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Bretagne-Pays de la Loire
École Mines-Télécom

Sparsity and patch for image restoration

UE COMPIM Project : Final Presentation

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CONTEXT

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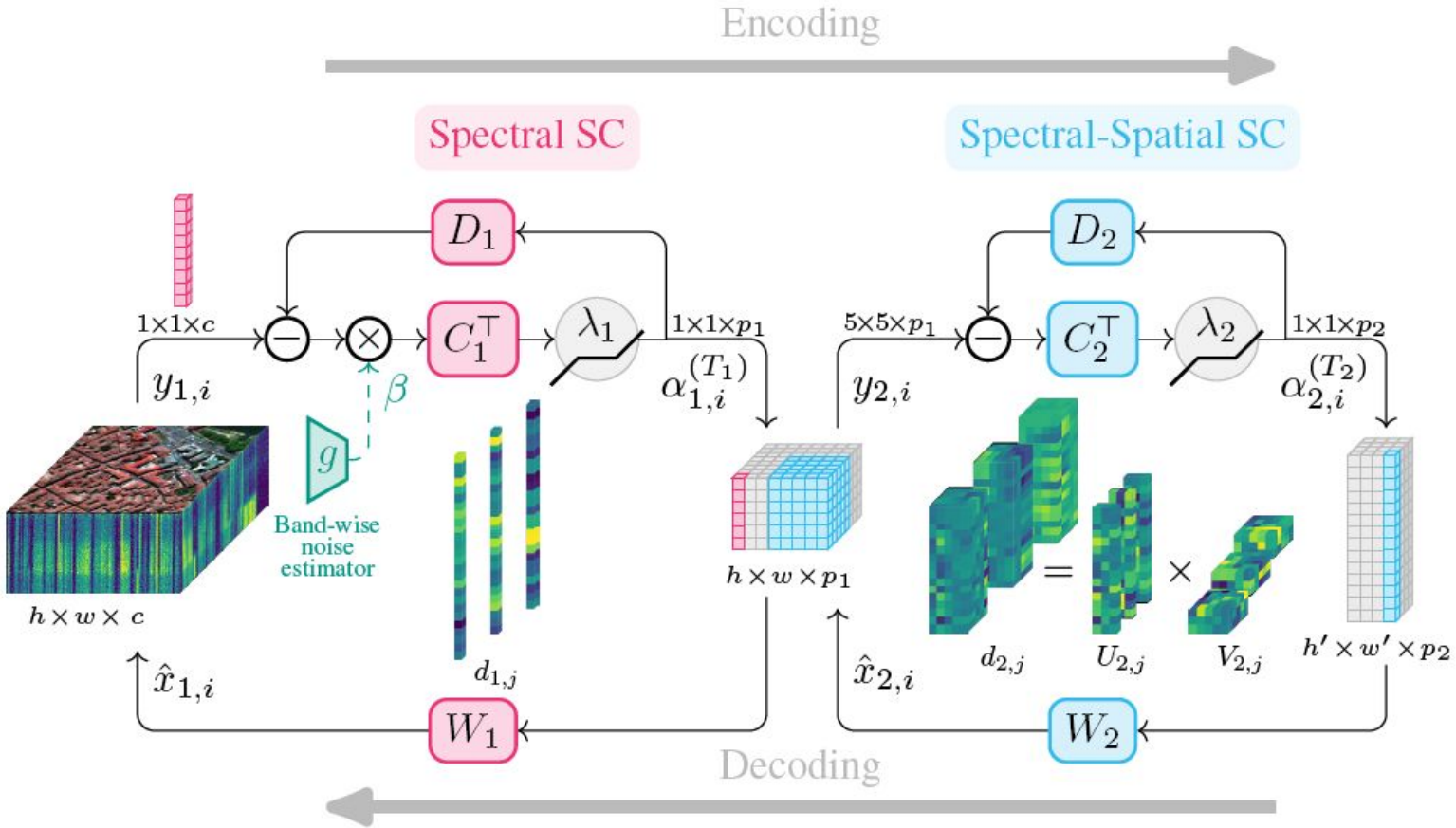
The T3SC model



