Deep Image Prior

Dmitry Ulyanov, Andrea Vedaldi, Victor Lempitsky, 2018

Article :
https://sites.skoltech.ru/app/data/uploads/sites/25/2018/04/deep_image_prior.pdf

Rappel sur les problèmes inverses

- x image à recréer
- $\hat{x}$ image corrompue

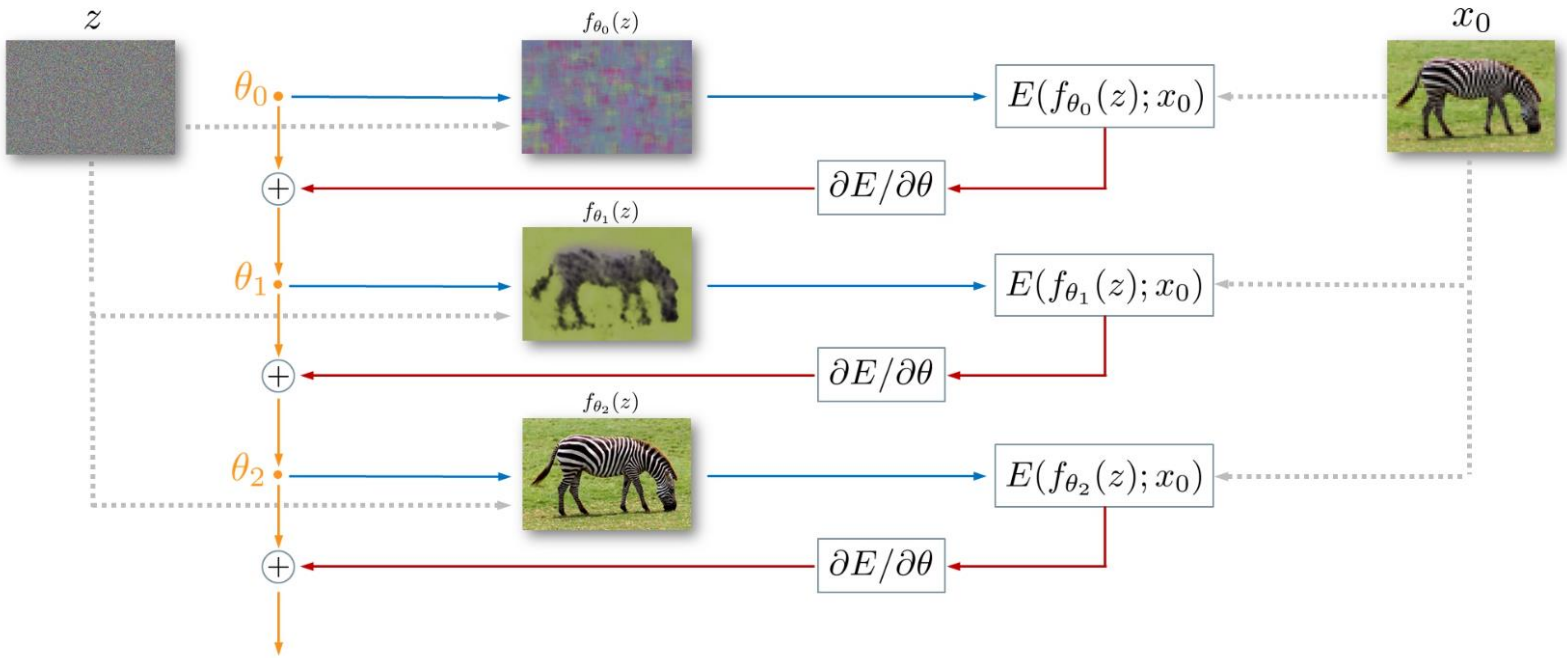
- $\arg\min_{x} E(x; \hat{x}) + R(x)$
- $\arg\min_{\theta} E(g(\theta); \hat{x}) + R(g(\theta))$

