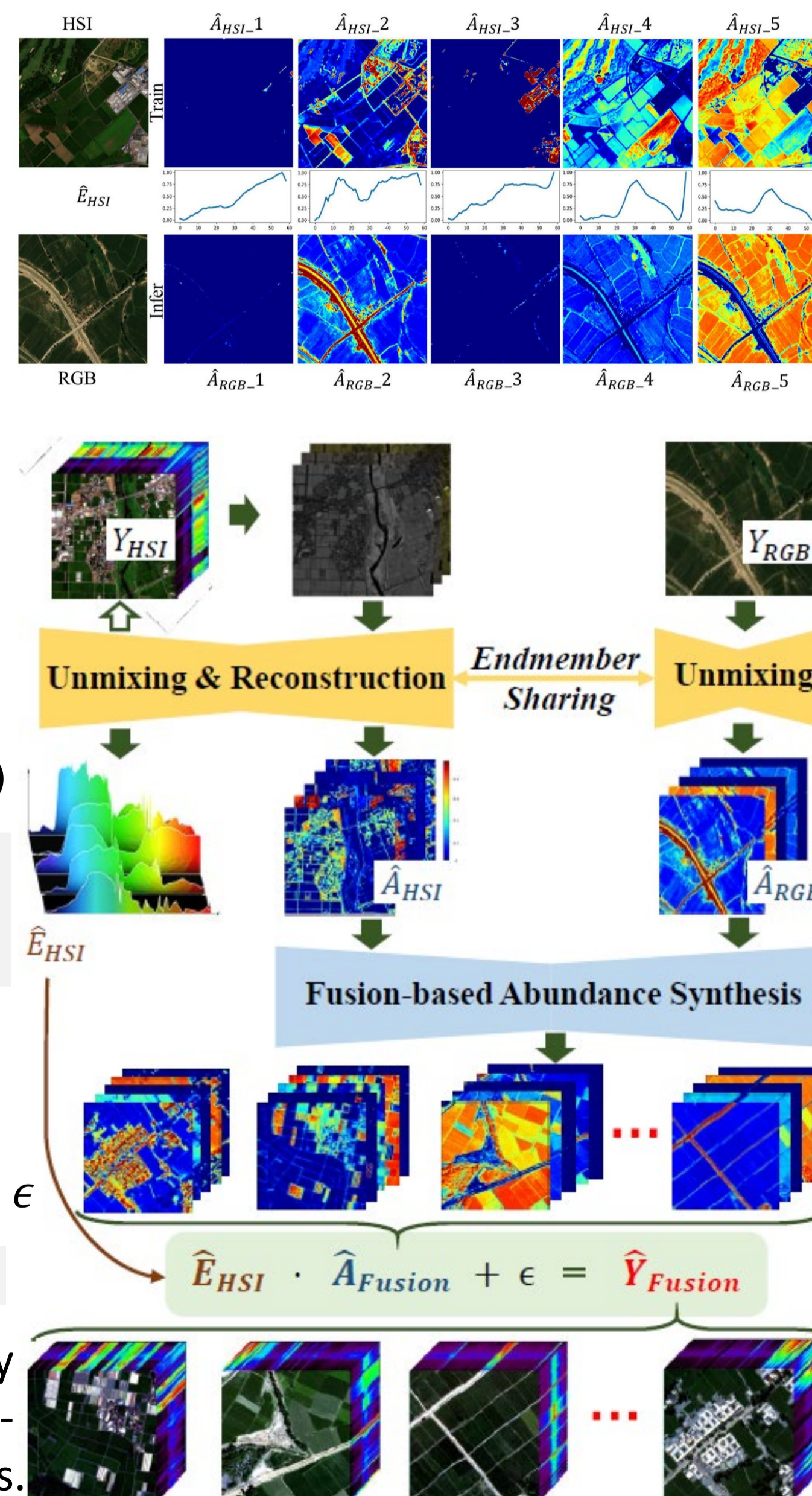
- **Fusion-based synthesis**

$$\hat{A}_{Fusion} = \mathcal{G}(\hat{A}_{RGB}, \hat{A}_{HSI})$$