IMPLEMENTATION

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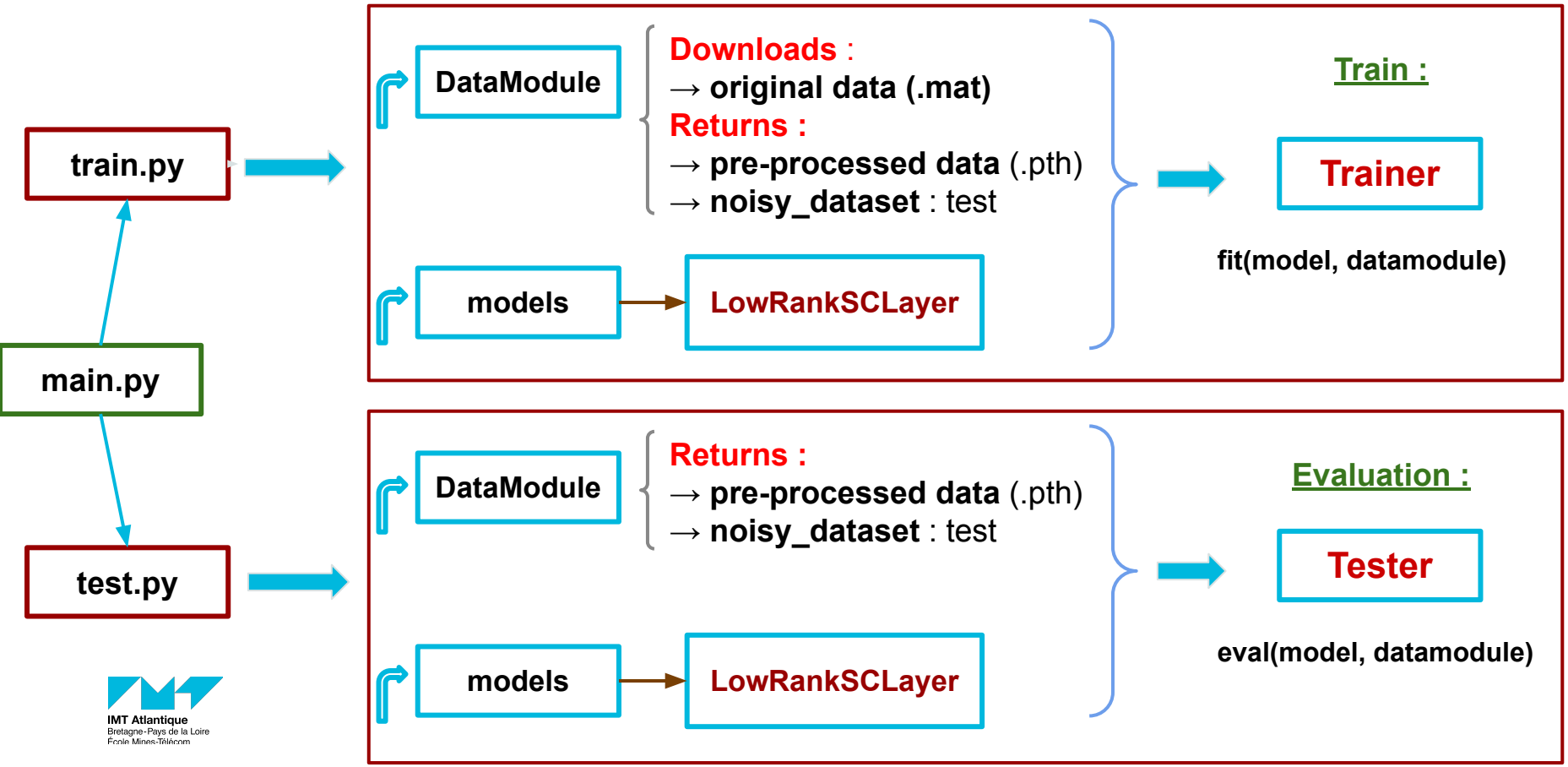
Overall structure of the code (Achraf)



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Training setup(Achraf)

The default hyperparameters :

- **Max_epochs :** 60
- **Optimizer :** Adam with MultiStepLR
- **Batch size** : 16
- **Model** : LowRankSCLayer
- **Data :** ICVL dataset was used in the train and test :
  - Consists of **204** images of size **1392×1300** with **31 bands** (100 images for training, 50 for testing)
- **Constant Noise :** Gaussian noise added to all bands of an image with std=50

Training setup

Training :

- The **training** requires a significant amount of **resources** :
  - A **lot of memory** for processing a huge dataset of **27 GB**
  - A **GPU** with **CUDA** support for efficient computation

⇒ **We used pre-trained models from the official repo on github**

Pre-processing :

- **Normalisation with GlobalMinMax** :
  (x - min(x)) / (epsilon + max(x) - min(x))
- **Data augmentation** in train :
  - Random Horizontal Flip
  - Random Vertical Flip
  - Random Rotation with 90 degrees

EXPERIMENTS

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Metrics

Several metrics to evaluate the denoising quality :

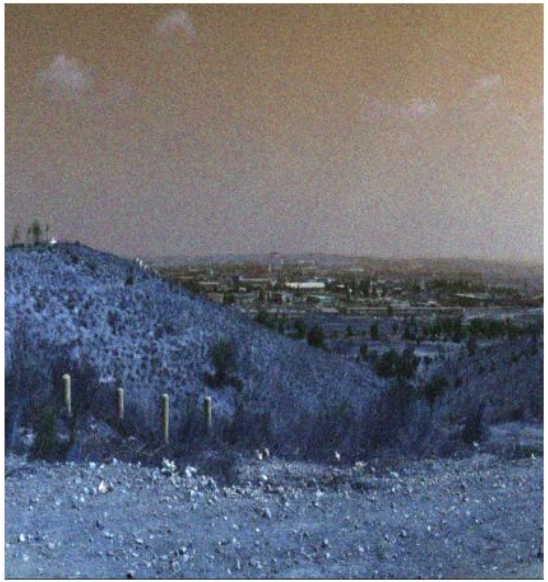
- Peak Signal-to-Noise Ratio (PSNR)
- Structural Similarity (SSIM)
- Feature Similarity (FSIM)
- Relative dimensionless global error synthesis (ERGAS)

Note: We take the average of these metrics over the dataset.

