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A CNN-BASED Super-Resolution of SWIR band

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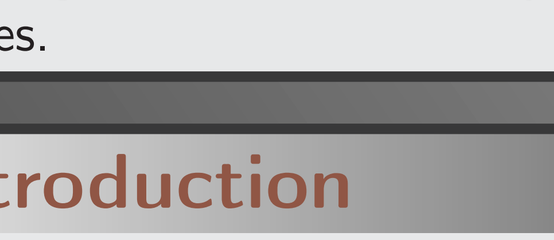
Abstract

We propose a Deep Learning approach for Super-resolution of Sentinel-2 SWIR band, using complementary higher resolution bands. The proposed method **[1]** compares favourably against state-of-the-art techniques according to different quality indexes.

Introduction

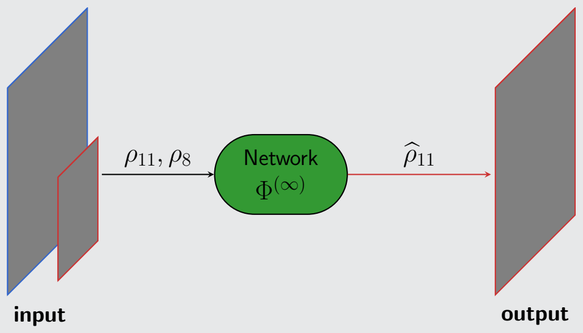
A classic pansharpening approach achieves its goal using the spatial details from a higher-resolution panchromatic component, whose spectral range overlaps with the MS bands.

Objective



Warning: in our case (SWIR) we do not dispose of overlapping higher-resolution bands. Thus, we resort to HR bands from visible spectrum.

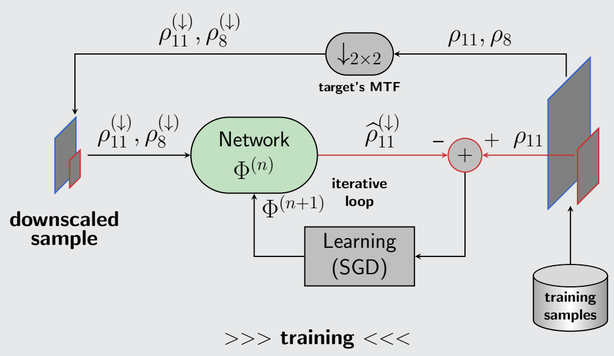
Methods

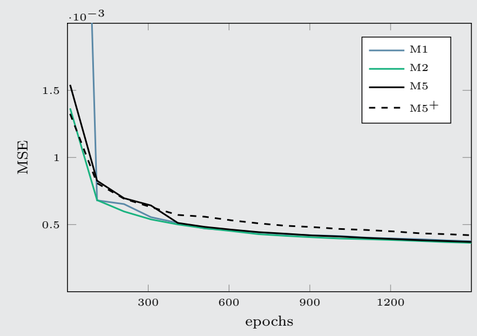


>>> **inference** <<<

Model	input bands	kernel size (# features)		
		$l=1$	$l=2$	$l=3$
M1	ρ_{11}	**3×3**	**3×3**	**3×3**
M2	ρ_{11},ρ_8	**3×3**	**3×3**	**3×3**
M5	ρ_{11}, ρ_8, ρ_2, ρ_3, ρ_4	**3×3 (48)**	**3×3 (32)**	**3×3 (1)**, $\widehat{\rho}_{11}$

Wald's Protocol





Loss: $L(W) = \frac{1}{128}\sum_{n=1}^{128} ||X_n - \hat{X}_n(W)||$

Backprop.: $W_{i+1} = W_i + \Delta W_i$

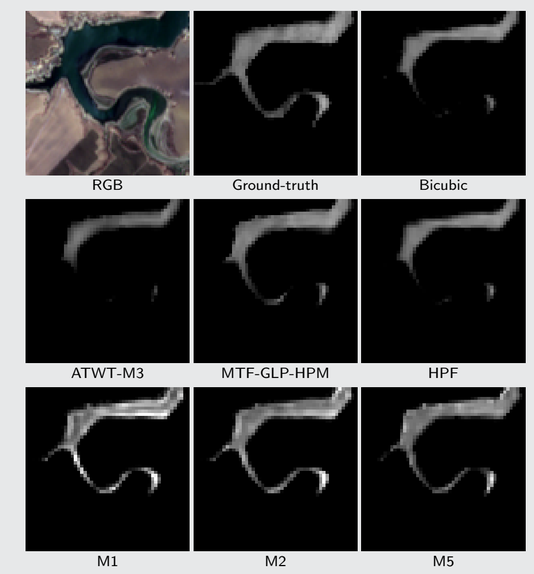
Model	kernel size $l=1$	$l=2$	$l=3$	time [s]
M5+	9×9	5×5	5×5	7605
M5	3×3	3×3	3×3	4794

Table

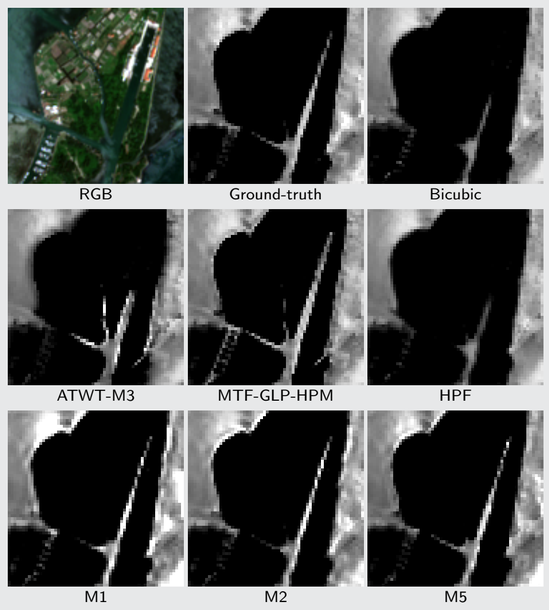
Methods (ideal value)	Q-index (1)	ERGAS (0)	HCC (1)	CER (0)	L-CER (0)
Bicubic	0.9914	4.992	0.5366	0.0166	0.1876
M1 (proposed)	**0.9970**	**3.036**	**0.7090**	**0.0086**	**0.0909**
ATWT-M3	0.9873	5.949	0.5828	0.0160	0.1762
MTF-GLP-HPM	0.9823	7.245	0.4509	0.0207	0.1370
HPF	0.9922	4.688	0.5832	0.0138	0.1680
M2 (proposed)	**0.9975**	**2.830**	**0.7718**	**0.0064**	**0.0637**
M5+ (proposed)	0.9947	4.294	0.8432	0.0142	0.0946
M5 (proposed)	**0.9983**	**2.354**	**0.8500**	**0.0066**	**0.0594**

Accuracy of $\widehat{\rho}_{11}$ (Q-index, ERGAS, HCC) and water maps (CER, L-CER) at 20-m.

Results



a sample from Tunisie



a sample from Italy

Future works

◇ Changing the loss function
◇ Considering deeper network
◇ Fine tuning on other areas with smaller dataset
◇ Further lower resolution bands

Warning: ***Deeper CNN → more data.***

Major References

[1] Gargiulo, M., Mazza, A., Gaetano, R., Ruello, G., and Scarpa G. (2018)
A CNN-BASED fusion method for Super-Resolution of Sentinel-2 data.

[2] Masi, G., Cozzolino, D., Verdoliva, L., and Scarpa, G. (2016)
Pansharpening by Convolutional Neural Networks.