- g est un a priori :
- $\arg\min_{\theta} E(g(\theta); \hat{x})$

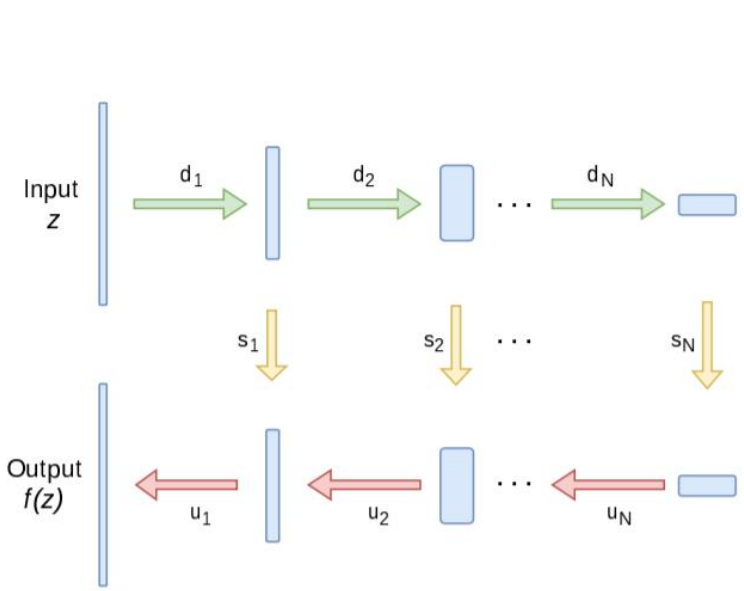
Deep Image Prior

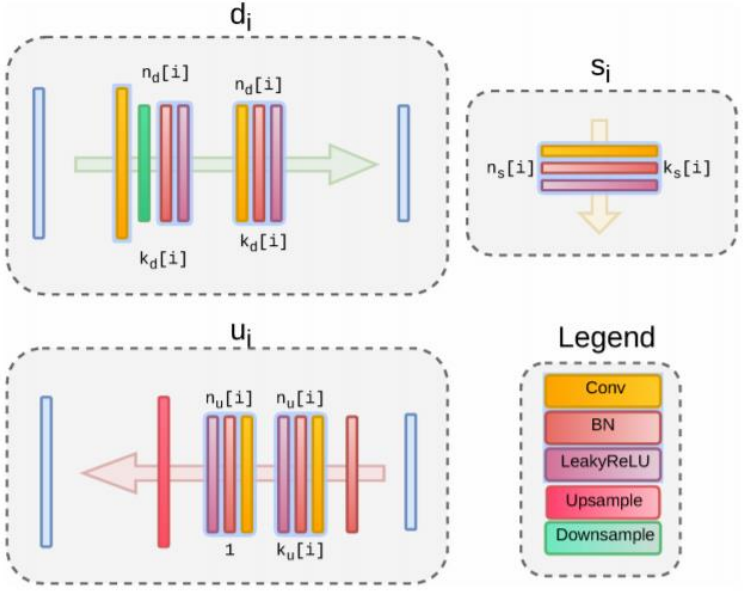
- $g(\theta) = f_\theta(z)$
- Initialisation de z :
  - Image aléatoire générée par la loi uniforme U(-1, 1)
- Résolution de : $\arg\min_\theta E(g(\theta); \hat{x})$
  - Descente de gradient
- MSE