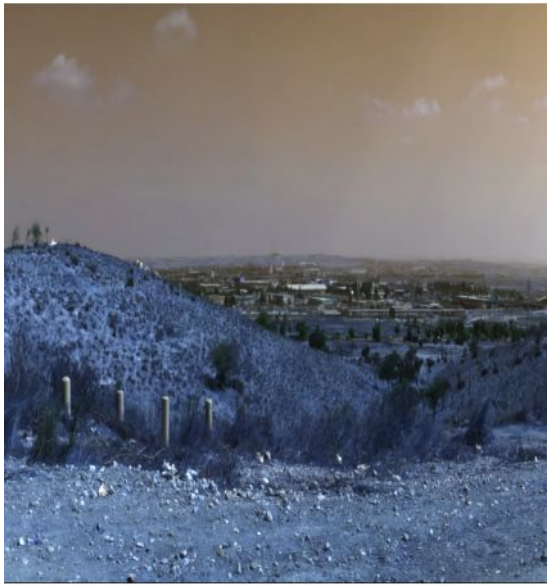
Results on constant noise

Clean image

Noisy image



Denoised image



Example of image denoising using T3SC model. The type of noised used here is constant noise.

METRICS:

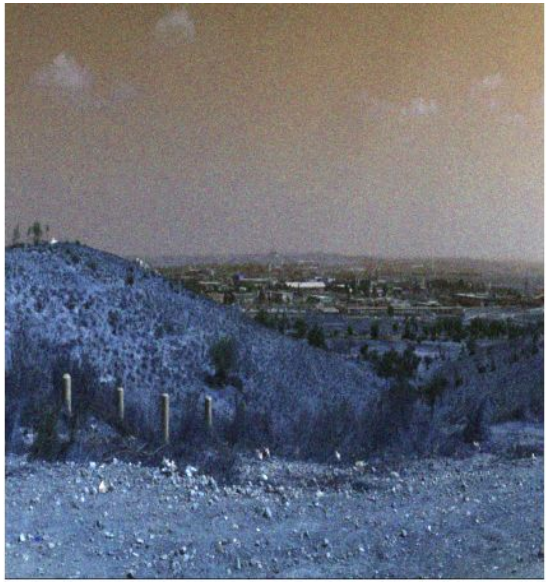
MPSNR_in = 20,64
MPSNR_out = 43,89

MSSIM_in = 0,16
MSSIM_out = 0,98

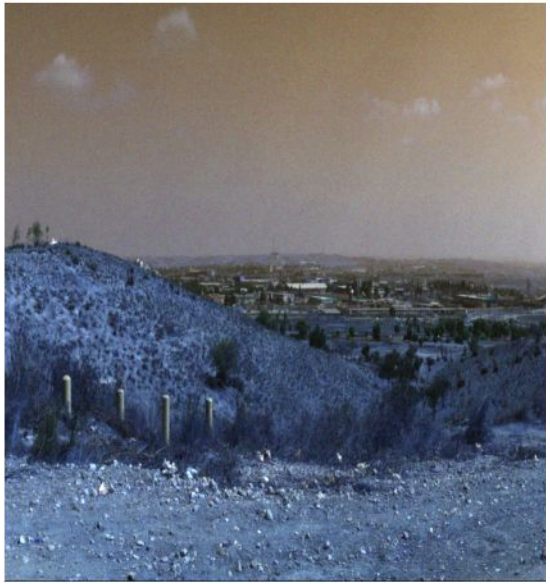
Results on correlated noise

Clean image

Noisy image



Denoised image



Example of image denoising using T3SC model. The type of noised used here is correlated noise.

METRICS:

MPSNR_in = 21,46
MPSNR_out = 29,33

MSSIM_in = 0,18
MSSIM_out = 0,55

CONCLUSION

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Conclusion

About the code :

- Problems encountered to run the code because some libraries use an obsolete version
- The code is not easily flexible to new images. Difficult to apply the model to extra hyperspectral images with different characteristics (bands etc.)
- Multiple pre-trained models available for different noise types
- Good variety of the computed metrics

About the T3SC model :

- Sensor-specific model
- Based on a strong mathematical background about sparse coding