# Projet d’Imagerie Numérique

## SinGAN analysed with PatchMatch

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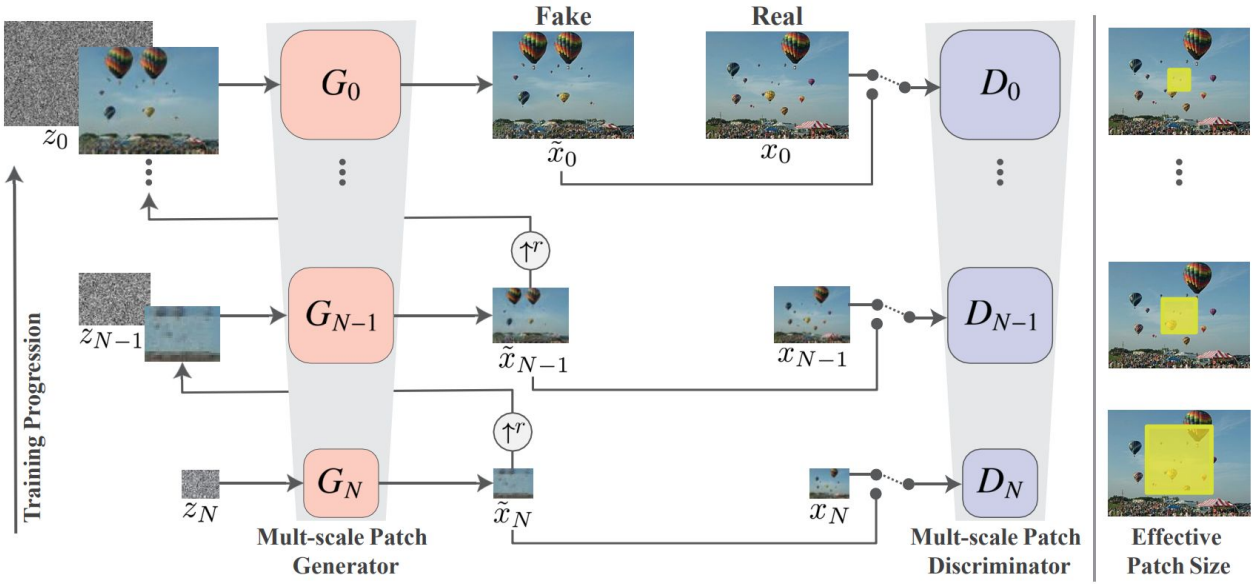
# I. Introduction