Deep Image Prior

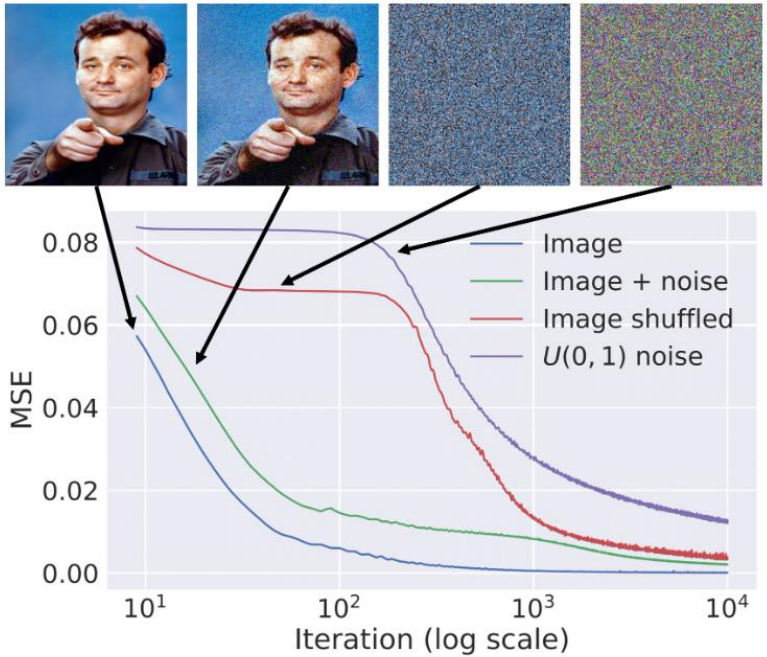


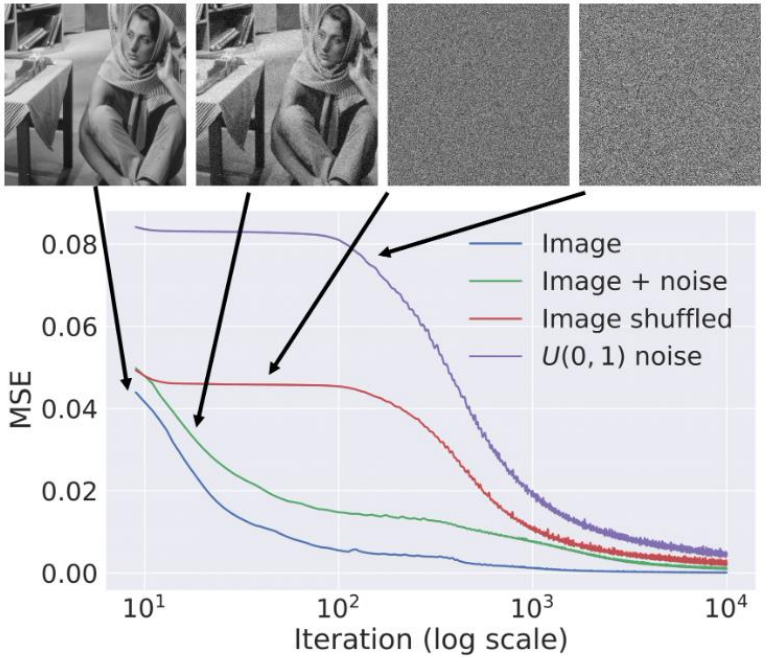
Architecture





Débruitage


0.08
0.06
0.04
0.02
0.00
MSE
10^1
10^2
10^3
10^4
Iteration (log scale)