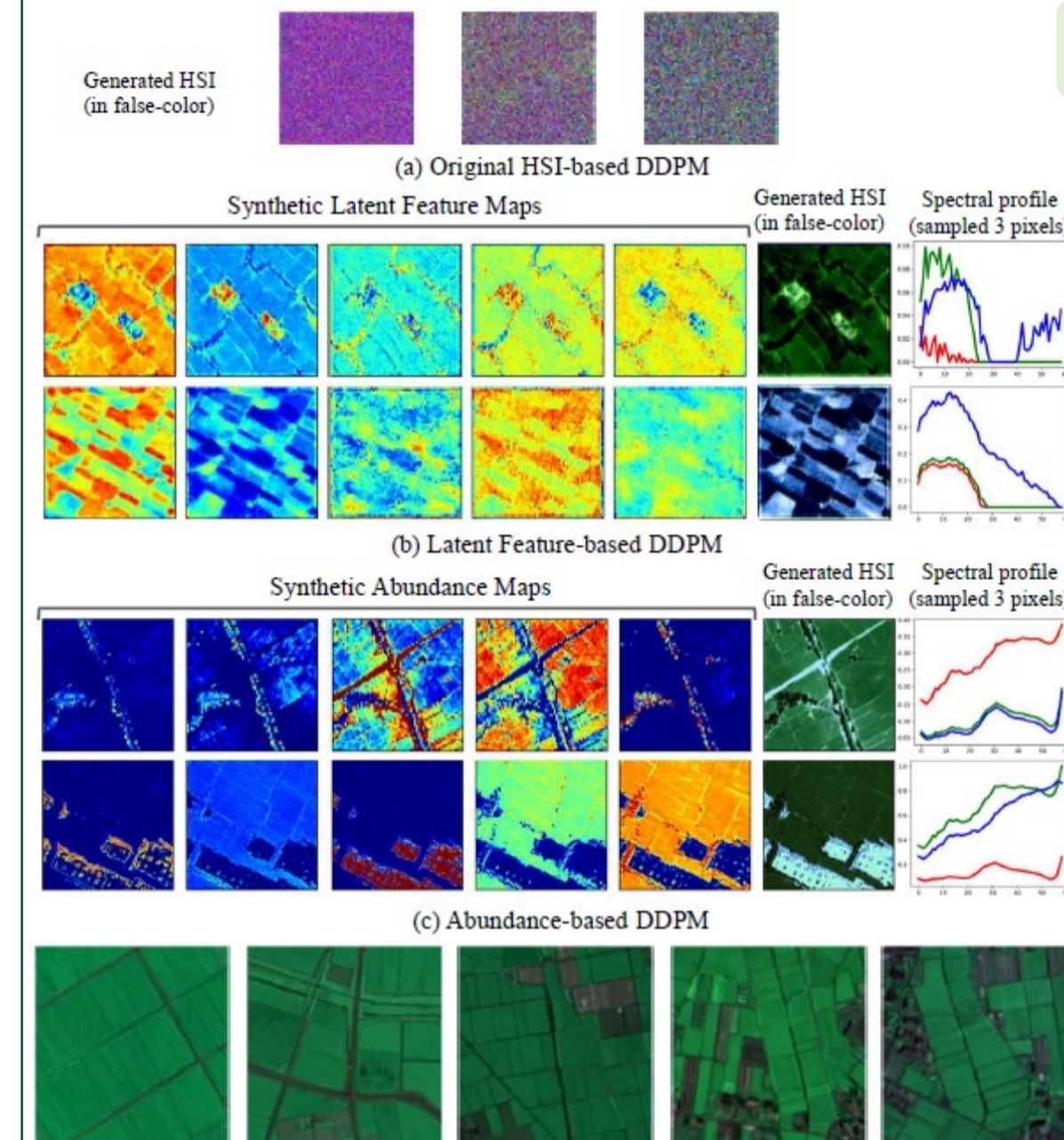
$$\hat{Y}_{Fusion} = \hat{E}_{HSI} \cdot \hat{A}_{Fusion} + \epsilon$$

$\mathcal{G}(\cdot)$: the generative AI model.