# SinGAN Network



# SinGAN : Example

(a) Original image

(b) GSS = 0

(c) GSS = 1

(d) GSS = 2

(e) GSS = 3

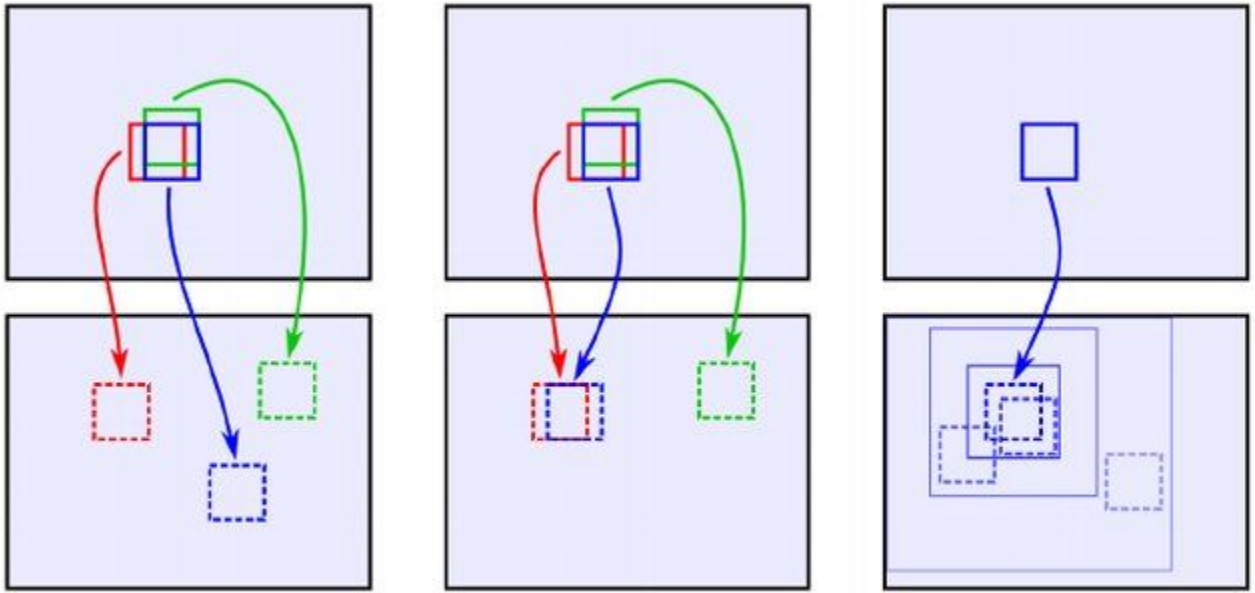
(f) GSS = 4

(g) GSS = 5

(h) GSS = 6

(i) GSS = 7

# PatchMatch : Principle



# II. Analysis of Originality

# Theory of Originality : Motivations and Philosophy

- "originality" = "absence of copies"
- Relative / Absolute originality
- Which is the most original fake image *from the reference* of the original image ?
- Why several metrics ?
  - Goodhart’s law : "when a metric becomes an objective, it ceases to be a good metric"
  - Validation

# Theory of Originality : Metrics

We use the offset field calculated with PatchMatch

Global Metrics :

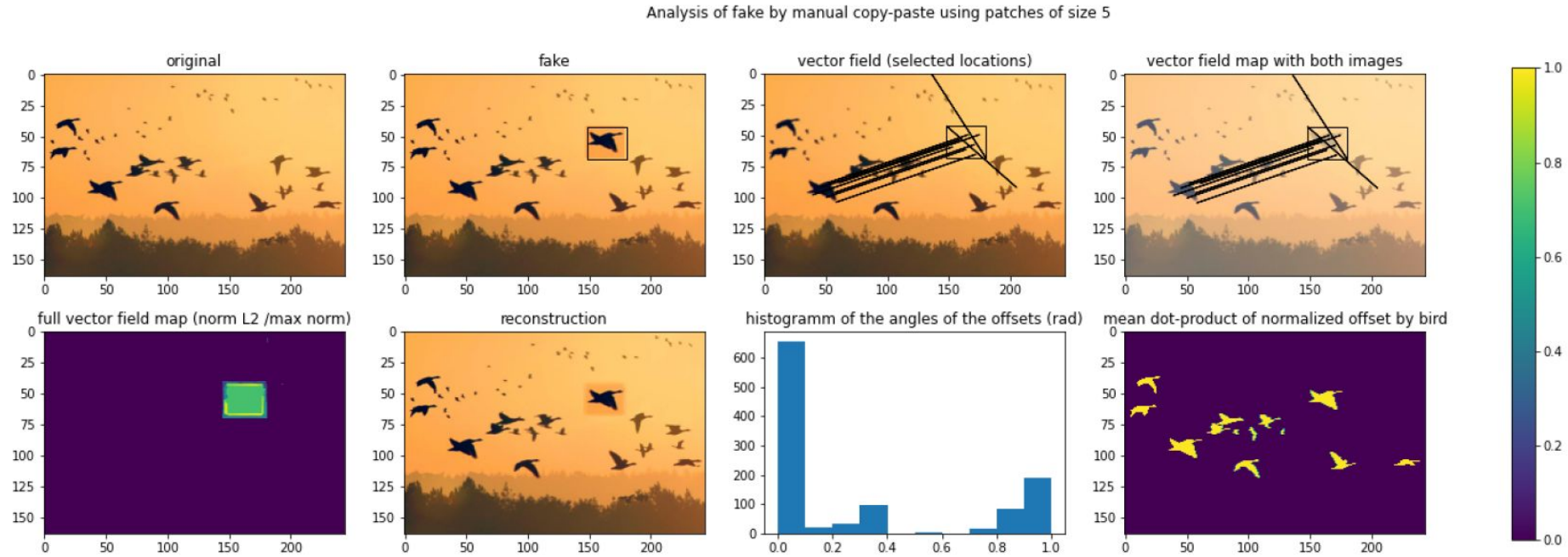
- NbSet : le nombre de zones de l’image avec un offset constant par morceau
- L2Norm : “L'intégrale des discontinuités de l’offset”
- AngleHistogramm : “Histogramme des angles de l’offset”

Local Metric :