Image
Image + noise
Image shuffled
$U(0, 1)$ noise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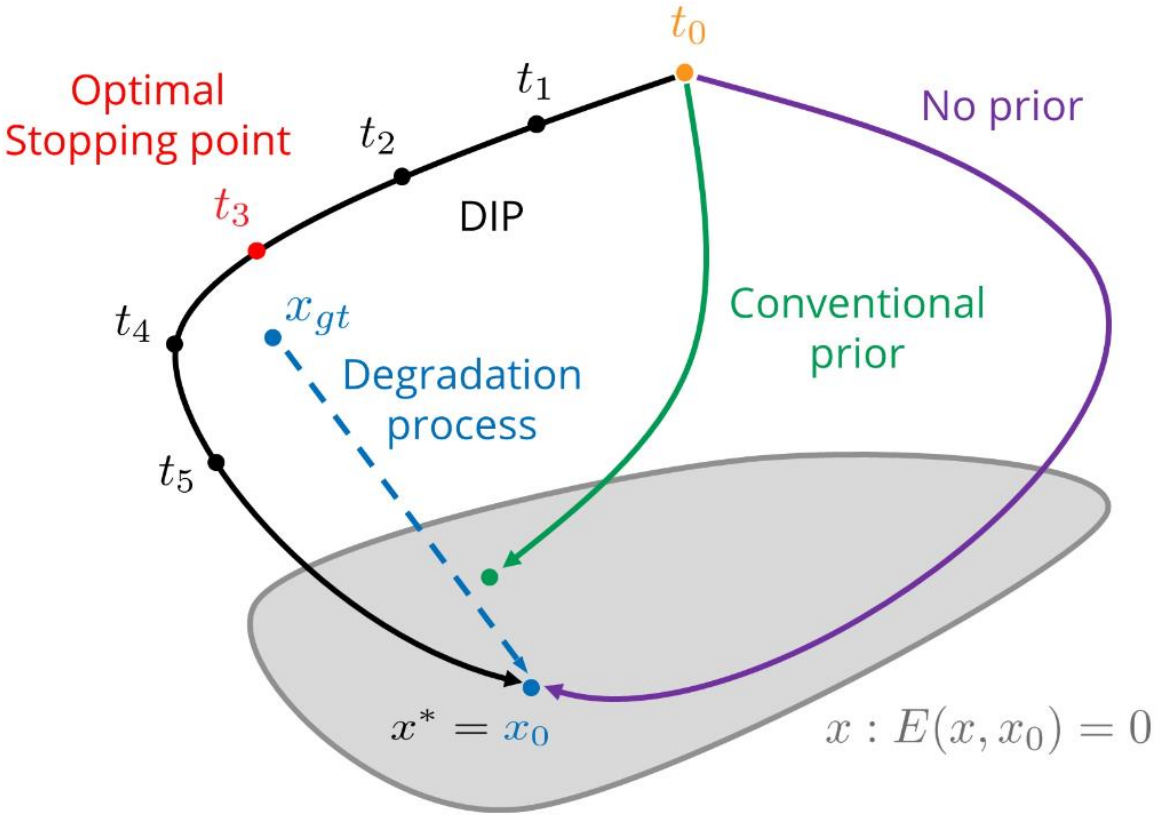
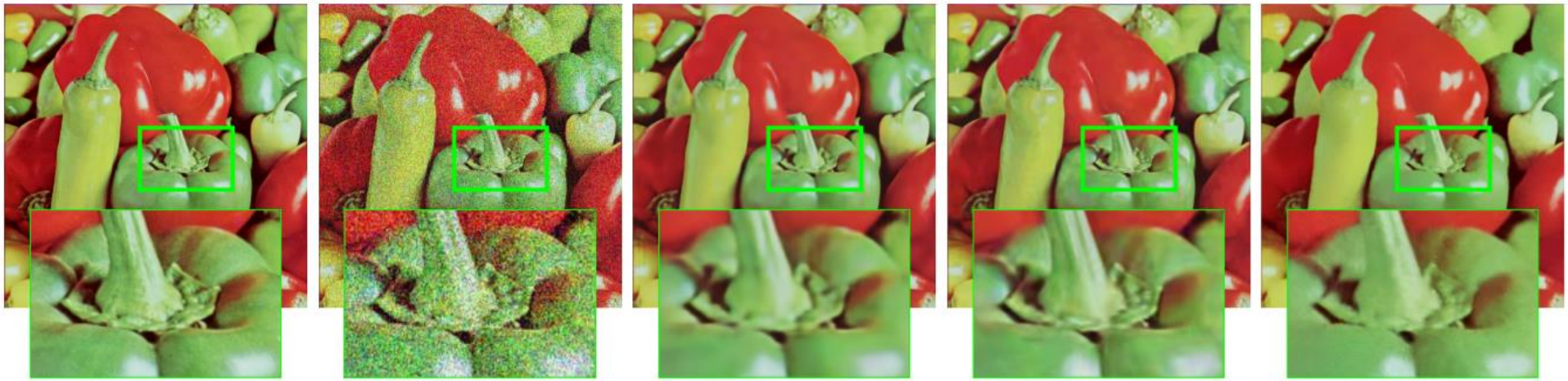
Débruitage