- ▶ Generating a vast quantity of diverse, reliable, and high-fidelity synthetic HSI samples.



Results



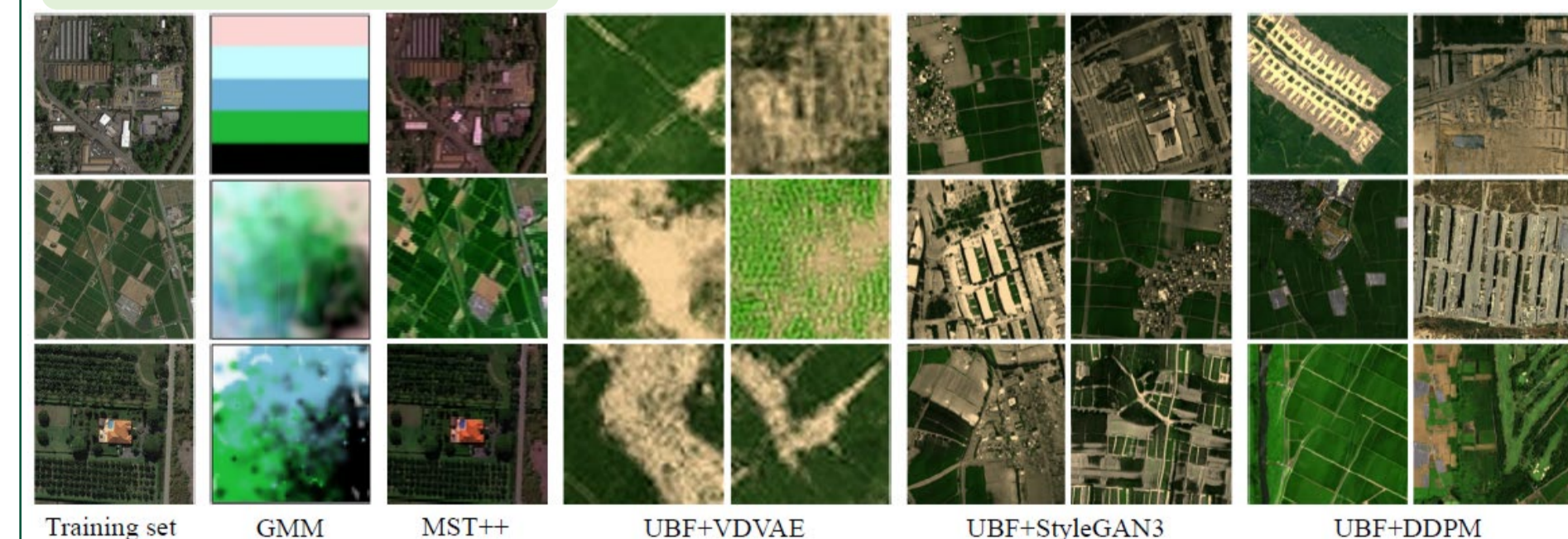
Ablation on unmixing

- ▶ Synthesizing from the abundance can largely alleviate the difficulties in high-dimensional cube space.
- ▶ Synthesizing with HSI datasets alone generate results in monotonous.

Ablation on fusion

ps: Please see more results/ablations in our paper.

Synthesis results



Validation on downstream tasks

Augmentation	Training set scale	AlexNet	VGG-16	ResNet-18
\times	761	89.51%	87.30%	37.14%
Affine Trans.	4k	91.11%	88.84%	41.75%
Our UBF	4k	92.70%	93.97%	44.33%
Our UBF	8k	94.29%	94.60%	45.76%



Check out the project website!

✉ yuyang1995@whu.edu.cn
✉ panerting@whu.edu.cn