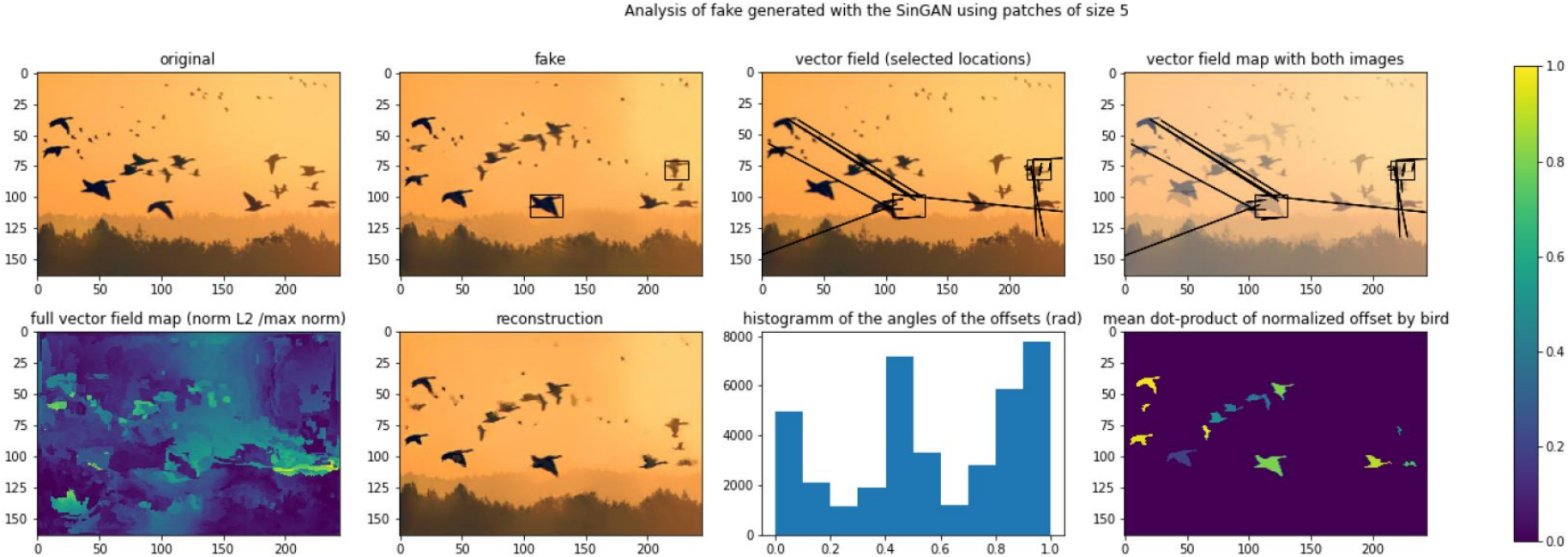
- MeanDotProduct : produit scalaire moyen des offsets normalisés par oiseau