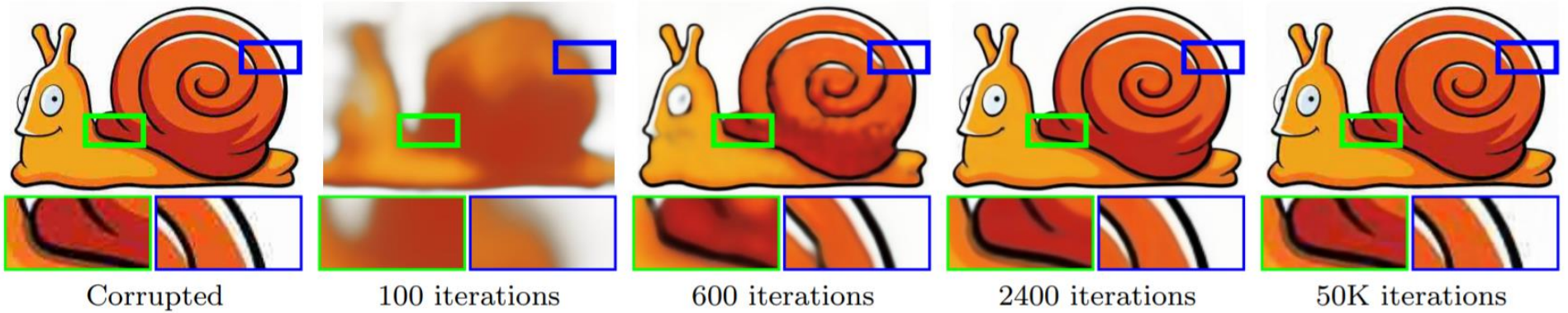

t_0
t_1
t_2
t_3
t_4
t_5
Optimal
Stopping point
DIP
No prior
Conventional
prior
x_{gt}
Degradation
process
$x^* = x_0$
$x : E(x, x_0) = 0$

Résultats



(a) GT (b) Input (c) Ours (d) CBM3D (e) NLM

Early Stopping



Loss

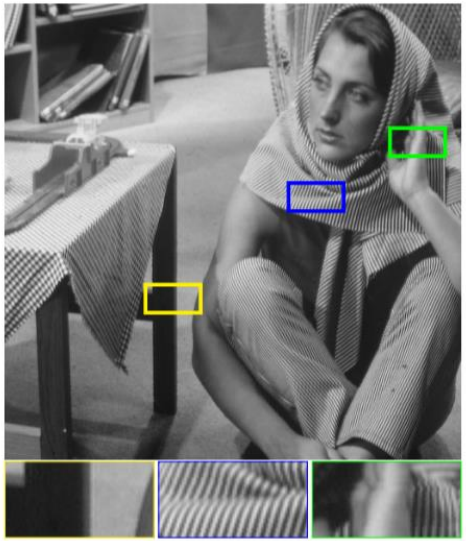
- x - image à recréer
- $\hat{x}$ - image corrompue
- m - masque

- Débruitage : $E(x; \hat{x}) = \|x - \hat{x}\|^2$ (early stopping)
- Inpainting : $E(x; \hat{x}) = \|(x - \hat{x}).m\|^2$
- Super-résolution : $E(x; \hat{x}) = \|d(x) - \hat{x}\|^2$

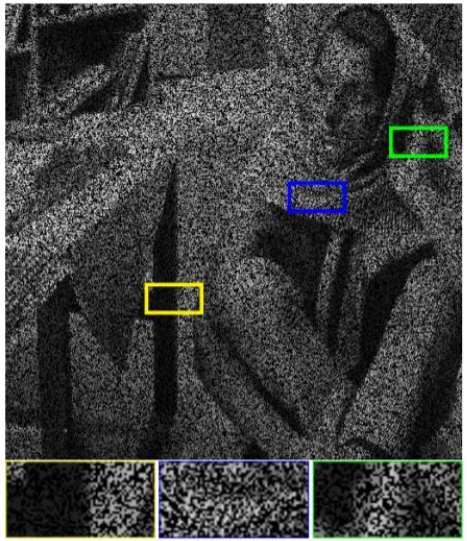
Inpainting

(a) Original image (b) Corrupted image (c) Shepard networks [44] (d) Deep Image Prior

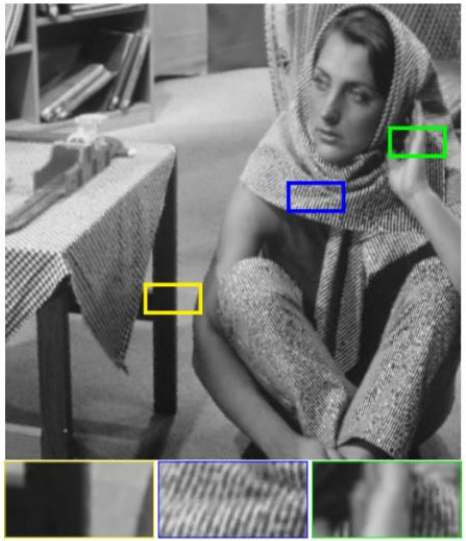
Inpainting



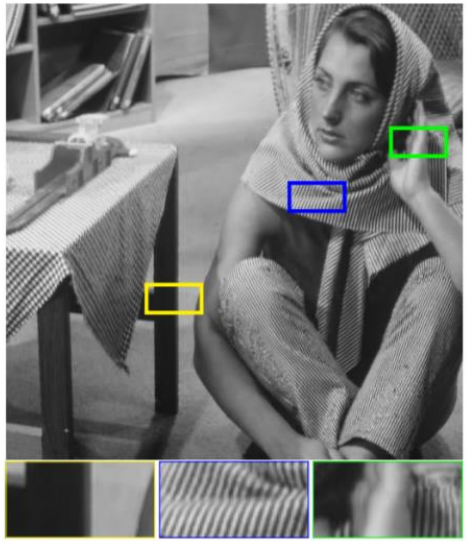
(a) Original image



(b) Corrupted image



(c) CSC [42]



(d) Deep image prior

Inpainting

(a) Corrupted image

(b) Global-Local GAN [27]