# Analysis of Originality : Visual Analysis

## > Baseline Copy and Paste

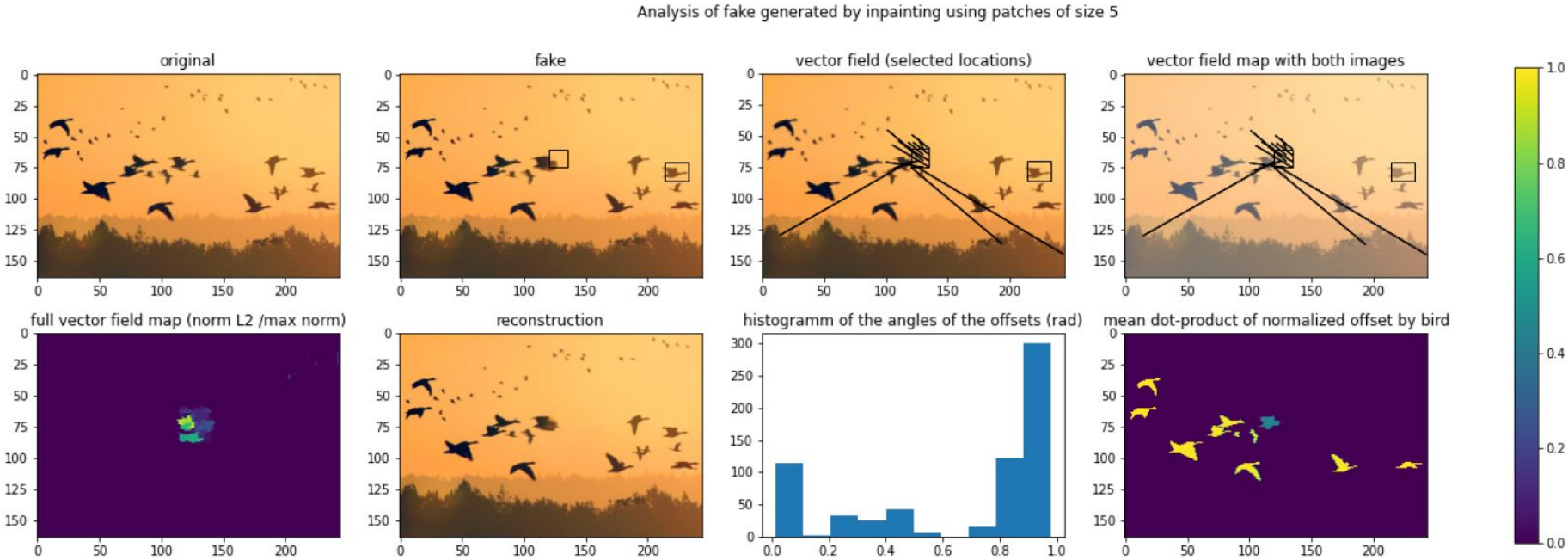


# Analysis of Originality : Visual Analysis
## > SinGAN Generation



# Analysis of Originality : Visual Analysis

## > IPOL Inpainting : Non-Local Patch-Based Image Inpainting



# Analysis of Originality : Global Metrics

| Technique | PatchSize | L2Norm | L1Norm | NbSet |
|---|---|---|---|---|
| SinGan | 5 | 15.85 | 12.80 | 9239 |
| Inpainting | 5 | 9.23 | 8.03 | 209 |
| CopyPaste | 5 | 11.48 | 9.28 | 245 |

# Analysis of the originality for different Generation scales

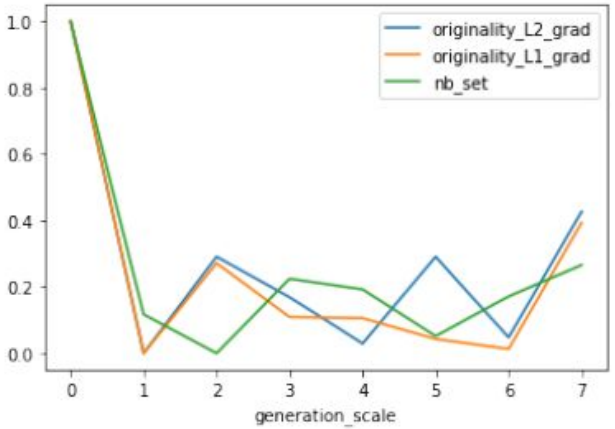



Figure 7: Result of the analysis for different scales (normalized between 0 and 1).

# Analysis of the originality for different Generation scales

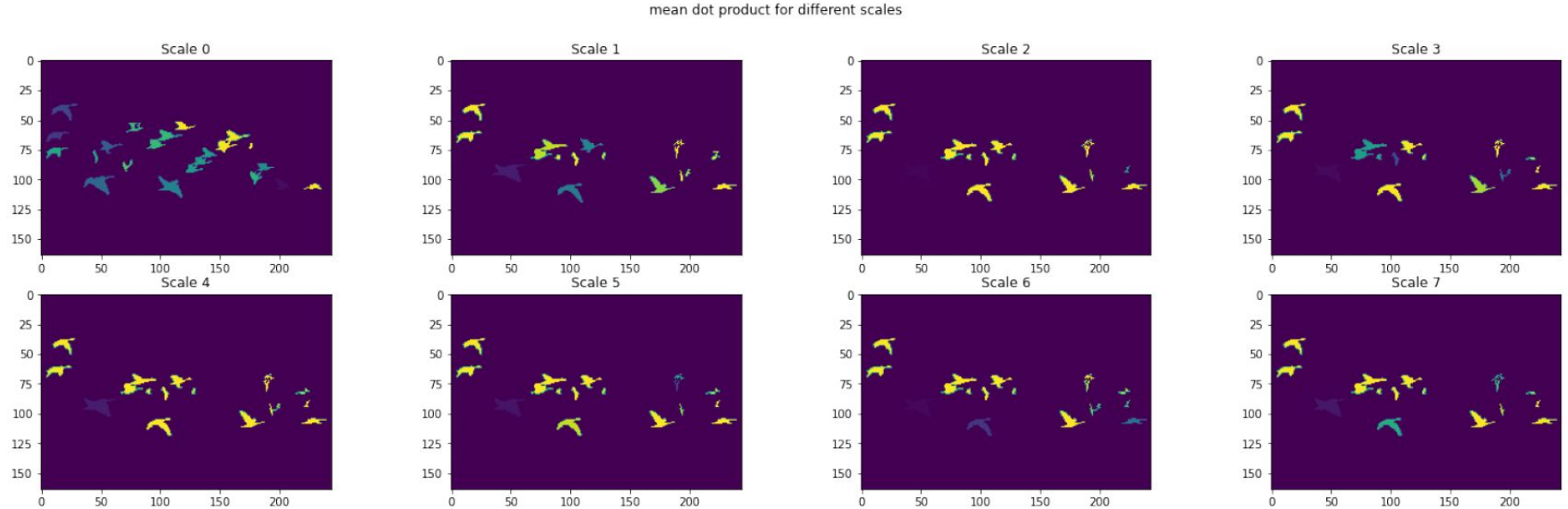



Figure 8: Mean dot product results for different scales.