(c) Ours, LR $= 0.01$

(d) Ours, LR $= 10^{-4}$

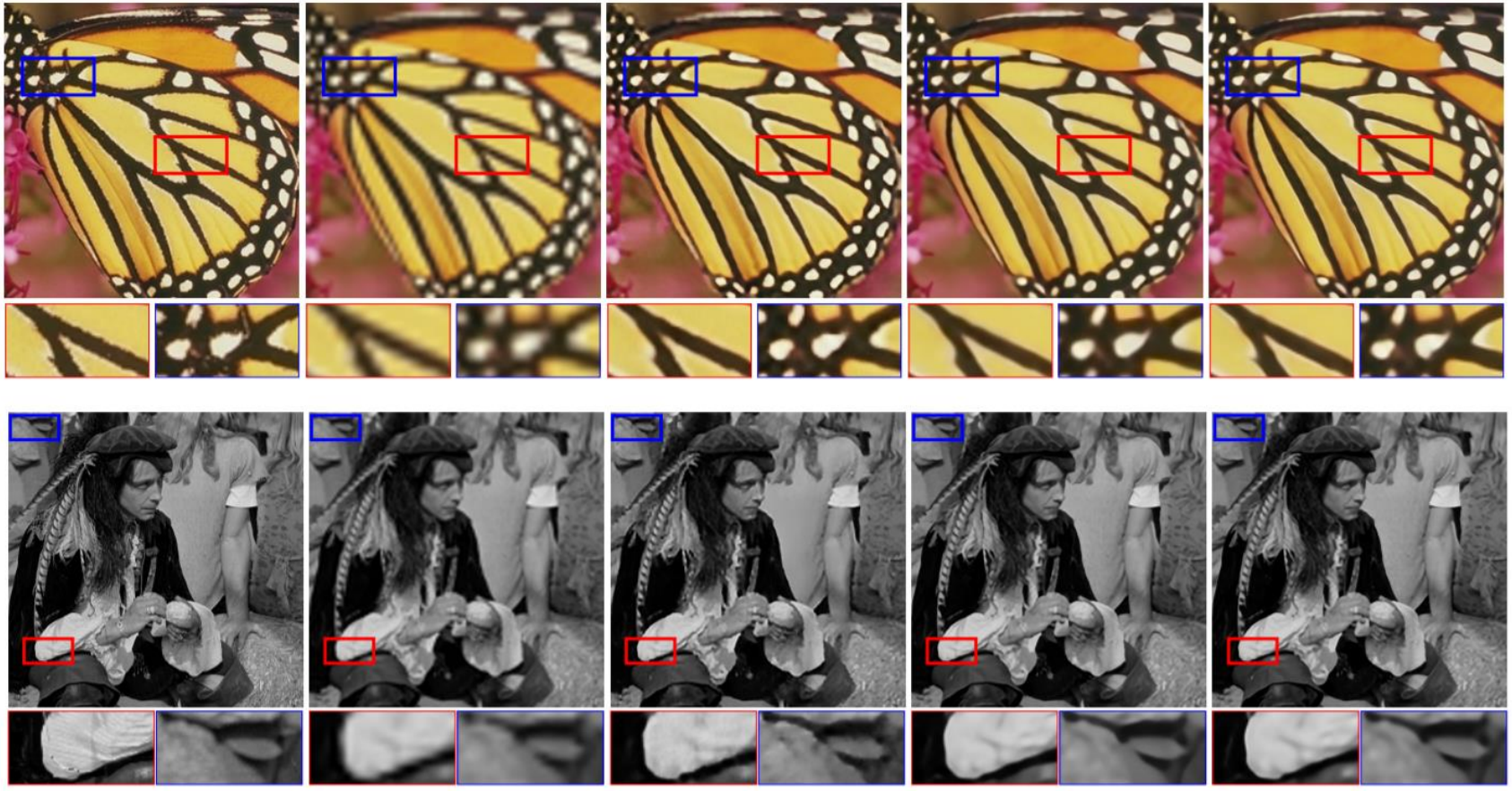
(a) Input (white=masked)

(b) Encoder-decoder, depth=6

(e) ResNet, depth=8

(f) U-net, depth=5

Super résolution



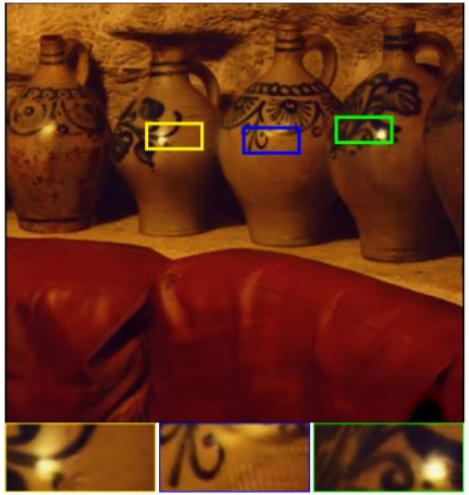
(a) Original image (b) Bicubic, **Not trained** (c) Ours, **Not trained** (d) LapSRN, **Trained** (e) SRResNet, **Trained**

Flash – No Flash

(a) Flash

(b) No flash

(c) Joint bilateral [43]

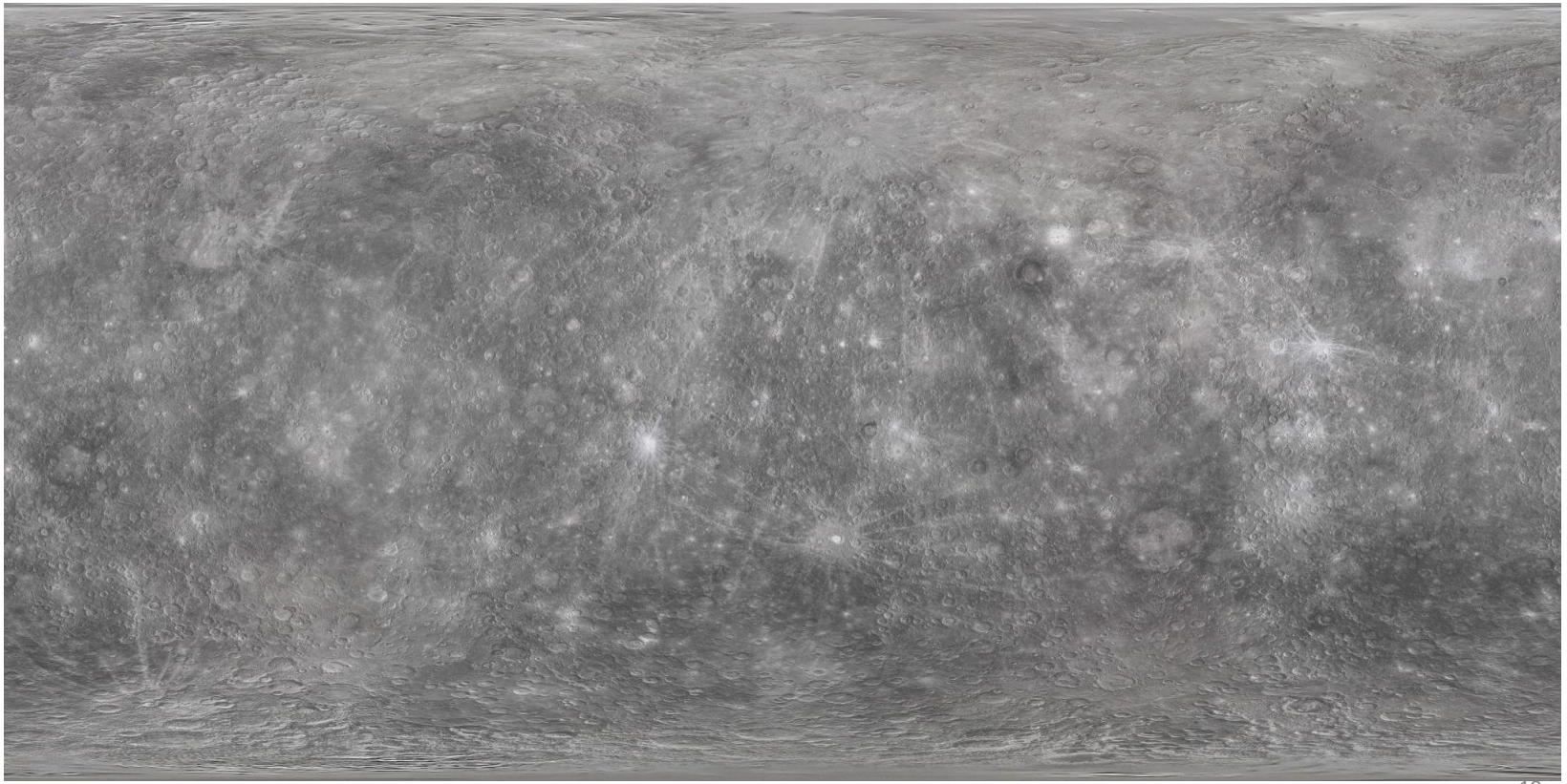


(d) Deep image prior

Discussion

- Beaucoup d’applications avec de bons résultats
- Entrainement rapide mais nécessaire à chaque nouvelle image
- L’architecture joue un rôle important dans la construction de l’a priori

Lien avec les textures



Lien avec les textures