# III. Complementary experiences

# The SinGAN Harmonization function

> Orange square

(a) Image to harmonize

(b) GSS = 1

(c) GSS = 2

(d) GSS = 3

(e) GSS = 4

(f) GSS = 5

(g) GSS = 6

(h) GSS = 7

# The SinGAN Harmonization function

> Black square

(a) Image to harmonize

(b) GSS = 1

(c) GSS = 2

(d) GSS = 3

(e) GSS = 4

(f) GSS = 5

(g) GSS = 6

(h) GSS = 7

# The SinGAN Harmonization function

> White square

(a) Image to harmonize

(b) GSS = 1

(c) GSS = 2

(d) GSS = 3

(e) GSS = 4

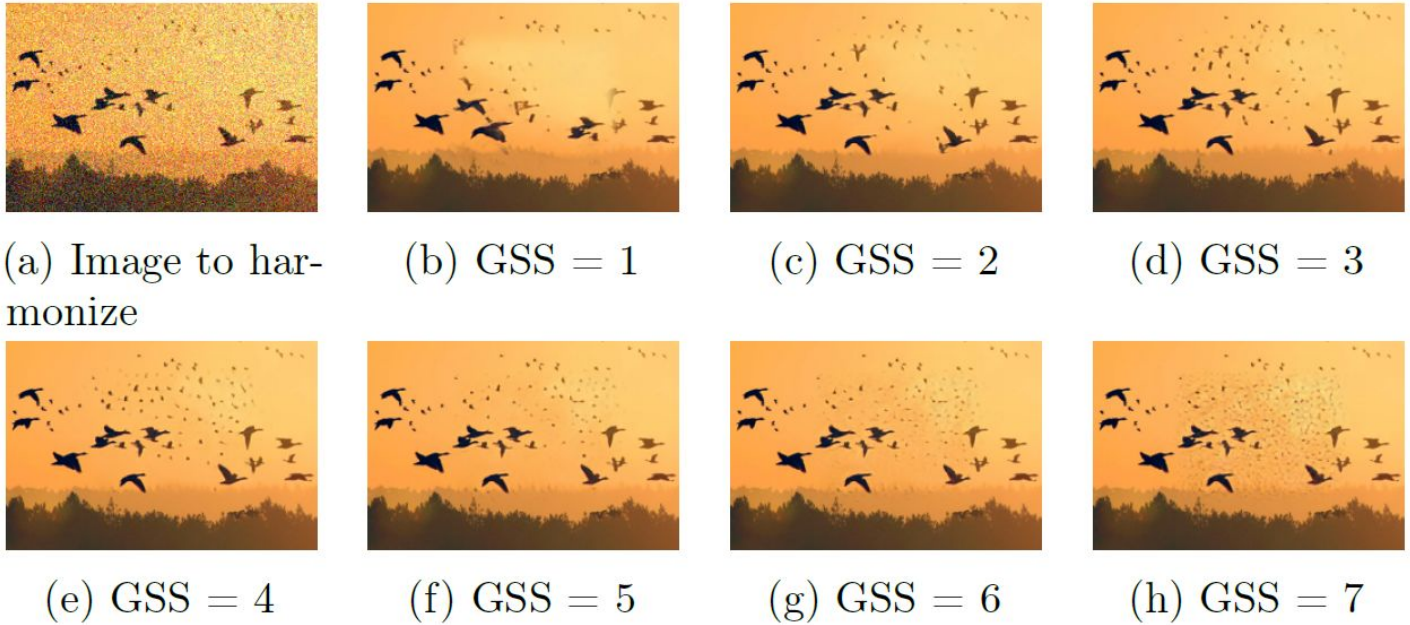
(f) GSS = 5

(g) GSS = 6

(h) GSS = 7

# The SinGAN Harmonization function as denoiser

> Gaussian noise (std = 30)



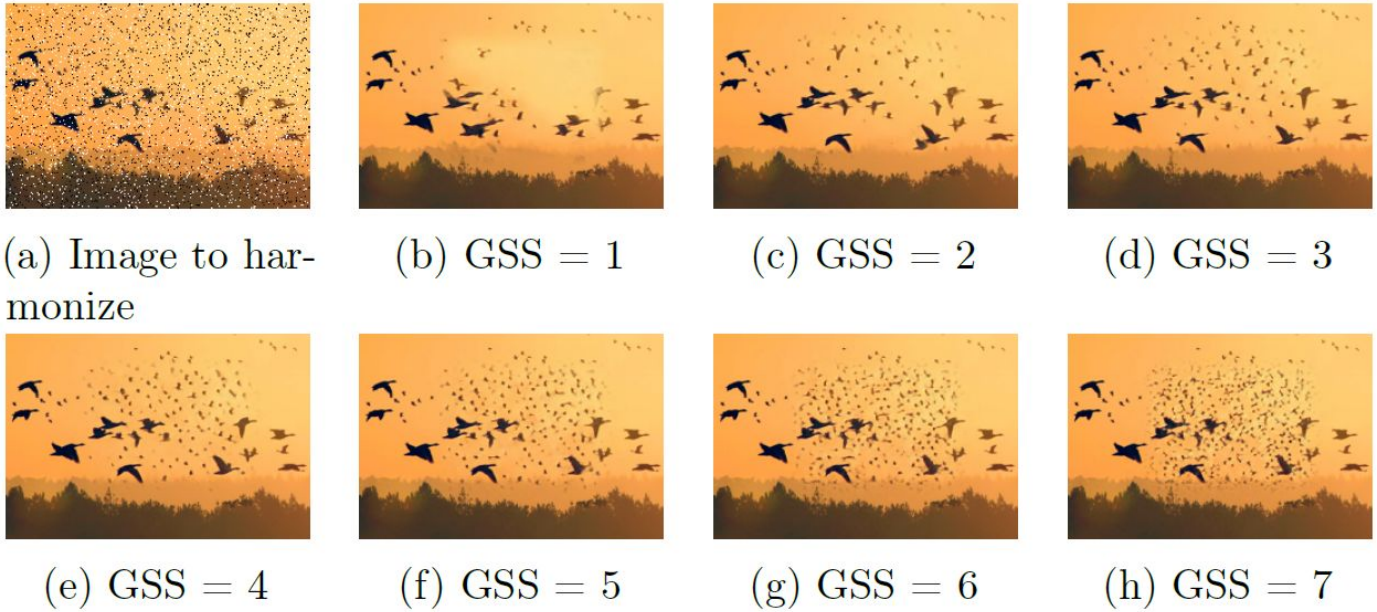
(a) Image to harmonize (b) GSS = 1 (c) GSS = 2 (d) GSS = 3

(e) GSS = 4 (f) GSS = 5 (g) GSS = 6 (h) GSS = 7

Figure 13: Results of image denoising for a gaussian noise with $\sigma = 30$ using the Harmonization function of SinGAN for different scales. GSS: Generator starting scale.

# The SinGAN Harmonization function as denoiser

## > Salt and Pepper noise



(a) Image to harmonize (b) GSS = 1 (c) GSS = 2 (d) GSS = 3

(e) GSS = 4 (f) GSS = 5 (g) GSS = 6 (h) GSS = 7

Figure 14: Results of image denoising for a salt and pepper noise using the Harmonization function of SinGAN for different scales. GSS: Generator starting scale.

# Annex

(b) Low resolution image upsampled naively

(c) High resolution image outputted by SinGAN